CHAPTER 4

ZOOLOGY Exploring the Biodiversity of Colorado and the World

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Before the Museum

The first collections of specimens that make up what is now the Denver Museum of Nature & Science were actually established well before the founding of the institution in 1900, the selection of a board of trustees, or the construction of a building to house and exhibit the specimens. Edwin Carter (1830–1900) (Fig. 4.1) collected Colorado birds and mammals from the 1860s through the 1890s. Born in New York in 1830, Carter arrived in Colorado in 1859 hoping to make it rich in the goldfields, but he soon became interested in the region’s natural history. He learned hide tanning and, as his prospects for hitting the mother lode faded, he earned his living selling buckskin clothing that he handcrafted. Carter supplemented these earnings by marketing foodstuffs and other provisions to the growing population of successful and (mostly) unsuccessful prospectors flooding the region.

His interest in nature turned to concern as he observed dwindling numbers of mammals and birds, owing largely to habitat destruction and overhunting. Period photographs of the area’s mining district show a landscape largely denuded of vegetation. By the 1870s, Carter noted that many animal species were becoming scarce. The state’s forests were being devastated, ranches and farms were replacing open prairie, and some species, including the last native bison in Colorado, were on the verge of extirpation or extinction. Carter started collecting the native birds and mammals to record what was being lost. Included with these specimens was a series of bird egg clutches. He also accepted animals from other hunters for his preparations. In fact, Carter worked closely with William Wilkinson, who hunted many of the larger mammals prepared by Carter.

Figure 4.1. Edwin Carter in his cabin-turned-museum, about 1899.
Wilkinson and Carter preserved these specimens as study skins and body mounts, most of which Carter prepared or mounted in a shed by his log cabin on the placer claim he owned below Breckenridge, Colorado (Hanington 1938), refining a boyhood acquaintance with taxidermy gained from an old Scottish Highlands gamekeeper in New York. He had already learned the process of tanning, but his mastery of mount construction came with trial and error. Many of his mounts excited visitors’ interest, but a later assessment by early Museum staff was less kind, citing the “poor quality” of Carter’s mounts. His stuffing experiments included materials from his local surroundings, incorporating river cobbles, gravel, and dried native grasses from the mountain slopes. “Mr. Carter’s preparation of bird skins was very good, but the quality of his mounted birds and animals left much to be desired. I have been told that the shoulder and hip bones of his mounted bison were huge rocks suspended from a rough wooden frame with baling wire, and that the bodies of the animals were stuffed with straw” (Rockwell in Hanington 1938).

The Carter Museum

For educational and research purposes, in 1875 Carter opened the Carter Museum, which still stands in Breckenridge, Colorado, and it attracted many international visitors and scientists (Figs. 4.2, 4.3). However, it was not well known to average citizens of Denver. Carter was careful to document the fauna around him. Robert B. Rockwell (in Hanington 1938) says of Carter’s collections:

I was greatly surprised by the accuracy of the Carter identifications. I found very few mistakes in identification and most of these could be traced apparently to his use of textbooks relating to birds of the eastern United States. When we consider the poor conditions under which Carter worked, the fact that he was truly a pioneer in Colorado ornithology.
and mammalogy, far removed from, and entirely lacking 
contact with other naturalists and their collections, and that 
during his day practically no literature had been published 
relating to Colorado natural history, we must conclude that 
his accomplishments were truly remarkable.

Carter’s methods for recording data on each specimen were unique 
and proved troublesome when the specimens were transferred in the early 
1900s to what would ultimately become the Denver Museum of Nature & 
Science. Victoria Cain (2006) said of his data collection:

Each evening, he took a stumpy lead pencil, tore pieces of 
brown wrapping paper from a larger sheet, and scribbled 
down notes, each animal meriting a separate and individu-
ally numbered scrap of paper. By the late 1880s, gunny sacks 
holding hundreds of these wrinkled scraps covered with 
barely legible handwriting filled the corners of Carter’s cabin. 
Though they didn’t look like much, these crumpled slips con-
tained years of close and practiced observation, and upon 
Carter’s death in 1900, served as the catalogue to the most 
complete record of Colorado fauna yet created. Squinting 
through the dim of his cabin each evening, Carter managed 
to compile a scrupulously detailed scientific census of the 
fauna of Summit County over the course of three decades, 
one accurate enough that, later on, professional and ama-
teur scientists did not hesitate to use it in their own work.
Founding the Colorado Museum of Natural History

Inspired by the 1893 World’s Columbian Exposition in Chicago, a number of future museum founders in several cities including Denver and Chicago joined the City Beautiful movement that would result in the creation of major parks and museums throughout the country. The Field Museum of Natural History in Chicago and the Colorado Museum of Natural History were two of these institutions. (The Denver Museum of Nature & Science has gone by several names in its history: first called the Colorado Museum and Library Association [1897–1900], then the Colorado Museum of Natural History [1900–1948], the Denver Museum of Natural History [1948–2000], and currently the Denver Museum of Nature & Science.)

Carter was among those who campaigned for a museum in Denver. He wrote in 1894, “As Denver is destined to be among the great cities of the Continent so will a museum here founded . . . grow up to be one of the great entertaining and educational institutions in the country” (Colwell-Chanthaphonh et al. 2010).

The specimens from Carter’s collection (Figs. 4.4, 4.5) were the very first objects and were the founding collections of the Museum. Carter had sold numerous specimens prior to the late 1890s to private collectors and other museums. He had intended to be an exhibitor at the 1893 Chicago Exposition but had sold so many of his specimens to a banker in Georgetown, Colorado, just prior to the fair that he did not have time to mount enough new specimens to show. Mrs. Martha Maxwell, another early naturalist and taxidermist from Colorado, took over the spot from Carter at the Columbian Exposition (Lincoln 1929). After several years of negotiation, the bulk of the Carter Collection, totaling around 3,300...
specimens, was purchased for $10,000 by the Colorado Museum of Natural History in 1900, the year the Museum was chartered (Fig. 4.6).

Carter never got a chance to see his dream realized: that his collection be on display at a museum in Denver. He died in 1900, possibly from arsenic poisoning, before the sale of his collection was final. At the time arsenic and mercury were used in the preparation of taxidermy mounts as pesticide treatments. Eight years before, Carter had "nearly died after rubbing two pounds of arsenic into a buffalo bull that he had acquired" (Cain 2012). The official cause of his death, however, was Bright's disease, an older name for nephritis, which can be brought on by exposure to arsenic or other toxins as well as exposure to cold weather. (Oddly, at the turn of the last century one of the recommended treatments for Bright's disease was a dose of arsenic!) Carter had gone to Galveston, Texas, hoping the lower altitude and warmer weather would ease his health problems, but they didn't. We will never know if Carter's use of toxins, his exposure to the cold mountain weather, or a combination of both was the cause of his death.

The Carter Collection almost didn't come to Denver: Professor William F. Slocum, president of Colorado College, had been considering the purchase of the collection for his institution. When he learned from the Museum's founders of their firm commitment, Slocum relinquished all claims to the Carter specimens.

Other Carter specimens had gone to collectors or to other museums before the remaining collection was sold to the Museum. Some of Carter's mounts, including the very last bison killed in Colorado, are currently housed at the Royal Gorge Regional Museum and History Center in Cañon City, Colorado. The specimens purchased by the Museum had been stored in basement rooms at the state capitol for a few years before the sale was completed, and some remained there for several years after. Storage conditions were not ideal, and mildew, pests, and neglect consumed a number of specimens. Surviving specimens were brought to the Museum in stages, first to a "fire-proof" building in Denver, and then, in 1903, to the Museum's first structure at the east end of City Park. Slocum's near purchase and the neglect of the specimens when in storage were not the last challenges to the Carter Collection's survival.
Bison in Colorado

*Bison bison*, the American bison, commonly called buffalo, once roamed in vast numbers over much of the interior North American continent. Estimates for the total population of these huge herds range from 30 to 75 million individuals before the great slaughter at the end of the 19th century killed the vast majority.

By the 1870s bison were becoming scarce in Colorado. The very last wild bison in Colorado were taken in 1897 (Meaney 1993). Some of these animals, mounted by Edwin Carter, are currently on display at the Royal Gorge Regional Museum and History Center in Cañon City, Colorado. Four early Carter bison mounts from South Park are part of the Denver Museum’s collections.

In 1933 a large male bison from South Park, Colorado, collected in 1872, was designated as the type specimen of a new subspecies of bison: *Bison bison haningtoni* (Figgins 1933). This mountain bison was thought to be different from the Great Plains subspecies *Bison bison bison* and from the woodlands subspecies *Bison bison athabascae* of northwestern Canada; it has since been shown to be synonymous with the plains subspecies (Skinner & Kaisen 1947).

After a gap of almost 100 years, bison have been returned to Colorado at several ranches and preserves. Some of these animals have cattle genes in their DNA, but others retain the pure bison DNA (Halbert & Derr 2008). While none of these bison are truly wild, it is exciting to view a piece of the past once again roaming the Colorado plains.

Zoology’s Beginnings

Thus, zoology was the Museum’s first scientific discipline, although not always formally called by that name. The first organized department at the Museum was the Department of Birds, established in 1901. In 1908, when the first public building was opened, bird and mammal mounts were highlighted in the majority of its exhibit halls. Fine art displays, insect cases, and a small mineralogy area rounded out the displays. The Museum focused mainly on exhibits, using ornate glass-walled cases to display the taxidermy mounts. Most specimens on exhibit were from Colorado, with the exception of a group of flamingos. Dioramas depicting specific places in Colorado or exotic locales from far away were a decade or more in the future. In the early days zoology as practiced at the Museum was about acquiring specimens for public display and education, with research having a minor, secondary focus. Modern collections management wasn’t to be implemented for 80 years.

The Formative Years

The Museum’s first administrator was John T. Mason (1853–1928) (Fig. 4.7), a native of England and a retired mercantile magnate. Mason served in an unpaid capacity and managed the birth and neonatal growth of the Museum for about seven years. He was a butterfly collector with a large collection of his own, which he donated to the Museum in 1918 (Webb & Peigler 1990). He was faced with many challenges because of lack of funding.
and construction problems, but he kept the young Museum functioning, to a degree. His first task was to find a suitable building for temporary storage of specimens and mount-making while a search for a permanent location was taking place. It took two years to build the first building, a modest rectangular structure in Denver’s City Park completed in 1903. Surrounded by dirt tracks and weeds, this building was not initially open to the public; it didn’t welcome visitors for five more years.

In addition to operating challenges, Mason was faced with the poor state of the Carter Collection: some of the mounts were ruined beyond repair and many others were no longer of exhibit quality. He took steps to rescue what he could, including having “moved from the Capitol the Buffalo of the Carter collection” in 1901. Mason then started looking for other bird and mammal specimens to fill the cases slated for the public building, acquiring objects through donation and some collecting field trips. These specimens included five large “Grizzley Bears,” two “Cayouttes,” a “Cow ’with abnormal hoofs,’” a “Black-footed Ferrett,” and a “White-footed Ferrett.” It is easy to figure out that “Cayouttes” means “coyotes,” but not so easy to figure out what a “White-footed Ferrett” really is.

In 1901 Mason employed a Denver taxidermist, Rudolph Borcherdt (1840–1931), to collect additional specimens for exhibit and remount the large Carter mammal specimens, the taxidermy of which, as reported by Rockwell (in Hanington 1938), didn’t meet the standards for the new Museum. The remounting sometimes demanded drastic action: during one}

John T. Mason

John “Jack” T. Mason was born in Lincolnshire, England, in 1853. He joined the ranks of avid natural history collectors as a boy of 12. By the age of 15, Mason had amassed a fine collection of birds, bird eggs, and butterflies. When schoolmates traveled to Australia and sent home specimens of birds, the young naturalist mounted them, keeping one specimen of each species for his private collection.

Mason came to the United States in 1872 and lived for short periods in New York, Mississippi, and Galveston, Texas, eventually settling in Houston, Texas. There he married a Miss Schaffter of Galveston in 1877 and opened a large department store, accumulating a fortune in the mercantile business from 1880 to 1892. Mason moved to Denver in 1895. By the time he retired from business, his zeal for collecting had grown into a scientific avocation; in fact, the U.S. government sent him to Mexico to collect butterflies. Mason donated his worldwide collection of more than 20,000 butterflies and moths to the Denver Museum in 1918, shortly before moving to Pasadena, California, where he spent the rest of his life. He died in 1928.
session, Borcherdt actually had to use an iron to flatten some creased elk hides from Carter’s old mounts to get them ready for a smooth fit over the new manikins. The famous Carter bison mounts were also remounted. Victor H. Borcherdt (ca.1874–1923), Rudolph’s son, joined the Museum shortly after his father. Victor worked, as funding allowed, until 1910, splitting his time between collecting new specimens, preparing taxidermy mounts, and constructing the early habitat exhibits. In 1912 Victor was appointed head animal keeper (equivalent of director) of the Denver Zoo, where he and landscape architect Saco R. DeBoer designed the Bear Mountain exhibit, the first natural habitat enclosure of its kind in North America and a national historic landmark (Etter & Etter 1995). From 1919 to 1923 the Saint Louis Zoo employed Borcherdt to implement his innovative ideas there, and became world-famous for its cutting-edge live animal displays.

Robert B. Rockwell (1883–1941) joined Mason and Borcherdt in 1906. Rockwell was an amateur oologist (a person who studies eggs) who did the first systematic curation of any of the Museum’s collections. One of his duties was to “iron out” the Carter egg collection. As reported above, Carter’s original records for all his specimens, including the clutch sets he collected, were written on pieces of brown paper. He speared these scraps onto loops of baling wire for storage, sort of like a giant Rolodex. The filing “cabinet” was a bunch of burlap bags. Rockwell took the paper scraps off their wires, trimmed them, and had his mother iron the pieces flat. Then he sorted them and glued them into scrapbooks. This treatment did indeed flatten out Carter’s scraps, but the extreme heat, old-school adhesives, and acidic paper of both the data slips and scrapbook pages make these some of the most fragile objects in the Museum’s archives.

Rockwell’s account (in Hanington 1938) noted, “The data for the most part [were] too brief and quite unsatisfactory from a scientific point of view.” This has presented quite a challenge for modern-day curators and collections staff, as many of the Carter specimens were described with the locality of “Breckenridge” and little else. Museum work in its early days, and that of its early collectors, was totally different from today: obtaining permission to collect, recording accurate data, creating an accurate catalog, and caring for natural specimens was very different from that of the modern museum world. The Carter mounts and skins were not the only specimens left in boxes for years; many other specimens sat waiting for collections care and cataloging, often for similarly long periods of time.

Also of interest is Rockwell’s description of one of Carter’s taxidermy methods: the use of “huge rocks” to round out the shoulders and hips of his mammal mounts. It is not surprising that today, when Zoology Department collections staff have to move the Carter bison mounts, it takes a large, dedicated, and strong team of men and women to accomplish the task.
By 1908 the vertebrate collections of mammals and birds were joined by a new and growing insect collection. Mason had promised to donate his extensive butterfly and moth collection at an 1899 meeting of the Museum’s founders; John F. Campion also promised the donation of his exquisite Breckenridge gold collection at the same meeting. The Carter, Mason, and Campion Collections are still considered the founding Museum collections. However, the John T. Mason Insect Collection was not the first entomology collection to be housed and displayed at the Museum.

Ernest J. Oslar (1858–1944) was the first curator of the Entomological Department at the Museum (photo in Krell & Stephenson 2012). Oslar was a professional collector who settled in Denver after leaving England in 1893. He collected for the Field Museum of Natural History and several other institutions, including the Denver Museum. “It is a tribute to his enterprise that he was able to support his wife and fourteen children by butterfly collecting!” (Ewan & Ewan 1981). Oslar’s approach to natural history was similar to Carter’s and many of the late 19th-century naturalists: these self-taught collectors could be described as amateur naturalists in that they did not receive formal training in the field, but made a profession of sorts by selling some (or many) of the specimens they collected and mounted.

Oslar’s collecting style, if not technique, may be gleaned from a report in the Durango Democrat of July 12, 1899:

For several weeks a peculiar individual has been putting in evenings catching bugs, beetles and butterflies under Main street arc lights. He speaks to no one, no one seems to know his name, he is fleet of foot and swift of hand; gliding after his intended victim, and catching it with dexterous movement. The bottom of his coat is [a] pouch or pocket all the way ‘round and hundreds of insects, gaudy and green and black and yellow, find their way in each evening. He is something of a mystery and it is a guess whether he catches bugs for scientific study, commercial use or just because he’s ‘buggy.’

By July 14, the paper had more information:

The mysterious individual which The Democrat made reference to in last Tuesday’s issue proves to be Prof. Ernest J. Oslar of Denver, who is down in this section of the state on an exploration trip for insects. The professor is one of the most noted entomological collectors in the United States and he is well known among entomologists not only in this country but in many others. He collects for almost
all scientific institutions in the east and for a great many private collectors as well.

To the uninitiated his actions are somewhat mysterious when taking insects. Almost every evening he may be seen around the electric lights pursuing his vocation with a pair of forceps and a killing bottle. He tells The Democrat reporter that he has taken a number of rare specimens since he has been here, some at the lights and others in the foothills during the day time.

Entomology, or the study of insects, is a science very little understood by the public, but every year it receives fresh enthusiasts and admirers. The result is there is a growing demand for bugs and insects of all orders, especially those that are rarities and only found in the Rocky mountain region, and if it be a new species to science it can command almost any price.

By late 1909 Oslar had already installed more than 6,200 identified specimens of insects in four “ornamental display cases” at the Museum and was readying and identifying another 1,500 moth specimens for two additional cases. He reported an additional “5,000 specimens, not prepared or mounted, of which 2,000 were collected the past summer and fall [in 1909].” This was well before the Mason Lepidoptera donation, which arrived in 1918. Oslar left the Museum sometime after 1911, when there appears to have been a disagreement with Museum leadership upon his presenting an invoice for these specimens, leading to his departure.

Both Oslar and Mason were well respected in the entomological community. Both were honored by having several species and subspecies of moths and butterflies named for them: Oslar had 18 and Mason had at least nine and possibly more.

The Museum had no curator of entomology, or as far as we can tell, no one looking after the insect collections from the mid-1910s to the late 1920s, when the curator of geology, Frank Howland, accepted oversight of this collection until 1935 (including the incorporation of the Mason butterfly and moth collection).

Luman J. Hersey (1852–1924) became curator of ornithology and mammalogy in 1909. Hersey was “widely known as a naturalist and respected for his knowledge of the bird and floral life of Colorado” (Preston & Haglund 2000). He began the systematic organization of the existing collection and put his well-honed skills as an avid duck hunter to work founding the study collection, a Colorado-based set of study skins collected for the purpose of research. He adopted the Museum’s first index card system to cover the bird
collection and tried to bring specimen cataloging up to date. The Carter Collection, however, suffered another setback when under Hersey’s direction “remnants of the old Carter collection . . . were donated to the East Denver High School.” Some duplicate Carter specimens were traded to other institutions too.

Hersey led the collecting of more than 950 birds by late 1909, aided by a young student from the University of Kansas named Frank Alexander Wetmore. Owing to a shortage of funds, Wetmore only stayed at the Museum for eight months, but he was very productive during this time. During his short stay at the Museum he conducted fieldwork and kept copious field notes, prepared study skins for the research collections, and mounted birds for exhibition.

Another challenge was in store for the Carter Collection, as described by Wetmore (quoted by Hanington 1938):

> When I arrived at The Colorado Museum of Natural History, in 1909, as a taxidermist in the Department of Birds I found the laboratory in a long, narrow room looking out over City Park to the mountains beyond, truly a beautiful view. The arrangements for my coming had been made by L. J. Hersey, then in charge of the bird department, and it was expected that habitat groups of birds would be prepared. In the meanwhile I was assigned to the mounting of birds to be used in exhibition and group work and to making skins for the study collection. On my arrival the laboratory room was crowded with large boxes containing mounted birds from the old Carter collection. These were supposed to be worthless and I was told to discard and destroy them. Many were damaged beyond repair as heads and wings were missing but a fair number were in good shape. These I salvaged to be retained in the collection, including a few record specimens for the state. In this I went against definite orders, but I could not bring myself to destroy valuable material as I realized that the order came through a misunderstanding of its worth.

Funds for the expected group work were not forthcoming so my duties consisted mainly in the handling of birds collected by Mr. Hersey. In addition, I occasionally went afield with him and Robert B. Rockwell to help in the collecting, making trips to Barr Lake, to Middle Park, near Granby, and to points nearer Denver. This continued until about the middle
of November when funds were exhausted and I returned to Lawrence, Kansas, to continue my University courses.

Wetmore went on to become the director of the National Zoo, the National Museum of Natural History, and, in 1945, the sixth secretary of the Smithsonian Institution. He is also remembered as one of the founders of the Museum’s research collections and as the person to thank for retaining many of the Carter bird mount specimens.

After a decade of operations the Museum still faced financial troubles, even with its new building open to the public. More than once Denver’s mayor intervened to keep the struggling institution alive. The board of trustees realized that the time had come for a paid professional to be hired, someone who could get the budget under control and chart the institution’s course.

In 1910 Jesse D. Figgins (1867–1944) (Fig. 4.8) was hired as the Colorado Museum of Natural History’s first paid director. Figgins was a seasoned professional by the time he came to Denver. His first scientific interests were in zoology: he studied ornithology, mammalogy, and herpetology, and worked for a time for the U.S. National Museum in Washington, D.C. He studied birds and mammals in the Potomac Valley from 1887 to 1895, and in 1896 made a biological survey of the Great Dismal Swamp. He was named as ornithologist and mammalogist of the sixth and seventh Peary expeditions in 1896 and 1897, accompanying the commander on both trips to the Arctic. He collected many mammals and birds, which proved so interesting to the American Museum of Natural History, the institution receiving the specimens, that Mr. Figgins was asked to join its staff. While there, Figgins conducted fieldwork in many diverse locales in North America, prepared taxidermy mounts, built habitat exhibit foregrounds, and painted exhibit backgrounds.

Upon his arrival at his new museum in Denver, Figgins found a carpentry shop, a small art gallery, mineral and insect exhibits on the first floor, mammal exhibits on the second floor, and bird exhibits on the top floor. The building was surrounded by native vegetation with no paved walkways or landscaping, and the staff was small. From the start he faced many challenges and moved quickly to establish a professional and balanced program of activities. He viewed the Museum as standing at a crossroads: “The Colorado Museum of Natural History has arrived at the point in its development where it must either confine itself to the lines of work that will place it with...
the majority of like institutions, or profitably join the few that are striving to attain their highest plane of usefulness by becoming centralized places of learning in all branches of natural history.”

The early Museum did not exactly match the characterization of similar institutions in other cities: “Open to the public, jointly funded by public and private monies, these museums attempted to serve as research libraries of natural objects, serving avid amateurs and scientific professionals, and tolerating the members of the lay public that occasionally wandered their galleries” (Cain 2006). The new museum in Denver relied mainly on public support from the city and did not have a surplus of wealthy benefactors. To bring the public into its galleries, and to continue receiving support from the city, the Museum from its start focused on collecting high-quality specimens for exhibition. Figgins continued the grand idea of its founders: to build the Museum into one of the leading natural history museums in the country.

Figgins insisted on maintaining a balanced approach, and he rapidly instituted improvements in the accuracy of exhibits, began programs for schools, started a publications program, made work more efficient, broadened the Museum’s collecting interests, emphasized the importance of documentation, introduced the Museum to both still and motion picture photography, and initiated public relations campaigns. Through his own collections work, he helped build the study (research) collections, emphasizing systematic coverage for Colorado bird and mammal species that included several first records of species for the state. He also published on a variety of ornithological topics.

**Early Expeditions**

Early collecting expeditions during the Museum’s first decades were carried out largely to replace some of the lost resources from the Carter Collection and to add specimens that could go on display when the doors eventually opened to the public. By 1910 Hersey and Wetmore had initiated systematic collecting for local and regional birds and mammals, as did Oslar for insects. Collecting activities were centered on Colorado and its immediate surrounding region. Acquiring exhibit-quality specimens through collection, donation, or trade also took precedence for the Museum naturalists. After Figgins took over, specimen acquisition for the Museum’s zoology collections retained its focus on Colorado and the surrounding region. However, additional expeditions farther afield were also carried out. Figgins kept a balanced approach between collecting specimens for research and for exhibit throughout these trips. In keeping with his vision for a museum that reached for “the highest plane,” Figgins would soon expand the collections and exhibits to regions outside the Rocky Mountains and Great Plains to the American Southeast, the Far North, the Caribbean, and South America.
Frederick C. Lincoln (1892–1960) (Fig. 4.9) was born in Denver and joined the Museum’s paid staff as an assistant in the Department of Birds in 1912. He started working at the Museum as a high school student volunteer in 1909, learning how to prepare bird study skins from Wetmore and Hersey. Lincoln decided against joining Wetmore at the University of Kansas, instead staying in Denver and later taking the Museum assistantship. In 1914, at the age of 21, he was hired by Figgins to replace Hersey as curator of ornithology (Tautin 2002). As curator, Lincoln continued the biological survey of Colorado begun by Hersey, collecting specimens and keeping detailed field notes. His Colorado specimen collection includes several birds made into mounts for exhibit, but also a significant number of contributions to the systematic research collection, including several type specimens that he named and several first state records for birds that he collected.

Lincoln remained in his position until called up for service in World War I from 1918 to 1919, serving as a pigeon expert in the U.S. Army Signal Corps. After the war he returned to the Museum, but only for a short time. In 1920 Lincoln joined the U.S. Bureau of Biological Survey, a division of the U.S. Geological Survey. There, his first job was to take charge of, reorganize, and, in effect, establish the first working national bird banding program, which he did with outstanding results. He was in charge of the program from 1920 to 1946. His model for bird banding was broadened to include international locations, and is still in use today. Lincoln is also credited with developing the concept of the migratory flyway and the Lincoln Index population model. He continued working with the Biological Survey until his death in 1960.

Albert C. Rogers joined the staff in 1913 (Fig. 4.10). In a way, Rogers followed the career path of Figgins, having first worked at the U.S. National Museum (Smithsonian) and then at the American Museum of Natural History. Rogers participated in many field collecting expeditions, including the Museum’s 1918 Alaskan expedition. This expedition lasted 40 days, obtaining 24 specimens of moose, Dall sheep, caribou, and mountain goat. Rogers did the taxidermy on these and many other mammals, several still

Figure 4.9. Frederick C. Lincoln, curator of birds, at the mouth of the Mississippi River, Louisiana, 1918.

Figure 4.10. Albert C. Rogers, curator of birds, with a moose, 1918.
He prepared Steller’s sea lions and fur seals starting in 1926, as well as marsh deer from Avery Island, Louisiana. These deer specimens were obtained by Alfred M. Bailey from Mr. E. A. “Ned” McIlhenny, owner of both Avery Island and the McIlhenny Company, which makes Tabasco. Museum mammalogist Frederic Walter Miller named this smaller variety of the white-tailed deer *Odocoileus virginianus mcilhennyi* in honor of McIlhenny, who helped the Museum on many occasions. These type specimens, as with all other Zoology Department types, are no longer on public display at the Museum but are housed behind the scenes in the research collections.

Rogers also conducted fieldwork in 1928 in Texas, New Mexico, and California, collecting peccaries and California sea lions. Rogers mounted or reinstalled most of the taxidermy mammals that were in the Museum. He helped catalog and organize the mammal collection beginning in the 1930s, and he served as curator of mammals from 1948 to 1958.

In 1918 Figgins appointed William C. Bradbury (1849–1925) honorary curator of oology (Fig. 4.11). Bradbury proposed that he acquire the small egg collection belonging to the Museum and, in exchange, he would supply the Museum with representative sets of eggs for all the North American species and subspecies of birds that he could obtain. The existing egg collection consisted primarily of clutches collected by Edwin Carter, so a portion of the Carter Collection was sold to Bradbury. Bradbury’s wife donated his large personal collection of North American birds’ eggs to the Museum after his death (after failing to find a buyer), so the Carter egg specimens that had been temporarily away from the Museum eventually found their way back. Of the 3,300 specimens in the original founding Carter Collection, only 10 percent can be reliably accounted for today. Given the number of reports of destruction, negligence, gifts, transfers, discarding, and sales, it is remarkable that any Carter specimens survived at all.

Bradbury traveled over much of Colorado collecting birds, eggs, and nests, and contributed a large amount of knowledge on the distribution, life histories, and breeding habits of the state’s birds. He also helped produce...
an exhibit on birds’ eggs and nests on display for a long time on the third floor. The exhibit was an introduction to the study of eggs and nests, including examples of different types of eggs, variations in color, protective coloration, and nest architecture. Bradbury was also responsible for adding an outstanding *Aepyornis* (elephant bird) egg to the collections. This specimen from an extinct species of ratite from Madagascar, purchased by Bradbury in 1916 from the estate of a New Jersey egg collector for $1,000, was “the first to reach America, and judging from all data obtainable, it evidently exceeds in size the two or three other specimens in this country, if indeed, it has an equal anywhere” (Fig. 4.12).7

In 1916 the Museum purchased the Austin Paul Smith bird collection, consisting of 732 specimens representing 380 species and subspecies. Some were incorporated into the new exhibits, but the main value of the collection was “the number of rare specimens from, or near, type localities.”8

The addition of the new Standley wing in 1918 offered the opportunity to present the first major exhibition dealing with a region outside of Colorado. Figgins, who led the fundraising efforts to procure the new space, also led expeditions to acquire specimens to fill the new diorama halls. In 1917 Figgins, accompanied by Lincoln and preparator A. H. Burns, went on an expedition to collect birds in South Carolina and Florida. In 1918 specimens were acquired through exchange and the help of local sportsmen for an exhibit of the winter birds of the Louisiana Gulf Coast. Alfred M. Bailey, then curator of birds and mammals at the Louisiana State Museum in New Orleans, arranged this exchange of specimens. In 1919 Bailey joined Figgins and Lincoln on a collecting expedition to Louisiana. These were Bailey’s first contacts with the Museum. Many more were to come, and eventually Bailey would become the Museum’s long-serving director.

Alfred Bailey (Fig. 4.13) almost became a Museum staff member in 1919. Having graduated from the University of Iowa in 1916, Bailey studied museum techniques under Homer Dill, head of the oldest museum studies program (begun in 1907) in the United States. Bailey received his first fieldwork opportunity as a camp cook and field member for the 1912–1913 U.S. Biological Survey to the northern Hawaiian Archipelago, including Laysan...
Island. Through his studies under Dill, Bailey learned taxidermy and related exhibition techniques, influenced by his mentor’s philosophy: “It is the impression that an exhibit makes on a spectator that counts” (Dill 1916). At the 1916 American Association of Museums meeting in Washington, D.C., the young soon-to-be graduate made several contacts, including Robert Glenk, director of the Louisiana State Museum. Bailey recorded in his journal, “He [Glenk] needs a man, and from the report he gave, it seems a highly desirable place. Brown, of the National [Museum], would like it. I feel that I have a chance, and will make the best of it.” Bailey did indeed make the best of it, as Glenk hired him to start in July 1916 as curator of mammals and birds, a position he held for three years. In the summer of 1919 Bailey was offered not one, but two attractive positions. One was to work under Figgins at the Colorado Museum of Natural History, and the other was to work under E. A. Nelson, chief of the U.S. Biological Survey. Nelson offered Bailey the opportunity to become the first representative of the survey in Alaska. Bailey accepted his second option, and held the Alaska position for two years. However the lure of Denver was ever present: Bailey indeed ended up coming to the Museum in 1921 as curator of birds and mammals.

Bailey’s survey work in southeast Alaska, from 1919–1921, provided him with the experience and contacts that the Colorado Museum of Natural History found extremely valuable when it finally lured him to the city in 1921. Bailey’s first Museum assignment was a 15-month expedition to northern Alaska, from 1921–1922 (Fig. 4.14), to collect bird and mammal specimens for exhibit, study, and exchange. Specimens continued to come to the Museum for decades after, due in large part to the contacts Bailey established in the Far North.
Bailey’s first curatorial career at the Denver Museum lasted a little over five years. He conducted fieldwork and bird specimen collecting in the Bahamas in 1923, and in Quebec in 1923 and 1924. When he wasn’t out of the country, Bailey collected in Colorado and Utah. Although scheduled to go to South America in 1925–1926 on the Museum’s most ambitious foreign collecting trip to date, Bailey was dropped from the trip four months before departure (Preston & Haglund 2000). During this expedition, led by Frederic W. Miller (Fig. 4.15), Frederick G. Brandenburg, and Frederick E. D’Amour, more than 800 birds and mammals were collected in Argentina, Brazil, British Guiana (today called Guyana), and Paraguay. This group of Museum collectors has come to be known as “The Three Freds.” Figgins joined one-third of the Three Freds (Miller) in 1928 to collect additional birds and mammals in Brazil and Paraguay.

Disappointed and pessimistic about his future under Director Figgins, Bailey began to look for opportunities elsewhere. He preferred fieldwork to laboratory assignments, and found just such an opportunity with the Field Museum of Natural History in 1926. Bailey joined a team from the Field for a two-year, 2,000-mile journey on mule back through Abyssinia. In 1927 Bailey became director of the Chicago Academy of Sciences. Mrs. Bailey, “with two lively children . . . and rather fed up with [his] being away so much” (Bailey, in Preston & Haglund 2000), had accepted the job for him in his absence. He had to give up a planned trip to Indochina as a result, but Bailey continued to conduct fieldwork in the United States during his Chicago years (1927–1936). In 1930 Bailey engineered an exchange whereby more than 500 bird specimens were sent to Denver from the academy. Among these were at least 290 specimens from the Steere Philippine expedition of 1887–1888. The Chicago Academy received 86 small mammals and 330 birds from the Museum in this transaction.

Toward the end of 1935, Figgins became “embroiled in a disagreement with members of the board of trustees, reportedly over a proposed expedition to Central America. The trustees won” (Preston & Haglund 2000). With Figgins’s resulting resignation from the Denver Museum, the post of director was now open. Bailey took the job, a position he held until his retirement at the end of 1969.
The Three Freds

Frederick G. Brandenburg was associate curator of birds from 1936 to 1946, Frederick E. D’Amour was a professor of zoology at the University of Denver, and Frederic W. Miller, associated with the Museum since the 1920s, served as curator of mammals from 1926 to 1935. Miller named several mammal species and did fieldwork in Argentina, Brazil, Paraguay, and Patagonia. These three gentlemen were never called “The Three Freds” while they worked at the Museum. The name comes from the Museum Archives Department, due in part to images from the South American expedition of the intrepid collectors on horseback or posing with their quarry, somewhat suggestive of “The Three Amigos.”

The Three Freds (Fig. 4.16) collected several hundred specimens, including giant anteaters, tapirs, jaguars, monkeys, parrots, peccaries, and Andean condors.

Museum Expansion: Filling the Diorama Halls

Bailey was an active field ornithologist and museum collector. But he approached specimen acquisition with a different attitude from those of his predecessors. Bailey was heavily influenced by his mentor, Homer Dill. As Bailey explained in 1971:

Field work, whether in local or faraway places, has been the lifeblood of natural history museums . . . It should be noted that only by collecting through the years has it been possible to acquire accurate information upon which are based the thousands of publications portraying the geographic distribution of plants and animals. Museums now have extensive series of specimens from all over the world, and general collecting in well-known areas is no longer necessary, but until comparatively recently it was the duty of naturalists not only to record the life history habits of species of interest, but to preserve specimens to authenticate their observations.

In the decades following Figgins’s departure, the Museum continued to collect, but the priority for acquisition changed from the former focus on collecting for scientific research and exhibition to a focus on collecting primarily for exhibition. The Museum was building new halls and making
new dioramas, and its naturalists spent time and effort on these endeavors. However, scientific work and collecting did not end during this period, as demonstrated by the following list of Museum expeditions, which Bailey led, participated in, and/or sponsored: Alaska (1921, 1948, 1953, 1956, 1959, 1961–1965, 1967), the Bahamas (1923), Mexico (1940, 1952, 1959, 1964), Greenland (1947), Australia (1949, 1952, 1954), New Zealand (1949, 1952, 1954, 1957), the Hawaiian Archipelago and other Pacific Islands (1949, 1952, 1954, 1957), Central America (1960), Canada (1924, 1946, 1949, 1951, 1955, 1956, 1965–1966), Campbell Island off Antarctica (1958), the Galápagos Islands (1960), and Botswana (1969). In addition to acquiring hundreds of exhibit specimens on each of these expeditions, the field teams, often led by Bailey himself, acquired specimens for the research collection. The expansion of the bird collection in particular, a reflection of Bailey's ornithological passion, resulted in the Museum's ornithology collection being “arguably the most significant collection held in trust by the Denver Museum of Natural History” (Preston & Haglund 2000).

Robert J. Niedrach (1889–1974) joined the Museum in 1912 when he was a teenager (Fig. 4.17). He was first employed as a preparator of birds but soon was accompanying Lincoln on bird collecting expeditions throughout Colorado, from 1915 to 1920. Niedrach continued preparing and mounting specimens at the Museum for another 15 years. In 1935 he was named curator of birds and later served as assistant director. Niedrach was the first person to hold that curatorial position since Bailey left the Museum in 1926. Niedrach was Bailey's alter ego, and the two maintained a close personal relationship, as well as closely linked professional lives, from the time they first met in 1921. Niedrach held the position of curator of birds until a 1968 Museum reorganization, when he became curator of zoology (1968–1969) and subsequently ecologist and curator of biology (1970). Bailey and Niedrach coauthored several publications, most notably the two-volume tome describing occurrence and distribution of the birds of Colorado (Bailey & Niedrach 1965). They conducted extensive fieldwork together. When Director Bailey left town on his annual lecture tour, he usually placed Niedrach in charge of the Museum for extended periods. It is frequently difficult to separate the work of the two men.
Niedrach’s particular strengths revolved around fieldwork and exhibit work. He supervised the installation of more than 50 of the Museum’s habitat dioramas. Niedrach’s observational, interpretive, and photographic skills were valued by Bailey and many others. Though best known for his work in ornithology with Bailey and others, Niedrach was an outstanding all-around naturalist. He was fully committed to the Museum’s educational role and contributed to its fulfillment through teaching and lecturing as well as exhibits. He helped found the Colorado Bird Club in 1935. This organization has since become the Denver Field Ornithologists, one of the most active community birding clubs in the nation. Niedrach also worked extensively with the Boy Scouts of America and the Camp Fire Girls. He is credited with helping to establish the Museum’s Education Department in 1969. He retired the next year, but continued to work at the Museum in an emeritus capacity, literally until the day he died (in the Museum’s parking lot, in 1974).9

Niedrach’s early interest in nature, and birds in particular, derived from prowling the meadows along the Hackensack River and the Palisades near his New Jersey birthplace. Frank M. Chapman, curator of birds at the American Museum of Natural History, was an early influence on Niedrach, who accompanied Chapman in local fieldwork. Niedrach’s career with the Museum even paralleled Chapman’s as a biological collector, nature educator, and preparator of lifelike museum habitat groups.

Niedrach’s fieldwork outside the United States included Central America (1935–1936), Mexico (J. R. Pemberton Colorado Museum Mexican expedition, 1940), mid-Pacific islands (1949), and Australia and Fiji (1952). In 1950 he worked with the National Geographic Society and Harold E. Edgerton of the Massachusetts Institute of Technology to field-test new equipment devised by Edgerton for high-speed photography in the field.

In 1936 Frank Clay Cross (1893–1953) began as honorary curator of entomology.10 Cross was an amateur naturalist and author who had far-ranging interests that spanned everything from serving as deputy director of publications for the Office of International Trade in the U.S. Department of Commerce to meteorite hunting with Museum curator Harvey Nininger to genealogy and ornithology.

The insect collection had been under the care of geology curator Frank Howland from the late 1920s until 1935. Cross, a Kansas native, was also an amateur lepidopterist. In his short tenure as curator, he re-curated the butterfly collection and, with the help of two volunteers, Robert Potts and Charles W. Dawson, made great strides in reorganizing the entire collection (Webb & Peigler 1990). He published a booklet called *Butterflies of Colorado* in 1937, which tripled the number of known species from the first published list, titled *Coloradian Butterflies* (Reakirt 1866). He also wanted to publish several types and paratypes discovered during the reorganization. This project was never completed; the newly rediscovered type specimens
went back into the collection and had to wait 50 more years before a new rediscovery brought them to light.

In *Butterflies of Colorado* Cross included “several very questionable records” according to some critics in the field, and Bailey commissioned a comprehensive volume on butterflies, which was published in the Proceedings of the Denver Museum of Natural History, to record a more accurate account of these animals. This five-volume work, titled *Colorado Butterflies*, was published from 1954 until 1957 by F. Martin Brown, with assistance from Donald Eff and the Rev. Bernard Rotger. Eff and Rotger were accomplished amateur lepidopterists, and Brown, a professional entomologist, is known for his long career at the University of Colorado Boulder working in modern and fossil insects (Brown et al. 1957).

Walker Van Riper (1887–1960) (Fig. 4.18) was named curator of spiders in 1943 (a position later changed to curator, Division of Insects and Spiders). Van Riper was a retired Denver investment banker. After schooling at Yale and Saint Louis University, he contracted tuberculosis and moved for health reasons first to Arizona and then to Colorado Springs. As he regained his health, he taught economics for a year at Colorado College, in 1915. He moved to Denver and pursued a career in investments, but in the mid-1920s his illness struck again, and he was mostly confined to bed from 1925 to 1926 (Cushing 1999).

During his confinement a friend loaned him a microscope to break the monotony. Mrs. Van Riper checked out books on how to use it. “The day he first looked at a drop of pond water on a slide and saw it teeming with microscopic life, the naturalist in him began to sprout,” she said (Lindberg 1955). Van Riper recovered and worked as an investment banker until his retirement in 1943, but he kept up his personal interest in natural history. In the 1930s Frederick E. D’Amour, now a University of Denver zoologist, got Van Riper interested in black widow spiders; Van Riper was hooked.

Van Riper had a wide range of interests beyond spiders, many that combined in very interesting ways. After Edgerton published the first reports on high-speed photography using his stroboscopic electric flash lamp, Van Riper worked with Joyce Sterns of the University of Denver Physics Department to build one. Van Riper went on to work with Edgerton and Niedrach to photograph natural history subjects. Perhaps Van Riper’s most famous image was of a striking rattlesnake, published in many journals and
magazines, including *Science* and *Life* (Fig. 4.19). Van Riper and Niedrach took high-speed photos of all the hummingbirds that they found, and later studied the feeding habits of these small, fast birds (Lindberg 1955).

Van Riper directed growth of the Museum’s insect collection throughout his career, starting in 1943 with a donation from Mr. and Mrs. A. E. Sprague of 127 boxes of beetles collected by Edwin B. Andrews around the Estes Park area. Several other donations, mostly of Lepidoptera, followed in the 1940s. In the 1950s W. H. Tyeryar, an amateur lepidopterist, collected and organized the butterflies and moths under Van Riper. Tyeryar’s collections concentrated on Colorado. In 1958 Tyeryar was named associate curator of the Division of Insects and Spiders, reporting to Van Riper.

Two years later, Van Riper was gone. The tuberculosis that had so drastically changed his life left him dreading its return and ended up contributing to his suicide in City Park in 1960 (Cushing 1999). Almost all of the spiders that Van Riper collected and curated are now housed at the University of Colorado Museum in Boulder.

An article written after Van Riper’s death relates an instance at a New Year’s Eve party when a scorpion stung him. Van Riper laughed it off. The next morning a physician friend who had been at the party called to find out how the curator was doing. “He’s miserable,” Mrs. Van Riper said. “The scorpion died.”

**Zoology under the Exhibits Department**

From the late 1960s through the early 1980s, under the leadership of Bailey and Niedrach, the focus of the Museum was on public programming over collections development and research. Until the mid-1970s, the Museum had no research biologists on staff; some collecting still occurred, even some expeditions to acquire specimens, but gone was any major emphasis on research or collections management during this period.
Near the end of Bailey’s and Niedrach’s careers at the Museum, the bird collection, and virtually the entire zoology collection, was stored in boxes, inaccessible to researchers or the public. The Department of Birds had been combined with the Department of Mammals and the Department of Entomology in 1947 to form the Department of Zoology, but by 1970 it was subsumed by the newly created Department of Natural History Exhibits.

A number of colorful characters worked for this hybrid department, and most came from the exhibits and taxidermy side. The Museum had a curator of botany, Ernest H. Brunquist, from the late 1950s to the late 1970s, and a curator of mycology, D. H. Mitchel, during the mid-1960s. Their efforts were largely focused on foreground development in the dioramas, which were being reinvigorated or newly created during this intense phase of exhibit development. Henry C. (Wichers) Inchumuk, who went on many Museum collecting expeditions and produced many of the taxidermy mounts now on display, was named curator of the Division of Mammals from 1959 to 1969. Inchumuk held other positions, titles perhaps reflecting the emphasis placed on exhibitry at the time. From 1971 to 1972 he was curator of mammals and zoological preparation, and from 1973 to 1974 he was curator, mammals, and curator of the Department of Interdepartmental Projects and Sculptural Resources.

Jack D. Putnam was named curator of natural history exhibits from 1971 to 1973. Putnam was also a veteran of many Museum collecting expeditions, ranging from Alaska to Botswana to Campbell Island. He often performed taxidermy on the very specimens he caught and skinned in the field. While on Campbell Island, Putnam was skinning the large bull southern elephant seal now on display on the second floor. He had to work on it in the surf, for the animal was too heavy to maneuver on shore. As he was taking the hide off the specimen, some skuas, opportunistic avian feeders of the southern oceans, kept swooping in for a free meal and pestering the field team. The team, however, had some very large nets for catching shorebirds, and the two skuas, now on display in the diorama, stayed too close for too long.12

Putnam spent nearly a year in Botswana with Bailey and Inchumuk in 1969. During their safari, they would create goodwill by cutting slices of meat from the large mammals they had hunted, drying them in the sun, and distributing them to local villagers along the way. They collected approximately 700 birds and mammals, many of which are now on display on the Museum’s third level. Putnam, like Inchumuk, held other titles: from 1974 to 1975 he was curator of the Department of Natural History.

Elizabeth “Betsy” A. Webb (b. 1947) was hired at the Museum in 1970 as an exhibits preparator (Fig. 4.20). Trained in anthropology at the University of Colorado, Webb became inspired by discussions with Niedrach and began reorganizing, rehousing, and tending to the conservation of the bird collection. She was named acting curator of special collections
in 1973, and essentially started a one-person campaign to reinvigorate a functional zoology program at the Museum. With the support of director Charles Crockett, Webb consolidated all zoological research collections, and in 1974 founded and was named curator of the Department of Zoological and Special Collections. This was the first time in the history of the institution that zoological collections and activities were administratively detached from an exhibits preparation function. The department eventually became the present-day Department of Zoology. Webb was granted a leave of absence from the Museum to pursue graduate studies in ornithology under Carl E. Bock at the University of Colorado from 1980 to 1982. During her absence, the department’s first professional collections manager, Paisley A. Seyfarth (now Paisley S. Cato), along with Charles A. Chase III, managed the zoological collections. Cato’s title was curator of zoology, but she spent most of her time at the Museum (1980–1981) attending to collections management issues. Cato went on to help found and lead the Society for the Preservation of Natural History Collections (SPNHC), authoring a widely consulted manual in 1986 on the management of bird collections. Webb joined Cato in making outstanding contributions to the early SPNHC organization. Chase was hired in 1981, first as curator of zoology, then serving as curator of ornithology from 1982 to 1984. Chase spearheaded a project that led to the publication of the book *Colorado Birds: a Reference to their Distribution and Habitat* published in 1992 by Robert Andrews and Robert Righter.

Webb completed her master's degree in 1985. Her graduate research focused on Botteri’s sparrow (*Aimophila botterii*) and formed the basis for several publications (e.g., Maurer et al. 1989, Webb & Bock 1990). Webb also authored several publications for SPNHC related to pest control and other conservation issues. Perhaps her most lasting contribution to the Museum lies in her successful efforts to reorganize and rehouse the entire research collection into modern cabinetry and institute an integrated pest management program for the entire zoology collection. In 1990, Webb worked with the Urban Wildlife Photo Club to produce a small exhibit on urban

Figure 4.20. Elizabeth A. Webb, one of the first curators in what was to become the Department of Zoology, preparing a great horned owl.
wildlife. This exhibit led to the publication of the beautifully illustrated book, *Close to Home: Colorado’s Urban Wildlife*. Many of the specimens used in the exhibit formed the public display at the Rocky Mountain Arsenal Visitor Center. Webb left the Museum in 1992 to become curator of collections and, later, director of the Pratt Museum in Homer, Alaska.

Another prominent figure in the Museum’s ornithological history in the 1970s and 1980s was Allan R. Phillips (1914–1996) (Fig. 4.21), contracted by Webb to serve as a part-time bird taxonomy consultant in the Department of Zoology from 1975 to 1990. Phillips was a well-known avian taxonomist with a complex, sometimes endearing, sometimes prickly character. He earned graduate degrees from the University of Arizona (MS 1939) and Cornell University (PhD 1946), and published 168 papers and four books between 1933 and 1995. He was a profoundly independent researcher throughout his life, funding his work primarily through adjunct teaching and research affiliations with a number of institutions in the United States and Mexico. A substantial portion of the two volumes of *The Known Birds of North and Middle America* (Phillips 1986, 1991) was written while he was in residence at the Denver Museum of Natural History. His work identifying type specimens was critical to the Museum’s curatorial efforts, and he and Webb described the few avian type specimens housed in the Museum (Phillips & Webb 1991). He also taught popular workshops on bird identification for local birding groups.

Phillips was a careful critic of anyone unclear or wrong about his or her facts and did not hesitate long in his attempt to put the record straight according to his point of view (Preston & Haglund 2000). But he was also known for enthusiastically sharing his knowledge of the birds he loved and loved to study. He often entertained staff and volunteers alike with his recitations of the poetry of Robert William Service (Preston & Haglund 2000). Although not employed by the Museum after 1992, Phillips continued to study the collections on and off until his death. Shortly before his death he was treated to a surprise birthday party in the Museum’s VIP Room. In turn, he treated all to a spirited, Phillipsian rendition of Service’s *The Cremation of Sam McGee* (Preston & Haglund 2000).

Alan Espenlaub, former diorama foreground preparator and Exhibits Division manager, led expeditions to Alaska and the Great Smoky Mountains in the late 1970s. These expeditions acquired specimens of birds and mammals as well as plants and background information to fill out the North American Mammals Hall renovation of this period. Espenlaub also helped the Museum acquire the Brown marine vertebrate collection. Consisting of more than 600 mounts of fish, marine mammals, and marine reptiles, most of the specimens were deaccessioned in the early 1990s and are no longer available. A handful of these specimens remain in the Museum’s education collections.
In 1970 curation of the conchology collection, established through various donations over the previous six decades, began. Charles T. Crockett, who later was named the Museum’s director, served briefly as curator of conchology. The first donation of shells was recorded in 1904, and periodically shells were displayed for the public. The collection was assigned at various times to the Geology Department and the Zoology Department. In the 1970s Pauline A. Morrison (Fig. 4.22), a longtime member and supporter of the Museum, reassembled the conchology collection from boxes “brought up from the basement.” Morrison also donated her private shell collection to the Museum and was the honorary curator of conchology from 1970 until her death in 1983. During the time that she was incapacitated, her maid and other volunteers maintained the collection. Pauline Morrison and her husband, George R. Morrison, established the Morrison Trust, and the Morrison Atria are named for them.

Morrison did not focus on collecting or retaining scientific data about most of the shells in her collection and in the collections added during her time at the Museum. Her initial catalog does not have any columns for scientific data about individual shells (e.g., locality, date, and conditions of collection). When she died, no one was available to take over, so the work area was closed. Two years later, Webb, then zoology manager, put together a team of volunteers whose instructions were to organize, identify, and catalog the hundreds of accumulated specimens. They worked with the catalog that Morrison had created but found many inconsistencies and much missing information.
Since none of the volunteers were experts on shells, they first needed to build a comprehensive reference library. They began with the books that had been donated by Morrison and others. The process of verifying past shell identifications continues, along with cataloging and incorporating numerous other donated collections of excellent quality.

The shell collection, which now numbers 17,500 lots, is being upgraded through selective deaccession of no-data specimens and acquisition of specimens with associated collection data. It is mostly marine in its coverage, with emphasis on the Caribbean and South Pacific, mostly of dry mollusk shell examples, with a smaller portion of dried echinoderms, corals, and sponges.

After a period of over a decade without dedicated entomology staff, in the mid-1970s Marc Epstein and Michael Pogue worked for the Museum’s entomology program. Epstein and Pogue continued the Museum’s long-standing focus of concentrating on Lepidoptera (moths and butterflies). Epstein recalled:

I grew up in Denver and made nearly weekly visits to the Museum. I particularly loved the dioramas after I somewhat outgrew the dinosaurs. In 1968, I made my [first] contact with behind the scenes people when I was researching a science fair project at Steck Junior High School, entitled *Altitude Zonation of Butterflies*. Robert Niedrach became one of my mentors.

The project was more of an exhibit than anything experimental, but it featured a detailed painting of the biotic provinces in Colorado with the butterflies that occurred in each zone pinned to it. In 1970, I came down to the Museum to volunteer in the foreground department and worked with Bill Traher in doing some detailed painting on his murals (cactus spines on the Galapagos exhibit) and worked with foreground folks, painting the plastic leaves. It was there that I met Elizabeth Webb, who had recently headed up the “Zoological and Special Collections.” Betsy knew about my knowledge of butterflies, [and] I believe my contract was one of her first hires, if not the first.13

Epstein (b. 1955) did his undergraduate work under Urless Lanham at the University of Colorado Boulder and received his PhD in entomology from Colorado State University working under Howard Evans (1977). Webb hired him as a contract curator in 1972, and he helped re-curate the Mason and Colorado butterfly collections. Epstein was involved in acquiring the large Raymond Jay Collection of Lepidoptera and made an extensive collection of the butterflies of Red Rocks Park. This fieldwork focused on the phenology
and life histories of the butterflies of the park and was intended to be the basis for an exhibit featuring the seasonal progression of these insects. Although Epstein’s work resulted in publications, the exhibit was never created. He left the Museum in 1978.

Epstein recalls his time at the Museum “overlapped with my close friend and colleague Mike Pogue, who came to the department after I did. I was primarily at the Museum during summers and Mike graduated from CU before me, and I lit a bit of a fire under him to get into Lepidoptera.”

Michael Pogue (b. 1955) served as a curatorial assistant from 1975 to 1979. He worked in foregrounds and exhibit preparation but also did field collecting in entomology, including a trip to New Guinea to collect insects.

Modern Museum Zoology: Professional Research and Collections Care

Soon after Webb returned to the Museum from her graduate studies, she began planning for expansion of the zoological staff. Webb eventually convinced the Museum administration to hire a full-time specialist in ornithology. Peter B. Stacey resigned his tenured position as associate professor at Indiana State University to assume the re-created position of curator of ornithology at the Denver Museum in June 1986. Stacey was aggressive in his pursuit of improved collections space and facilities for the bird collection. The Museum as a whole was beginning a transition toward increased emphasis on collections and research, but even with administration support, this change was slow in developing and an interim Museum management team did not provide complete support for Stacey’s ambition. Stacey left the Museum in January 1987, after only seven months of employment. After Stacey’s departure, Webb delegated direct management of the bird collection to part-time contract personnel, notably Phillips and Michael F. Carter, the founder of the Colorado Bird Observatory, now the Rocky Mountain Bird Observatory.

Carron Meaney started working in the Zoology Department in 1983 (Fig. 4.23). The position of curator of mammalogy was created for her in 1985. Meaney obtained her master’s degree and doctorate in biology from the University of Colorado Boulder. She served at the Museum until 1993. During that time she worked on the mammal collection, acquiring certification; organized and reviewed cataloging of the fur vault in the old Planetarium, including the many specimens from Botswana that had been protected from insect infestation with DDT; led six trips, to Kenya, Tanzania, Zambia, Zimbabwe, Botswana, and Namibia, and one trip to Baja through the Museum’s travel program; taught numerous classes through the Museum’s Education Program; acquired and supervised a very active group of volunteers, interns, and research associates; developed the
interpretive material for the Australia Hall; and served as the curator on the Museum’s team to completely restore and interpret the Explore Colorado hall, contributing to the Museum’s publication of the book Explore Colorado: A Naturalist's Notebook. Meaney is coauthor of Mammals of Colorado (1994, 2nd edition 2011) with David Armstrong, University of Colorado, and Jim Fitzgerald, emeritus, University of Northern Colorado.

In 1988 Denver-area voters approved a Scientific and Cultural Facilities District tax to help fund local institutions, including the Museum. This increased source of funding, in addition to strengthened support from a new chief curator, Jane Day, and a new executive director, John Welles, allowed the Museum to move forward in its efforts to bolster its collections and research presence.

In 1990 Charles “Chuck” R. Preston (b. 1952) was hired as the new curator of ornithology (Fig. 4.24). Preston received his doctorate in 1982 from the University of Arkansas, Fayetteville. He had curated vertebrate zoology collections through various appointments at the Arkansas Museum of Science and History, University of Arkansas Museum, and University of Arkansas at Little Rock between 1977 and 1989. He resigned his tenured position as associate professor of biological sciences at the University of Arkansas to become curator of ornithology at the Museum in January 1990.

Preston was named chairman of the Denver Museum Department of Zoology in August of 1990. Preston’s major objectives at the Museum were to strengthen bird, mammal, and arthropod holdings from the southern Rocky Mountains and Great Plains, verify documentation and computerize all specimen records, encourage and facilitate increased use of collections by students and outside researchers, and expand field research and public outreach in zoology and conservation biology. He initiated the practice of avian combination specimens (skeleton and skin) and tissue preservation in the zoology collections, and led collecting expeditions to several underexplored regions of Colorado. Preston directed and acquired more than $1 million in funding for an integrated ecological research and public education project at Rocky Mountain Arsenal, designed to explore the response of select bird and mammal populations to planned cleanup activities toward converting this federal Superfund site into a national wildlife refuge. This project spanned five years, supporting five graduate students under
Preston’s direction from four universities, and produced an hour-long broadcast documentary, a traveling exhibition, and teacher education guide in addition to numerous reports and publications. Preston was assisted in directing the Rocky Mountain Arsenal project by Carron Meaney, Betsy Webb, and Cheri Jones.

Chuck Preston and Betsy Webb also contributed to the first *Colorado Breeding Bird Atlas*. This project and publication was led by departmental research associate, Hugh Kingery. This project is ongoing and the department is still involved in supporting the effort to document Colorado’s breeding bird populations.

Preston also initiated and directed a long-term project in the Comanche and Cimarron National Grasslands, the Comanche Grasslands Ecosystem Project. This was a large endeavor to study the nesting habits of raptors in relation to landscape composition and prey populations in the grasslands community while creating a platform for formal and informal ecological education for teachers, students, and the general public. Preston also cofounded the Dinosaur Ridge Raptor Migration Station, in partnership initially with Mike Carter, executive director of the Colorado Bird Observatory, and eventually joined by Jefferson County Open Space. This project was initiated to help document the migratory patterns and population trends of raptors throughout the Intermountain West and to provide new opportunities for public education. During Preston’s tenure at the Museum, he established the endowed Bouslog Ornithology Fellowship, a part-time position that supported young ornithologists working at the Museum. Frank Hein and Kirstie Bay, both graduate students directed or codirected by Preston, were hired as Bouslog fellows during (and after) Preston’s tenure. Preston left the Museum in June 1998 to direct the development of exhibits and programming for the Draper Museum of Natural History at the Buffalo Bill Historical Center complex in Cody, Wyoming. The Draper Museum opened in June 2002 to become the first American natural history museum established in the 21st century. By 2004 Preston held the position of chief curator of the Buffalo Bill Historical Center, as well as founding curator-in-charge of its Draper Museum of Natural History.

In 1990 Richard “Ric” S. Peigler (Fig. 4.25) was hired as zoology collections manager. Peigler received his PhD in entomology from Texas A&M University. His hire represents the beginning of continuous professional collections care in the department. Indeed, the Museum did not have

Figure 4.24. Charles R. Preston, department chair of zoology from 1990 to 1998.
a professional collections manager from the time Paisley Cato left in 1981 until Peigler was hired. From 1993 to 1997, he was the curator of entomology, continuing his studies of wild silk moths of the family Saturniidae. Several thousand specimens of this worldwide group, collected from Colorado to the Philippines and elsewhere around the globe, are now in the Museum’s collections.

From 1993 to 2004 William “Bill” G. Alther (Fig. 4.26) was the Department of Zoology’s collections manager after Peigler became curator of entomology. Alther was born in Topeka, Kansas, in 1959, and was a professional...
The Unwritten Life of a Curator

Most of the time the day-to-day workings of the Zoology Department would not make headlines on the Internet or be presented on America’s Funniest Home Videos. However, every now and then, things go south and events become legendary, if perhaps not educational.

On one occasion some volunteers and staff hatched a plan to dispatch a live porcupine that had been brought into the Museum. They put it in a cardboard box and placed the box into the large walk-in freezer, hoping this would do the trick. They hoped to find a well-frozen carcass ready to prepare after returning from their three-day weekend. Unfortunately, porcupines are used to very low temperatures, and the beast chewed its way out of the cardboard and also chewed up several rare mounts of waterfowl.

On another occasion volunteer vertebrate preparators made a mistake while dissecting a striped skunk in the prep lab. Ric Peigler’s office was connected directly by an air vent to the lab, and he suffered the full effects of that ill-fated incident. Unfortunately, at this time the Zoology Department sat right next to the T-Rex Cafe, the Museum’s eatery, and directly below the IMAX Theater. When the most offending gland was punctured, several things occurred at once: the zoology volunteers bolted, most visitors left their midday repast, many complaints were lodged, and Peigler tried to find sympathetic shelter in colleagues’ offices. The volunteers later recovered, visitors were assuaged, the Department of Zoology was banned from skinning skunks in its primitive work conditions, and Peigler was sent home by several unsympathetic Museum staffers who suggested a change of clothes and a shower before he visited their offices again.

Figure 4.27. Cheri A. Jones, curator of mammalogy from 1992 to 2003.
activities within the mammal collection and was instrumental in rehousing the Museum’s large collection of Botswana fauna. Jones left the Museum as a result of staff layoffs.

Rob Roy Ramey II served as curator of mammals from 2000 to 2005. Ramey received his PhD from Cornell University in 1993. He was appointed department chair in 2000 as a replacement for Charles Preston. His work included studies on the diseases, ecology, and restoration of bighorn sheep in Colorado and the genetics of the Preble’s meadow jumping mouse. His fieldwork carried him to sites throughout Colorado and to Mongolia, where he took part in an expedition studying wild sheep populations. Due to an economic downturn during Ramey’s tenure at the Museum, the Bouslog Ornithology Fellowship was redirected toward general Zoology Department budget relief. Ramey left the Museum in 2005.

In 1998 Paula E. Cushing was hired as the Museum’s curator of entomology (Fig. 4.28). Cushing received her PhD from the University of Florida in 1995. She quickly established an arachnology program and collection through a major donation from Bea Vogel, first president of the American Arachnological Society. In 1999 Cushing also initiated the Colorado Spider Survey, a citizen-science project to document the biodiversity of spiders throughout the Rocky Mountain/Great Plains ecoregions. From 1998 to 2007 Cushing curated the arachnology, entomology, and conchology collections. Cushing received a National Science Foundation (NSF) Biological Research Collections grant in 2004 that allowed her to re-curate a donation of arachnids from Colorado State University and to rehouse and create a database for much of the collection, with the help of grant-funded assistants Hank Guarisco, Jozef Slowik, and Aaron Spriggs. In 2007 Cushing and Lorenzo Prendini from the American Museum of Natural History received a five-year NSF grant to study Solifugae diversity. Through this funding, Cushing carried out field expeditions throughout the Desert Southwest, including Arizona, New Mexico, Texas, Utah, Nevada, and California.

Cushing chaired the Zoology Department from 2006 to 2011, after Ramey’s departure. During her tenure as department chair, she worked with longtime Museum board member Jack Ferguson to establish a new ornithology fellowship, hired Jeffrey Stephenson as the new collections manager, hired two new curators (John Demboski and Frank-T. Krell), and established...
a five-year collections internship program with funding from the Lloyd David and Carlye Cannon Wattis Foundation. She stepped down in 2011 and is currently the curator of invertebrate zoology, overseeing the arachnology and marine invertebrate collections.

Stephenson (Fig. 4.29) started as zoology collections manager in 2005. He had been the Museum’s education collections manager from 1989 to 2005. His focus is on proper care and continued access for all the collections in the Zoology Department. Stephenson has been instrumental in the continued professionalization of collections care, increasing the zoology volunteer program, helping supervise collections assistants and volunteers, maintaining a growing number of incoming and outgoing loans, increasing pest management and checks on collections, reorganizing collections, and preparing for the anticipated move into the new Rocky Mountain Science Collection Center. From 2008 to 2012 he was assisted by Aaron Spriggs, who was a collections assistant hired to help prepare specimens for the move. Spriggs previously was Cushing’s grant-funded research assistant.

John R. Demboski was hired in 2006 as the Museum’s curator of vertebrate zoology (Fig. 4.30). Demboski, who received his PhD in 1999 from the University of Alaska Fairbanks, is an evolutionary biologist studying mammals. Since coming to the Museum, Demboski’s fieldwork has taken him throughout the West as well as overseas (Mongolia). Demboski received funding from the National Science Foundation in 2007 to study chipmunk evolutionary genetics in western North America. Through collection and modern molecular genetic analysis, Demboski and his colleagues have uncovered cryptic diversity and discovered new hybrid zones. He, along with students from the University of New Mexico, has also started to examine codivergence of chipmunks and their parasites. Demboski aggressively grew the mammal collection from about 10,500 specimens to approximately 15,500 by 2013. This is the largest period of growth for this collection over the last 112 years. Along with this growth, the bird and mammal collections are now enhanced by frozen tissue and parasite subcollections to ensure a comprehensive record for future study and to add to our growing knowledge of the fauna of the western United States. The vertebrate collections continue to grow through active collecting, salvage,
transfers, and donations, and they are consistently the most active collections in the Museum. Demboski received National Science Foundation funding in 2011 to support rehousing, reorganizing, and creating a database for the mammal collection in preparation for the move to the new collections facility in 2014. Since 2007 four grant-funded or donor-funded personnel have worked in the vertebrate collections, including research assistant Kayce Bell, collections technician Meghan Truckey, and ornithology interns Sarah Manor and Andrew Doll. Demboski became department chair in March 2011 and director of the Zoology and Health Sciences Branch in April 2012.

In 2007 Frank-Thorsten Krell was hired as the Museum’s curator of entomology (Fig 4.31). Krell earned his PhD at the University of Tübingen in Germany. His research focuses on scarab beetles and their allies, and includes the taxonomy, evolution, anatomy, and ecology of this super-family of beetles. On arrival at the Museum, Krell immediately started two research projects: the Colorado Scarab Beetle Survey and the Bison Beetle Project. The focus of the Colorado Scarab Beetle Survey is to achieve a census of this group as the initial element in a larger Colorado Beetle Survey. The last catalogue of beetles in Colorado was published in 1902 (Wickham 1902). The second project is a 10-year study focusing on the response by indigenous and invasive Colorado dung beetles to the reintroduction of their once most abundant food source, namely bison droppings. Colorado once was home to free-ranging wild bison, but they were wiped out between the 1870s to the 1890s. Within the past few decades, ranchers and agencies have been reintroducing bison in different parts of the American West, including Colorado. This study is aimed at a particular herd introduced into the Plains Conservation Center’s Bijou Creek preservation area in 2007, when workers from the Museum started collecting samples and preserving the insects found in the bison dung. Krell also studies fossil scarabs, the biodiversity of scarabs in West Africa, and human impacts on beetle biodiversity in Africa and Colorado. Krell brought a large personal collection of beetles and other insects with him and donated his entire collection to the Museum in 2007. This one donation increased the size of the entomology collections more than sixfold (from about 90,000 to 600,000); it also multiplied the size of the Zoology Department collections many times over and doubled that of the Museum as a whole. In 2012 Krell received two collection grants from the National Science Foundation.
to rehouse and digitize the entomology collection. The collection became a part of the Southwest Collections of Arthropods Network (SCAN), which will digitize the Museum’s regional holdings of soil arthropods. A collections improvement grant will provide new cabinetry for the collection’s move into the new collections preservation facility. Additionally, these grants provided funding for hiring David Bettman as a curatorial assistant in June 2012, and Christopher Grinter as a databasing assistant and photographer in November 2012, which allows for a comprehensive re-curation of the entomology collection.

Conclusion

Starting in 1900 with 3,300 mammals and birds from the Carter Collection, the vertebrate collections housed and curated in the Zoology Department by 2013 numbered about 54,000 birds and 15,500 mammals. Beginning in 1908 with 12,000 insect specimens from Osler, and adding 18,000 butterflies from Mason in 1918, the insect collections numbered about 90,000 in 2006 and more than 865,000 in 2013. Since the Van Riper spiders were deposited at the University of Colorado Museum of Natural History, the arachnid collections established by Cushing now number more than 55,500 vials (or lots) in 2013 (all acquired since 1998). The conchology collection now numbers about 17,500 lots. (Individual animals in collections counted by lot are very large numbers; these numbers would increase the department’s holdings by well over 300,000 individuals.) As of the end of 2013, Zoology Department holdings exceeded 1 million specimens and specimen lots (Table 4.1).
To maximize accessibility, help maintain records, and help better organize the collections, the Zoology Department joined with other collections departments in acquiring an electronic database in 1989. This database, called ARGUS, represented the first time that Museum specimen and artifact records were entered and made accessible in an electronic format. In 2011 the Museum embarked on selecting a new and more powerful database, KE EMu, which can better serve collections management needs and will allow staff to better organize and share data concerning all Museum specimens. In addition, all of the department’s bird, mammal, and marine invertebrate holdings are available online through the Arctos database system, a multi-institutional database consortium that publishes to several different public data portals. The arthropod collections are available through the SCAN (Southwest Collections of Arthropods Network) data portal.

Since 2008 the Zoology Department, with the rest of the Museum, has participated in planning many of the aspects of designing, building, outfitting, and moving into the new Rocky Mountain Science Collections Center, a state-of-the-art facility for safe preservation and work areas associated with the Museum’s various biological collections. This facility is the single most important endeavor the Museum has undertaken since its founding in 1900. Beginning in 2014, the Zoology Department will begin moving more than 1,011,000 specimens and specimen lots into the new facility, where staff anticipate better care and increased visibility and use of the collections.

Curatorial and collections management practices are now in place to better ensure specimen safety; the safety of Museum staff, volunteers, and visitors; the availability of specimens to all of our audiences; and the integrity of specimen data. These modern practices also ensure that specimens will be available for research projects that will help shed light on the changing biota and their environment.

Today, bird and mammal specimens are not preserved solely as study skins; instead, an individual bird or mammal may be represented

### Table 4.1. List of Holdings, Zoology Department (Oct. 2013)

<table>
<thead>
<tr>
<th>Department</th>
<th>Holdings</th>
</tr>
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<tbody>
<tr>
<td>Arachnology</td>
<td>55,600 vials</td>
</tr>
<tr>
<td>Botany</td>
<td>3,400 specimens/herbarium sheets</td>
</tr>
<tr>
<td>Marine Invertebrates</td>
<td>17,500 lots</td>
</tr>
<tr>
<td>Entomology</td>
<td>865,000 specimens</td>
</tr>
<tr>
<td>Herpetology</td>
<td>160 specimens</td>
</tr>
<tr>
<td>Mammalogy</td>
<td>15,500 specimens</td>
</tr>
<tr>
<td>Ornithology</td>
<td>54,300 specimens</td>
</tr>
</tbody>
</table>
by up to five subsets in the collections, with associated data, study skin, skeleton, frozen tissues, ectoparasites, and endoparasites all preserved for future study and use. Sampling of Museum specimens for genetic, protein, zoonotic disease, and stable isotope analysis is now common in the scientific community. Museum specimen data made available through electronic databases and portals are now invaluable when attempting to assess the impact of climate change, habitat destruction, and invasive species on our planet. Many answers to questions in natural science are time factored, and long-term events such as habitat loss, habitat destruction, human population growth, introduction of invasive species, and climate change require continued collecting of specimens. In some cases, species populations move or change before we can formulate questions. And new scientific techniques and technologies such as DNA recovery and analysis, protein analysis, and stable isotope studies also mean that new and additional specimens from well-known areas will need to be collected into the future.

Maintaining good data records and sharing them with researchers worldwide is also a regular feature now at the Museum. Slowly but surely, the Museum’s zoology program has grown into an important research and learning resource for citizens and students, researchers and lifelong learners, from Denver and the Front Range to the rest of Colorado and the Rocky Mountain-Great Plains region to a worldwide audience.
Literature Cited


Endnotes

1. CMNH Annual Report, 1901, report by Mason “To the President and Directors of the Colorado Museum of N. H.”
2. CMNH Annual Report, 1901B, handwritten ledger accompanying the report by Mason “To the President and Directors of the Colorado Museum of N. H.”
13. Marc Epstein, e-mail to Frank-T. Krell, October 17, 2011.
14. Marc Epstein, e-mail to Frank-T. Krell, October 17, 2011.
The Denver Museum of Nature & Science has engaged in geology-themed activities since its inception in 1900. Early Museum geoscientists, beginning with the Museum’s very first curator (William S. Ward), focused on building informative and attractive exhibits at the Museum with an eye toward developing sustainable public support for the institution. As the Museum matured, they expanded their efforts to include publishing original scholarship, conducting public outreach, and building regionally focused collections to benefit science and society (Fig. 5.1). Today the Museum’s geologic work occurs under the umbrella of the Earth Sciences Department, where the subdisciplines of geology, mineralogy, and meteoritics are partnered with paleontology in order to decipher and convey past and present planetary processes. Anchored by the deep knowledge of departmental volunteers, over the last century the Museum’s geology staff have amassed approximately 45,000 objects that tell the story of the Rocky Mountains and our planet, including stunning collections of meteorites, rocks, and minerals. Each of these collections has been grown and continually pared with an eye toward preserving specimens that are of aesthetic, historical, educational, and/or scholarly value. In the process of collecting, interpreting, and showcasing such items, the department has helped cultivate public appreciation for nature’s resources and beauty, deep time and dynamic earth processes, and other planets. Along the way, the Museum became the first institution in the United States to espouse collection and study of meteorites (Fig. 5.2), and the department created the first citizen- and student-staffed meteorite monitoring and fall study program. Much of the department’s success has been fostered by generous donations of specimens by fellow scientists and collectors, such as a collection of diamonds from Paul Seel that is the most diverse in the museum world. More recently, the department has gained support through creation of the Museum’s first endowed position, the Tim and Kathryn Ryan Curator of Geology.
Figure 5.1. Summary graphic illustrating the history and products of the Geology Department, including histograms characterizing the tenure of departmental staff, volunteer involvement, scientific and outreach outcomes, key exhibits and acquisitions, and the growth and evolution of departmental collections. Scientific publications only include peer-reviewed contributions; popular publications include videos, movies, popular articles and books. Published abstracts of oral or poster presentations are not included. Quantitative volunteer data from 1985–1987, 1993, and 1995 are missing. Data used in this analysis are available as DMNH Archives # IA.148-12-12; interpolations and interpretations of collections data, publications, and staff and volunteer information are described in detail on an annotated spreadsheet in this archive.
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The Geology Department, perhaps more than any other scholarly branch of the Museum, has also spent the last 40 years reaching out to audiences who never step foot in the building, impacting tens of thousands of people every year with temporary thematic or educational exhibits that the department presents at national and regional mineral, gem, and educational fairs and events. Today, the geology group at the Museum does all of this and more, collaborating with Denver Museum of Nature & Science research associates such as Robert “Bob” G. Raynolds (Fig. 5.3) as well as regional and international geologists to create and publish new knowledge. In the process they build collections and translate knowledge about the earth to both the scientific community and to the public. Today’s geology group is young, inspired, and full of energy—much like other Museum scientists hired in the last few years. Like a similar cohort of young scientists and professionals hired by the Museum in the late 1960s, the geology staff is ready to embark on new adventures with the Museum and its audience.

Departmental Structure

Over time, the Geology Department has been described variously as its own department, a group, an area, or simply by the departmental staff’s realm of expertise. For example, geologic research, outreach, service, and collections work has been conducted under the aegis of the Departments of Mineralogy, Minerals, Meteorites, Geology, Earth Sciences, and as the conjoined
Departments of Mineralogy and Art, Geology and Paleontology, and Geology and Mineralogy. At the heart of each of these administrative units has been study of the earth’s processes and materials, whether derived from another planet (e.g., some meteorites) or from Earth itself. With this in mind, throughout this chapter the term Geology Department is used to encompass all the Museum’s nonpaleontologic geology-related activities from 1900–2012.

Staff
The core of the Geology Department has always been its vibrant personnel, who, like the department, have held myriad titles including volunteer, curator, collections manager, secretary, registrar, assistant, mineralologist, preparator, and support staff. These staff members can be grouped into three categories: curators, collections managers, and volunteers. Their responsibilities span the range of duties performed by the department.

Curators
In the Museum’s early years, the curators were jacks-of-all-trades, fulfilling many job functions at the Museum, probably with the aid of volunteers (Fig. 5.4). For example, curator of geology and mineralogy Frank Howland also was curator for the Museum’s bird eggs, nests, shells, and Yuma and Folsom artifacts, was the Museum’s librarian, and was caretaker of the entomology collection. The Museum’s first curator was mining manager and metallurgist William S. Ward, who served as curator of mineralogy and art from 1905–1914. He built the Museum’s first exhibits, helped acquire collections, and is notable for saving the Museum from closure and bankruptcy in October of 1908. Ward, who was often called Dr. Ward because he had an honorary doctorate from Princeton, was later joined by mining geologist Richard “R. C.” Hills, first as honorary curator of geology (1911–1913) and then as honorary curator of geology and mineralogy (1914–1923). Hills was notable for displaying a 2,006-foot-long rock core around the Museum’s main hall, for donating a major book collection to the Museum’s nascent library (Fig. 5.5), and for helping build relationships between the Colorado Museum of Natural History (the Museum’s name in those years) and other organizations such as the Colorado Scientific Society. Howland joined Hill when he became assistant curator of geology and mineralogy (1919–1923) at the tender age of 63. Subsequently he became curator of geology and mineralogy (1923–1936) and then emeritus curator of geology (1936–1938). One of his notable contributions was reorganizing the Museum’s mineral collections according to the Dana System (see Fig. 5.5), an organizational scheme for minerals still widely used by geologists today. Howland was later joined by commercial meteorite-hunter Harvey H. Nininger (curator, Division of Meteorites, 1930–1942; honorary curator, Department of Meteorites, 1943–1945; Fig. 5.6). Nininger was one of the Museum’s most
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Figure 5.4. Some historic departmental curators (top row, left to right): William S. Ward, R. C. Hills, Harvey H. Nininger; (at left) Frank Howland; (bottom row, left to right) Harvey C. Markman, Florian Cajori, and Jack A. Murphy. (Ward and Hills photographs courtesy of the Denver Public Library Western History Collection)
notable scientists. His his work put the study of meteorites, meteor craters, and meteorite falls on the scholarly map, and at the same time he built the most extensive collection of meteorites known at the time. Harvey C. Markman started at the Museum as a handyman and succeeded Howland, first as curator of geology, then as curator of geology and paleontology (1956–1954), and finally as emeritus curator (1955–1968). Adding rocks and fossils to his resume as an avid birder and naturalist, he shifted emphasis to earth sciences. He was the first geology curator known to have brought the Museum’s outreach and education work to the Denver schools. John A. Murphy Jr. followed a similar trajectory. He was an avid photographer, birder, and the Museum’s longtime projectionist in Phipps Auditorium. He filled a personnel gap, starting first as an assistant in the Geology Department (1955) and then becoming acting curator or curator of geology (1956–1966). Perhaps one of the most catalytic curators in the department was professor and biochemist Florian “Jerry” A. Cajori, who as an honorary curator (1967–1978) was the first staff member who was trained as both a scientist and teacher. Cajori was also the department’s first PhD, and was notable for inventorying and cataloging the Museum’s mineral exhibits and collections. Jack A. Murphy (assistant curator of geology, 1968–1969; curator of geology 1969–2004; emeritus curator 2004–present), son of John Murphy and grandson of former Museum director Alfred Bailey, formally started his Museum career by volunteering in the summers during his high school and university studies, from about 1962–1968. Work on his first exhibit began at the age of 15, with unpacking one of the Museum’s former exhibits, the El Potosi cavern (Fig. 5.7). Murphy later helped collect selenite crystals from the Naica Mine (Chihuahua, Mexico) to expand and reinstall the El Potosi-Naica cavern at the Museum. Murphy was one of the most successful curators in departmental history, spearheading prolific growth in collections, increasing outreach to public school children, fostering meteorite and mine awareness, and involving large numbers of volunteers in the field, in exhibits, and in the collections (Fig. 5.8). In addition, he shepherded publication of and wrote much of the epic Minerals of Colorado book and oversaw the opening of the Coors Hall of Minerals (recast as the Coors Hall of Gems and Minerals in 2011), an exhibition that showcases many specimens that he helped bring into the Museum’s collections. Like Ward, Murphy was awarded an honorary doctorate, from the University of Colorado Denver, for his many outstanding contributions to science, mineralogy, and public service.

Figure 5.5. Seminal editions of books from R. C. Hills’s personal library, a major donation that helped kick-start the nascent Museum library and which included James D. Dana’s A System of Mineralogy and Thomas M. Reade’s pre-plate-tectonics tome, The Origin of Mountain Ranges.
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Other curators served for brief intervals in the department, such as professor and geothermal geologist Paul Morgan (curator of geology, 2006–2008), who created the department’s first long-term research and collection plan, and James “Whitey” Hagadorn, who has been curator of geology from 2010 to the present. Other curators of brief tenure held interim or honorific positions, such as Raymond H. Hammer, who served as acting curator of geology and mineralogy at the beginning of World War I (1914–1915), and John Roberts (1955), Carroll “Shorty” E. Withers (1980–1981), Robert R. Cobban (1983, 1984, 1986), Logan D. Ivy (2004–2006), and Ian M. Miller (2008–2010).

In addition to its curators, collections managers have been critical to the growth and success of the Geology Department (Fig. 5.9). Perhaps the first people occupying collections manager-like roles were Carolyn Jones (1971–1973) and Julie Grazulis (1974–1977), both of whom were curatorial assistants in the department. Patricia “Pat” R. Bacon, who was the departmental secretary in 1977, also frequently filled the role of departmental collections manager. Joanne “Jody” Anderson started out as the geology volunteer registrar in 1978, then became geology contract registrar in 1979, and followed as geology registrar in 1980. In 1984 Jill L. Newmark occupied both the role of department registrar and secretary. Patricia “Pat” L. Jablonsky was department secretary, collections manager, and volunteer coordinator from 1985 to 1988. Mary Lynn Swain was geology collections manager in 1989. In 1992 Logan Ivy became the Earth Sciences Department’s first long-term collections manager, overseeing both geology specimens and the Museum’s paleontology collections. As collections continued to grow apace, some relief arrived in 2010 when Carol H. Lucking, who originally had worked as an intern at the Museum, was hired as a half-time collections manager.
Figure 5.7. Clockwise from upper left: El Potosi cavern exhibit in the original Museum building, ca. 1912; workers inside the actual El Potosi Mine, Chihuahua, Mexico; and the renovated El Potosi-Naica cavern, ca. 1975. Originally called the “Calcite Grotto” when it opened in 1912, the first version of this exhibit was one of the museum’s first permanent dioramas, and drew large crowds during its installation.
The contribution of volunteers to departmental research, collections work, and outreach cannot be overstated. Unfortunately the names of many of the department’s early volunteers are unknown to us. For example, the Museum employed many Works Progress Administration (WPA) workers to help with exhibits and other projects, but few records were kept of the names or contributions that were made by volunteers working with geology-themed exhibits or collections. In addition, many volunteers propelled the department’s success in the early days of the Museum, but their contributions were not recorded. Many of the key geology curators were also volunteers, either acting as honorary curators or emeritus curators, and donated their time and expertise to the Museum (Fig. 5.1).

The era of modern volunteer involvement began in the early 1970s with help from the Junior League of Denver. From this time forward the abundance, diversity, and time investments of departmental volunteers increased markedly (Figs. 5.1, 5.10). Over the approximately 40 years since Museum volunteers have been regularly documented, there have been nearly 100 volunteers working in the department, with many contributing 10, 20, or even 25 years of continuous service and tens of hours per week of work on behalf of the Museum. The majority of volunteers have had strong professional or hobbyist expertise in meteorites, crystallography, mineralogy, mining, exploration, or regional geology (Fig. 5.11). These skills facilitate their ability to collect and curate specimens, write popular and professional articles, conduct fieldwork, and construct exhibits both within and outside the Museum. For example, Shorty Withers not only helped seed and grow the Museum’s micromount mineral collection, he was subsequently inducted into the Micromounters Hall of Fame, the first of three Museum contributors (including also Paul Seel and department associate James “Jim” Hurlbut) to receive this honor (Fig. 5.12). Within the Geology Department, Hurlbut’s skills were of such high esteem that he was given the title of associate curator of micromounts from 1972 until he became a department associate in 2004.
Figure 5.9. Staff who have served as informal or formal collections managers (row-by-row from upper left): Carolyn Jones, with a giant specimen of pyrite; Julie Grazulis, preparing an exhibit; Jody Anderson, in the Mineral Hall; Bart Weis, explaining a meteorite; Cheryl DeGraff, logging specimens; Logan Ivy, in the Big Bone Room; Carol Lucking, at Snowmass Village, Colorado; and Pat Jablonsky, in Hidden Cave, New Mexico.
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Figure 5.10. Curator Jack Murphy and departmental volunteers and associates in Denver, 2004 (upper right) and curator Whitey Hagadorn and departmental volunteers in the field at the Yule Marble Quarry, Colorado, 2011 (right and below).
Figure 5.11. Longtime Museum volunteer and departmental associate Jim Hurlbut (above) and his 1950 teaching certificate (right), which permitted him to teach mineralogy at East High in the 1950s. Hurlbut has taught generations of avocational and professional mineralogists, both informally as well as in his University of Colorado Boulder courses Rocks and Minerals of Colorado and Field Excursions in Geology.

Figure 5.12. Left: Award plaques for induction of three Museum geology contributors to the Micromounters Hall of Fame. Above: Shorty Withers working at the microscope.
Science

A key charge of museum scientists is to create new knowledge. Early in the Museum’s history, its geoscientists focused on research related to mineral deposits and meteorites. In the latter half of the 20th century, most of the department’s focus was on discovery of outstanding mineral or meteorite specimens from the Colorado region and building rock and mineral collections representative of the state. Many talks, posters, and exhibits were produced to convey the results of this collections work (see DMNH Archives # IA.148-12-12). In the 1990s and early 2000s, the Museum’s Meteorite Research Team and All-Sky Camera Network began tracking meteor falls in Colorado, and they were the first to involve K-12 students in analyzing sky data to predict and then collect witnessed meteor falls. In the last decade, more attention has been focused on publishing results of the Museum’s field and laboratory research, and today one of the main metrics for evaluating the success of this process is through peer-reviewed publication in scientific journals. With the exception of a 40-year window, over the department’s 107 years of history there has been a steady suite of such contributions by Museum geoscientists, resulting in 71 peer-reviewed publications and many more published abstracts (Figs. 5.1, 5.13). One of the most notable
and well-cited volumes produced by Museum staff and volunteers is the tome Minerals of Colorado, a must-have reference for any geoscientist in Colorado (Fig. 5.14). Since the recent refocusing of the geology group and reintegration of its staff within the Earth Sciences Department, Museum geoscientists’ scholarly productivity has continued to increase. For example, over half of the department’s cumulative publications were produced in the last five years in multidisciplinary geology projects aimed at explaining key moments and processes in earth history.

**Outreach**

Hand in hand with its responsibility to create new knowledge, one of our Department’s main charges is to disseminate new and existing geoscience information to the public in ways that are informative, interesting, and curiosity-inspiring. From the Museum’s inception, geology-themed outreach has been anchored by permanent onsite exhibits and dioramas (Fig. 5.15) augmented by off-site temporary exhibits and displays. In the early years of the Museum, exhibits were constructed that focused on Breckenridge gold (e.g., from the John Campion collection, 1908); coal, gold, and iron ore (e.g., the giant cone-shaped piles of ore from Gilpin County, 1909); fuels and minerals (e.g., the Colorado Fuel and Iron Company and Charles Limberg collections, 1909); and Arizona copper ores and Mexican calcite caves (e.g., the Church and El Potosi Mine collections, 1912). The Museum
was the first to produce a display that demonstrated radioactivity (using uraninite, 1914) and subsurface geology using a full-scale drill core (i.e., the La Plata Mountains core, 1915). Other key early exhibits focused on crystal forms (e.g., using the Mary Pratt collection, 1926) and the Dana classification system (1935–1936). Later exhibits integrated new technologies and new knowledge to bring fluorescent minerals to life (e.g., using the George Williams collection, 1942) and illustrated materials used to make atomic bombs (1945) as well as new varieties of quartz (1952). In the 1970s, old displays that had been mothballed years earlier were rejuvenated, such as the fluorescent mineral display (1971), the famous Tom’s Baby gold specimen (1974), and the Naica-El Potosi crystal cave (1975). In addition to renovating the Museum’s mineral exhibit as Coors Hall of Minerals in 1982, the Museum continued to strategically obtain and display iconic minerals such as the faceted Salvador Dali topaz (1978), the Alma King rhodochrosite crystal (1994), and the Mount Antero aquamarine plate (2006). Today
the Geology Department remains involved in many parts of the Museum, contributing meteorites, volcanic rocks, and thin-sections to the Museum’s Space Odyssey exhibition (2003) and using rocks in the Prehistoric Journey exhibition (1995, 2011) to tell stories of tectonics, extinctions, and planetary dynamics (Fig. 5.16).

Figure 5.16. Above: Banded ironstone and stromatolitic limestone rocks and other specimens in Prehistoric Journey. Below: Visitors viewing rock thin-sections in Space Odyssey.

Since at least 1972, when Jack Murphy presented the Museum’s first display case at the Denver Gem and Mineral Show, the Geology Department has annually presented educational display cases at the Tucson, Denver, Colorado Springs, Fort Collins, Kansas City, and other regional mineral shows, as well as presented hands-on materials at Museum-staffed tables at educational fairs in the Front Range area (Fig. 5.17).

Denver Museum geoscientists have also produced many popular publications to bring geology into context for the public. For example, curator Harvey Markman’s book Fossils: A Story of the Rocks and Their Record of Prehistoric Life was popular enough that it was in print for nearly 30 years and focused not just on fossils but on how rocks are a geologist’s
window into ancient Earth. Similarly, Jack Murphy and Museum volunteer photographer Ken Erickson collaborated on two popular guidebooks that are still widely used today, *Geology Tour of Denver’s Buildings and Monuments* and *Geology Tour of Denver’s Capitol Hill Stone Buildings* (Fig. 5.14).

In the 1970s geology-themed outreach expanded its focus from exhibits to popular media such as movies, popular magazines, and newsletters (Figs. 5.1, 5.13). Curator Jack Murphy, for example, penned many popular articles and contributed to several films focused on building stones, meteorites, minerals, and mining. Communication skills are increasingly a cornerstone of every earth scientist’s toolkit, and popular or public outreach continues to increase in importance. To this end, nearly 85 percent of the department’s popular geology contributions in books, movies, and related media were produced in the last 30 years, with nearly 30 percent of these occurring in the last five years.

Much of the department’s outreach still occurs in person, with behind-the-scenes tours, K–12 teacher training and summer workshops, public lectures, field trips, and adult continuing-education courses. Yet, the
Internet offers the department new opportunities to reach audiences via online video, remote identification of specimens, and web pages. One advantage of such all-digital formats is the ability to rapidly address timely issues that are geologic in nature but that don’t lend themselves to collections or standard museum displays. A recent example is the Science Bites video with curator Whitey Hagadorn that addressed the pros and cons of Colorado’s renewable and nonrenewable energy resources (www.dmns.org/science/science-bites/the-energy-equation/).

Collections

The Museum has four major geological collections. These include: (1) minerals, a subset of which are gems and minor permineralized fossils, tektites, jewelry, and carvings, (2) micromounts, which are a special collection of small minerals that require a microscope for study, (3) rocks, which also include building stones, drill core, and solid fuels such as coal, and (4) meteorites, which include both uncut specimens, cut, polished, and etched slabs, and thin-sections. All of these collections have grown immensely over the last century as a result of staff collection, donations, and the Museum’s purchase of specimens (Figs. 5.1, 5.18). With the exception of micromounts, all of these collections have been featured in exhibits since the Museum first opened.

The mineral collection was one of the founding collections of the Museum, principally a result of the donation of John Campion’s crystallized gold collection from Breckenridge, Colorado (Fig. 5.19), along with the rest of his mineral collection. The bulk of the Campion gold has been continuously on display since the Museum opened. The department’s mineral collection grew rapidly after the opening of the Museum and the hiring of its first two geology curators, both by staff collection and by purchase and donation of strategically relevant specimens. Significant early contributions to the mineral collection came from William Church (including azurites and malachites from Morenci, Arizona, 1912), R. C. Hills (minerals, fossils, and mining ores, 1912), Henry Porter (principally opal, gold, and other minerals, 1914), and Sadie House (quartz, rhodochrosite, geodes, 1926). From World War I until the early 1960s, the Museum’s collection grew very slowly, with the only major acquisition coming from donation of the Cloyd Woolley collection (approximately 400 agate, jasper, petrified wood, and other specimens, 1952). The heyday of growth in the mineral collection was from approximately 1962 to 1984, when Jack Murphy and a team of volunteers actively collected, purchased, and solicited donation of many specimens. Notable among these were the acquisition of the Henry Arnes collection (more than 2,000 specimens, 1962), the Larry Hammond collection (approximately 250 specimens, 1972), the Lawrence and Agnes Oliver collection (approximately 400 specimens, 1974), the John H. Alexander...
Figure 5.18. Historical growth of the mineral, micromount, rock, and meteorite collections. It is not clear what happened to many pre-1911 collections such as the stacks of minerals and rocks illustrated in Figure 5.15, and thus these are only included in this analysis in cases where the authors are reasonably certain of their collections status.
collection (approximately 200 specimens, 1978), the E. William Heinrich collection (a 1,100-specimen synoptic collection, 1981), and the Mr. and Mrs. Philip Andrews collection (approximately 300 specimens, 1981). In the 1980s and 1990s, collections were substantially augmented by persistent donors such as Russell Honea (approximately 400 specimens from 1950–1989), together with donation of two collections that were global in scope: the Paul Seel collection (approximately 1,000 specimens, 1984) and the Verne Reckmeyer collection (approximately 600 specimens, 1995).

The micromount collection was founded in 1971 by Shorty Withers, who over a ten-year period created 2,929 of these microscopic mounts from the Museum’s existing mineral collections. Donation of his personal

Figure 5.19. Campion gold collection, including (clockwise from upper left) the original “Campion Cage,” the special gold safe built by D. W. Brunton, Tom’s Baby, and another spectacular gold specimen. (Campion Cage photograph from Denver Municipal Facts, August 28, 1909)
Figure 5.20. Clockwise from right: Paul Seel’s Zentmayer Centennial microscope, Paul and Hilde Seel, and diamonds from the Seel collection, including a specimen strung on thread. (Diamond photographs courtesy of Phil McCollum)

collection of more than 3,000 specimens in 1983 helped further establish the Museum’s micromounts as a substantial collection (Fig. 5.18). But it was not until Paul Seel’s widow donated her late husband’s collection in 1985 that the Museum’s micromount collection became truly international and significant in scope. Included in the Seel collection were a Zentmayer Centennial microscope, nearly 9,000 minerals, and more than 1,500 diamonds, including many unusual forms (Fig. 5.20). Over the next 25 years, Museum volunteer Lawrence “Larry” G. Havens (in the argyle sweater-vest in Fig. 5.10) and department associate Jim Hurlbut (Fig. 5.10) mounted and added more than 3,300 specimens to the collection, including additional unmounted materials donated with the Seel collection. Today, the micromount collection continues to grow, in 2012 adding nearly 5,000 specimens as a result of a generous donation by longtime department associate Leonard “Len” Keller and donation of the historical Willet R. Willis collection from Willis’s heirs and the U.S. Air Force Academy.
The Museum’s rock collection is small and locally focused (Fig. 5.21). The first rocks in the collection were purchased from R. C. Hills, and together with other early donations and acquisitions, they represented specimens from Colorado and Rocky Mountain mines that were used in building, combustion processes, or in production of raw or industrial materials. The rock collection did not grow significantly from 1909 to 1991 until Jack Murphy began intensively collecting rocks that were used as Colorado building stones, adding more than 120 specimens to the collection and leaving many more specimens uncataloged (Figs. 5.1, 5.18). Growth in the early 1990s was also catalyzed by donation of many materials from marble and other building stone quarries or distributors, as well as by donation of the Geoff Dunn collection (approximately 110 specimens, 1998) and acquisition of the Ken Lump collection (34 specimens, 2003). Today this collection continues to grow, albeit slowly, with focus on acquiring specimens of local interest or of high pedagogical value.

The meteorite collection has grown episodically throughout its 112-year history (Figs. 5.1, 5.18) with major donations of specimens by Harvey Nininger (56 specimens, 1931–1940), former U.S. representative from Colorado Dean. M. Gillespie (192 specimens, 1955–1956), and Blaine Reed (42 specimens, 1998–1999). Nininger and Reed also sold the Museum a total of 45 and 59 specimens, respectively and, in the case of Nininger, also traded Museum specimens for others in his own personal
collection. Today such activities would be viewed as a potential conflict of interest, but at the time it was standard practice for meteorites and minerals. The meteorite collection has experienced steady but slow growth over the years, with particularly successful efforts by Jack Murphy to acquire additional notable or Colorado specimens for the collections. One of the most famous such specimens is the Cañon City, Colorado, meteorite, which punctured the roof of a garage as it fell. The Museum has a piece of the punctured roof and a portion of the associated meteorite (Fig. 5.22). From 2000 to 2005, Murphy also submitted and had approved the naming of ten new meteorites by the World Nomenclature Committee of the Meteoritical Society.

Figure 5.22. Roof (right) and ceiling (below) of garage hit by a meteorite in Cañon City, Colorado. A portion of the meteorite at lower right.

Time Line

Following is a chronological description of the history of the geology program at the Denver Museum of Nature and Science based on analysis of Museum records, annual reports, personal staff accounts, bibliographic databases, and archival newspaper reports (see also DMNH Archives # IA.148-12-12). This time line is not exhaustive but highlights key moments, characters, and items relevant to departmental history.
The Early Years

The foundation of the mineral collection was the collection of crystallized gold donated by John Campion from his mining properties in the Farncomb Hill area of Breckenridge, Colorado. This material originally occurred as veins of gold entombed inside quartz and other minerals within the rock. By dipping the raw rock and ore into strong acids, it was possible to dissolve away the surrounding rock, leaving the impervious gold veins behind. Some of these veins could be quite featherlike or ribbonlike, whereas others were more robust. The collection includes more than 600 individual gold pieces, including the largest recorded gold piece found in Colorado, nicknamed Tom’s Baby. When originally discovered in 1887 in the Gold Flake Mine, Tom’s Baby weighed about 160 troy ounces. After cleaning with acids, two pieces broke off from the intergrown gold leaves, and the largest piece weighed 136 troy ounces, still considered the largest recorded gold sample found in Colorado. A further addition to the original mineral collection was a suite of economic minerals from the Leadville district, donated in 1902 by Charles T. Limberg. This collection, together with subsequent donations by Limberg, amounted to approximately 1,000 specimens in 1908.

The first curator of minerals, hired in 1905, was William Ward, who worked to increase the size of the displayable mineral collection via donations and loans from several of Colorado’s economic mineral, building material, and hydrocarbon fuel companies. Representative mineral specimens were borrowed from the Colorado School of Mines in Golden, and a large systematic collection was borrowed from R. C. Hills, a geologist and mineralogist working for the Victor Fuel Company, with the intent of purchasing the collection. All told, there were an estimated 5,000 mineral specimens in the Museum, either owned or on loan, by the end of 1908.

By 1911 there were 50 hip-height glass-topped display cases showing minerals, including the Campion gold (Fig. 5.15). The estimated 3,500 minerals and rocks on display were arranged into an industrial collection and a synoptic collection. Included in the display were about 1,500 specimens of Hills’s systematic mineral collections that had been purchased in 1911, including about 1,100 rocks and associated thin-sections from Hills’s mapping of the Colorado mountains. In 1911 Hills was offered and accepted an honorary curatorship of minerals, and Ward concentrated on the economic mineral part of the collection. The systematic displays were organized in accordance with the latest edition of Dana’s System of Mineralogy (Fig. 5.5), a system of organizing minerals by their chemical composition and their crystal habit. The economic mineral displays were organized by economic mineral content (i.e., iron-, lead-, copper-, gold-, or silver-bearing).

In 1912 the Mary Kimball Pratt collection of minerals was purchased by Museum board member Henry M. Porter and was donated to the Museum.
The remainder of the Hills collection was acquired, including a 2,006-foot-long drill core from the La Plata Mountains. This core was displayed around the circumference of the mineral hall. New York mining engineer Grant B. Schley and Dennis Sullivan of Denver made the first donations of selenite crystals from the El Potosi Mine in Mexico, and a small scale model of the grotto from which the crystals came was built and installed in the mineral hall (Fig. 5.7). Schley donated more material in 1913. The display of the Campion gold was improved by installation in a viewable safe built by David W. Brunton (Fig. 5.19), a man who designed a tool close to the heart of most geologists: the widely used Brunton field compass.

Ward resigned as curator and Raymond Hammer was appointed the acting curator of geology and mineralogy in 1914, while Hills remained as honorary curator of geology and mineralogy. In this year the interest aroused by the work of Marie and Pierre Curie in Paris convinced Hammer to install an exhibit on radioactivity using radium salts and six scintilloscopes for public viewing. With the organization of the mineral displays in the systematic fashion of Dana, work was begun on exhibits explaining that system. The Mary Pratt collection was installed in a separate five cases, also arranged by chemical makeup.

Hammer left the Museum in 1915, and the economic minerals portion of the collection was merged with the other minerals into the Geology Department. Hills accepted the position of honorary curator of geology and held the position until 1923. Frank Howland joined the department as assistant curator of geology and mineralogy in 1919. For the next few years, the emphasis of the department was to improve the mineral displays by reorganization, supplying updated signage, and adding models of crystals. Cataloging of the mineral collection began during this period. New displays included a model of the La Plata Mountains to go with the drill core, additional systematic minerals, a selection of rough and cut gems, and minerals important in mining. One of the larger loans of economic minerals from Jesse Randall of Georgetown, Colorado, was returned, resulting in seven display cases being available for the systematic mineral displays. In 1920 Hills donated his library to the Museum. This donation comprised about 650 volumes on geology, mineralogy, mining, and chemistry. These were cataloged over the next few years and constituted the first major donation to the Museum library. Hills resigned from the Museum 1923 and passed away that year. Frank Howland was appointed curator of geology and mineralogy.

Since 1914 Lazard Cahn had been donating mineral specimens to the Museum. He made significant donations in 1923—the same year when the geology displays were first upgraded with a loan of gold, meteorites, and rocks from the Colorado Scientific Society. By 1924 sufficient specimens of the Four Corners meteorite were acquired to trade for nine meteorites from falls in New Mexico. In that same year, the Johnstown meteorite fell in Weld County,
and the Museum was able to acquire some pieces of that specimen, one of
which was traded the next year for three other meteorite specimens. Following
earlier donations, the mineral collection of prominent local jewelry store
owner Arthur G. Pohndorf began to arrive via exchange in 1924 and 1925.

In 1926 a large collection of minerals from the West collected by a
Mr. House were donated by his widow, Sadie House. The total number of
donated specimens numbered about 500. The rough and cut gems loaned by
Pohndorf to the Museum were converted into a donation in 1926. No large
donations of minerals occurred for the next few years, except for donations
of a few or single specimens. The one exception was a donation of a mineral
lot from the estate of David W. Brunton.

The Nininger Era

In 1930 Harvey Nininger joined the Museum as curator of meteorites.
Nininger brought to the Museum his considerable private meteorite collec-
tion for display and began to add to the Museum’s collection and his own
by agreement with the Museum director. Using his knowledge of meteorites,
Nininger rearranged and relabeled the meteorite display to reflect the classi-
fication scheme of the time. During the next couple of years, new specimens
from 17 meteorite falls were acquired for the Museum and for Nininger,
including a fragment of the large Willamette, Oregon, meteorite in 1932.

By 1933 Nininger had established the Museum as a place that would
acquire meteorites from interested owners. Records indicate that specimens
were either purchased or acquired via donation as circumstances allowed.
The price of meteorites was not great at this time, and some were purchased
for $10 per pound. In this year Nininger was able to amass a large amount
of the Canyon Diablo meteorite via trade, donation, and purchase, accumu-
lating about 2,100 pounds of the material (Fig. 5.23). Nine other meteorites
were donated or loaned to the Museum in this year. Nininger heard of a
possible new witnessed fall near Haviland, Kansas, and he began a search
and excavation project to try to acquire specimens from this fall. This work
was somewhat impeded by an economic downturn.

Through the 1930s the mineral collection only grew minimally while
the meteorite collections of Nininger and the Museum attracted the most
donation attention. By 1936 Nininger had acquired representative specimens
from 351 falls for his personal collection, whereas the Museum collection
was only represented by 107 falls. The meteorite display was particularly
large in the later 1930s, as both the Museum’s and Nininger specimens were
on display for the public to see. In 1936 Nininger began working with a
magnetic detector around the Haviland, Kansas, site with only minor success.
By 1938 Nininger counted his collection of specimens at 4,000 pieces from
450 falls. In 1939 Nininger began using a magnetic rake in the area around
Barringer Crater in Arizona, site of the Canyon Diablo meteorite impact.
This process worked well, producing many small nickel-iron meteorite fragments, as well as a plethora of random iron bits of recent human origin.

The mineral collection grew slowly in the 1930s. Curator Frank Howland began to donate his collection of about 250 specimens in 1932 as work continued on identifying and relabeling specimens that had been added to the collection up to that time. The collection of Denver resident Otto Heck (269 specimens) was acquired. In 1934 a portion of the Mary Kimball Pratt collection was moved out of the synoptic collection and placed in an education collection. Work on the collections was slower due to the economic conditions, but in the later 1930s employees paid by the WPA began to help. In 1935 Howland became ill and Harvey Markman filled in for him as acting curator. Markman had worked with the Museum since 1919, starting in the paleontology area as an assistant to preparator Philip Reinheimer. His broad education in biology and geology brought him into the Geology Department as the paleontology work of the Museum slowed down in the middle 1930s. In 1936 Howland retired from the Museum and became emeritus curator of geology. Markman was appointed curator of geology to replace Howland. Markman began a reorganization of the mineral collection into the revised Dana system and took on a greater education load than previous curators. The Museum benefited from large donations from W. V. Hodges (1936), H. H. Lake, and B. Lane (1937).

In 1938 Frank Howland passed away. The educational mission of the department was increased with the production of slides on geological processes and permineralization. Continued reworking of the mineral displays made them more educational for the general public than they had been previously. A preliminary inventory of the mineral collection revealed about 700 mineral species in the collection at this time; today there are approximately 4,700 known species of minerals worldwide. Markman’s time began to be taken up with paleontological work as well as mineralogic work for the Museum. An important collection of fluorescent minerals was
donated by G. L. Williams, and Mrs. Frank Howland began to donate the remainder of her husband’s mineral collection.

By 1940 the remainder of the Howland collection was received as a donation from his estate. WPA workers continued helping with the relabeling of display and study specimens. The increased display of paleontology specimens impacted the mineral displays when the plesiosaur from Baca County was mounted and some mineral displays were removed to make the area available. Minerals from near Black Hills, South Dakota, were acquired, including a number of Fairburn agates from Grace Cearns of South Dakota. A fluorescent mineral display was planned, and a search began for ultraviolet (UV) lights in both long and short wavelengths.

With the onset of the war, operations in the Museum were curtailed as the help of the WPA workers ended. Finding UV lamps for the fluorescent mineral display became harder as the materials needed for the lamps were classified as essential war materials. Nevertheless, the lamps were finally acquired and the display opened in late 1941 (Fig. 5.15). These lamps proved inadequate, and better models were not acquired until 1943. Nininger became involved in the war effort, and his acquisition of meteorites stopped by early 1942. An increased public awareness of the importance of mineral sources for the war effort led to an increase in mineral identification requests from the public. More classes on minerals were being requested and taught by Markman in the Museum and at external venues. Ernest M. Gunnell began to donate his mineral collection in 1943 and continued to do so over ensuing years. This donation eventually amounted to approximately 120 specimens.

By 1943 Nininger’s work on the war effort consumed most of his time, and his title reverted to that of honorary curator of meteorites (i.e., without pay). In order to lengthen the life of the UV lamps, the fluorescent mineral display was only open on Sundays and holidays. Wartime materiel shortages made it difficult to replace the lamps should they fail. These shortages continued to curtail expansion activities even after the cessation of hostilities. Planning was begun in 1944 to place more mineral displays in the Museum’s south wing, but a shortage of construction materials delayed any work on this project until 1946. Work in the later war years was primarily in education outreach to the public, both in-house and at mineral society meetings, and preparing newer display labels for and continuing to rearrange the display minerals to conform to the Dana mineral classification system.

By the end of 1945, the manner in which the war was concluded resulted in a large interest by the public in fissionable materials. Displays of such minerals, including uraninites from Colorado, were created as well as signage explaining the fission process. Many of the minerals that bear fissionable elements had been in the Museum’s collection since the early
part of the century from now-famous mines and districts. Concomitant with the end of the war, the public’s interest in finding these minerals was high, and the number of identification requests increased such that in 1946 more than 300 identifications for the public were made. After the war, many geologists and mineral experts were conscripted into educating the public and fortune seekers about radioactive minerals (e.g., Fig. 5.11).

**After World War II**

Harvey Nininger did not return to the Museum after the war but left for the University of New Mexico and subsequently moved to Arizona State College (later Arizona State University), where he became associated with its research in meteorites in 1946. After donating some specimens to the Museum and trading some of his material for specimens in the collection, he took most of his personal meteorite collection with him. The departure was amicable, and it seems that Nininger may have wanted to live in a warmer climate and at an institution where the laboratory equipment needed for research on meteorites was available.

Toward the end of 1946, supply shortages caused by the war had eased and new display cases could be built. Plans to expand the mineral displays into the south wing could go forward. However, there still were building material shortages due to the postwar building boom, and actual construction was delayed. The cavern- or grotto-like exhibit based on the El Potosi Mine was improved with better lighting and painted backgrounds. The collection was improved via collecting trips to Arizona and old mining districts in Colorado. The postwar easing of monetary restrictions allowed Markman to make trips to other museums to study the latest ideas in mineral displays, the better to inform planning for the expanded displays in Denver.

Continued interest in fissionable materials prompted planning on expanded displays on the sources and processes of nuclear fission. The postwar boom resulted in many more people being able to afford vacations to the U.S. national parks, and interest in the geology of Yellowstone National Park was aroused in Museum visitors. Accordingly, planning began on an exhibit on the geothermal and geologic history of that park. The moderately large collection of Leadville minerals held by Mrs. Ruth Kassler was acquired by the department in 1948. During that year Museum visitorship was so high that routine maintenance of the collection was all that could be accomplished after informing the public about matters mineralogical via classes, lectures, and specimen identification. To help with the high visitorship, the Museum’s lapidary shop was reopened to cut and polish material for the public and for better displays.

In 1949 Markman expanded his official responsibilities, being appointed curator of geology and paleontology. The lapidary shop expanded and helped cull the backlog of donated materials for use as display
specimens. The interest of the public in radioactive minerals continued to be strong, and viewship of the relevant displays was high. Hector Jenkins of Alice Springs, Australia, donated a collection of minerals from central Australia, including specimens of opal from the Coober Pedy area. The Museum began a physical expansion with the construction of the west wing; expansion of the mineral displays into the south wing was delayed due to problems of access during construction. The plans for this expansion were improved, and it was decided to organize the displays based on historical geology rather than solely on mineral species.

The El Potosi selenite grotto was removed in 1951 due to construction of the west wing. This same construction also rerouted more visitors to the geology exhibit areas, which stimulated more questions of the curator. Better access to technical supplies allowed the purchase of better UV lamps for the fluorescent mineral displays. An expanded lapidary shop opened after the donation of supplies and Fairburn agates by geologist and mineral collector Cloyd Woolley. Woolley helped found the Colorado Mineral Society, which met at the Museum from at least World War II to the mid-1960s. He gave of his knowledge of lapidary techniques to help the Museum create an efficient and capable lapidary shop. More Australian specimens were donated by Hector Jenkins in 1952.

In 1953 the west wing construction had progressed sufficiently that the construction of new geology display alcoves could begin. The order of the alcoves was from “regular” minerals, then onto radioactive and cave minerals, and thence to gems. The alcoves transitioned to historical geology through displays of rocks from important formations and sites and then on to fossils leading to the Dinosaur Hall. Meteorites were displayed at the far end of the main hall, far away from the dinosaurs. At this time the lapidary shop was moved into the new west wing. Included in the mineral lots donated in 1953 were fragments purported to be from the area of the first atom bomb test.

Markman retired from the Museum in October 1954 and was appointed curator emeritus of geology and paleontology. John Roberts, a retired businessman with interests and experience in geology and paleontology, was appointed honorary curator of geology and paleontology to replace Markman. The three new mineral alcoves were finished at this time, and this area was named after John Rogers, who donated funds that allowed their construction. At this time the Museum acquired a cast of one of the largest gold nuggets recorded, the Welcome Stranger nugget from the National Museum of Victoria in Australia.

During 1955 two more mineral display alcoves were opened in the John Rogers Hall, and excess minerals were moved to new storage on the second floor. Markman began to donate his personal rock and mineral collection to the Museum. An important donation of meteorites began to
arrive. These meteorites were the collection of Dean M. Gillespie and were donated by his heirs, Mrs. Ruth Gillespie and Mrs. Walter Land. This collection comprised 192 specimens from 22 individual falls and was soon placed on display in the meteorite display alcove. In this alcove the latest ideas on the evolution of the solar system were displayed, illustrated by meteorites.

Roberts left the Museum in 1955, and John Murphy was appointed acting curator of geology in 1956. In agreement with the implied renaming of the department, Markman became curator emeritus of geology. By 1957 the remainder of the geology display alcoves had opened to the public. The displays were concerned with the subsurface geology, first of the earth’s crust and then with the Denver area via an illustrated cross section showing the geology from the Museum to the Red Rocks area (near Golden, Colorado). About this time the Museum received about 45 copper minerals from the Morenci, Arizona, area from Lewis A. Smith. Cabinets were constructed for the storage of nondisplay minerals, and a model for the new El Potosi Mine display was built. Planning for this new mine exhibit included collecting trips to Mexico over the next three years to acquire more material for the expanded exhibit. Construction of the grotto-style display commenced in 1960 and continued episodically for the next 15 years.

The large (860-mineral) collection of Henry Aarnes, mineralogist and founder of the Colorado Mineral Society, was acquired from his heirs in 1962, and some minerals from avocational mineralogist and lapidarist William Anderson were donated. These minerals were accompanied by pieces of lapidary equipment that served to improve the lapidary lab. The appearance of the seventh edition of Dana’s Mineralogy prompted plans to reorganize the study collection of minerals to follow this new standard reference in 1963. This work required upgraded labels for the collection and the displays, and this work took up a fair amount of the staff time for the next couple of years. In 1965 the Museum received about 45 minerals of the southwestern United States from the estate of Reginald A. Ovitt. Planning began on a reorganization of the geology displays with focus on geologic processes and time. In the realm of geologic processes, in 1966 the Museum acquired, from Wallace R. Hansen of the U.S. Geological Survey, a suite of rocks from the formations exposed in the Black Canyon of the Gunnison. The lapidary shop was improved via a donation from Markman of chemical testing equipment and books relating to mineral identification and analysis. In 1966 the Museum also received a donation of small gold nuggets (72 nuggets, all but two of which are small enough to fit into a single glass vial) from Herman Schutz that were panned by Schutz and his father and brother from the Cache Creek placers in the late 1800s.

Florian Cajori, a retired biochemist, professor, and avid mineral collector, joined the Museum as honorary curator of geology in 1967. He replaced John Murphy, who resigned from the Museum and took a position
as director of the Jesse Besser Museum in Michigan. Work on the El Potosi Mine display continued. Cajori undertook a journey to eastern museums to see how the large mineral collections there were displayed and cataloged.

The Murphy Era

Jack Murphy, son of John Murphy and grandson of former Museum director Alfred M. Bailey, was appointed assistant curator of geology in 1968. His first major task was the completion of the El Potosi Mine display. Florian Cajori attended the Tucson Gem and Mineral Show to acquire specimens for the collection. Although the majority of good specimens had to be acquired either via donations from collectors or by purchase, Cajori was able to arrange exchanges of minerals with the Tasmanian Museum and Art Gallery, thus increasing the Museum's collection from the Southern Hemisphere. Also in 1968, the public profile of the Museum's mineral display was enhanced by a program on PBS that focused on its colored mineral specimens. Several Campion gold specimens that had been removed during the newly finished west wing construction and subsequent building of new display cases were reinstalled.

Jack Murphy became curator of geology in 1969 and directed the inventory and cleaning of the mineral display alcoves. At this time the meteorites were separated from the mineral collections and kept as a separate collection with their own catalog. There were about 500 specimens from 140 falls in the meteorite collection. The fall represented by the largest number of specimens is that which produced Barringer, or Meteor, Crater, designated the Canyon Diablo meteorite. Cajori traveled to Salt Lake City to acquire specimens from that mining region, and donations arrived representing ores from Cripple Creek and Leadville, Colorado. In the mineral collecting field there is a subgenre of collecting sand samples from various formations and localities around the world. In 1969 the Museum acquired a donation of one of these sand collections, in glass bottles, from Denver resident Virginia Moore.

By 1970 the mineral collection contained nearly 12,000 cataloged specimens or lots of specimens. Work continued on the improvement of the card and ledger catalogs of these specimens. The stored minerals, which were usually not cataloged, were gone through, and several good specimens were found and cataloged. At the same time, some duplicates of little utility were sent to the Museum's education group for use in classes. A new display case of recently acquired specimens was installed and was partly filled with specimens acquired during collecting field trips in the western United States. A good microscope for mineral analysis was acquired at this time. E. Mitchell Gunnell, an accomplished mineral collector, began to volunteer in the collections. Due to the contacts made by Cajori and Murphy, the number of lots of minerals donated began to increase. In the early 1970s, Jack Murphy recognized the abundance and significance of regional minerals. Colorado's mining boom provided vast opportunities for growth of the collections and
the intellectual stimulus of mineral research and collecting could promote the museum’s standing. Through lectures and off-site displays, Murphy began galvanizing the mining community’s expertise and interest, leading to significant donations and financial support for specimen purchases. A key milestone in this effort was in 1973 when Murphy launched “The Colorado Mineral Recovery Project”, which aided in gaining underground mine access for museum collecting.

Shorty Withers, an enthusiastic collector and aficionado of micromounts, began to volunteer in the mineral collections in 1971. He brought mineral expertise to the department and worked on the nascent micromount collection, identifying and making micromounts. K. Don Lindsey began work in the quiescent paleontology collection, which was the charge of curator Jack Murphy. The primary work of the department personnel was to improve the mineral displays, reference collection, and the general department facilities. The “Recently Acquired Specimens” display case was maintained and a new display of minerals of Colorado was opened. The number of mineral donations continued to be high, and these included the start of the donation of minerals from Thomas Addenbrooke, a local mineral collector of some note, as well as specimens accumulated by Albert Biesecke, whose early to mid-1800s era European collection of approximately 250 minerals was donated by his grandson, Colorado mountaineering pioneer Carl Blaurock.

The Reverend Mark Fiester of Breckenridge was writing a book in 1972 on the history of Breckenridge and began to wonder about the Campion gold material at the Museum. He was particularly interested in the specimen known as Tom’s Baby, which had not been displayed for several years (Fig. 5.19). Murphy learned that a portion of the Campion gold was stored in the vaults of the First Denver National Bank. The bank was visited, the keys matched the boxes, and inside were specimens of the Campion gold collection. After weighing and measuring the specimens, two large pieces fit together, and when compared to newspaper photos proved to be part of Tom’s Baby. A third fragment could not be readily identified, although several pieces were almost the correct size and weight. The conclusion was that the large specimen had broken over the years, being fragile without its supporting rock matrix, and that the lost piece had further fragmented such that it could not be easily reconstituted.

Many of these smaller fragments or crystals of the Campion gold were mounted into the micromount collection by Withers. Micromounts are defined as mineral crystals that must be viewed with a microscope (Fig. 5.24); they are typically fit into a covered one-inch-square box and are glued to a pedestal-shaped mount. The usual fashion in which micromounts are made is that a larger sample of a mineral is sampled for a particularly fine set of crystals without destroying the original specimen, if possible. This small crystal is mounted on a peg in the box. The advantages
of micromounts are that you can store many in a small area, you are more likely to get a perfect mineral crystal from a sample if it is small, and you can often produce several micromounts from a single hand sample. Duplicate micromounts can then be used as trade material to acquire other minerals from other collectors who might have material that is hard to get.

In addition to creating micromounts from the Museum’s collection, Withers donated many of his own micromounts to the Museum. Following a 1972 donation of gems from the family of Museum trustee Joseph G. Hodges, in 1973 the museum received funds from the family to fund expansion of the gem collection. Much work on renovations of older displays was accomplished, and an increase in public awareness of the mineral collection was evidenced by many tours, lectures, and specimen identifications by the staff. Some of these lectures and identification sessions were external to the Museum, so Murphy designed a secure traveling case and had it built. The case facilitated safe display of minerals at various locations around the state. In the study collection, Cajori completed the inventory of specimens while Mitchell Gunnell continued work on improving identifications of the minerals. Storage was improved by the acquisition of a suite of metal storage cases. By 1973 the micromount collection numbered in excess of 1,050, principally resulting from Withers’s work. There was a witnessed fall of a meteorite in Cañon City, Colorado, where a meteorite fell through a residential garage, causing a fair amount of concern. The Museum visited the site and managed to purchase the piece of the roof that had been penetrated by the meteorite and a fragment of the meteorite itself (Fig. 5.22).

In 1974 Tom’s Baby was placed back on display in a purpose-built and highly secure case (Fig. 5.25). A search of the Museum records indicated that the last time this piece had been on display was in 1930. The last two of the display cases dedicated to the minerals of Colorado were also opened in this year. The traveling display case acquired the previous year saw much use at various shows around Colorado, including the Denver Gem and Mineral Show, a large mineral trade and display show recently started by a group of mineral clubs in the Denver area. Denver Gem & Mineral Society members Mr. and Mrs. Lawrence Oliver and their family donated a large collection of minerals (approximately 400 specimens), and the newly started Hodges fund was used to acquire nine gemstones. These joined other gemstones in the collection in a new display, paid for by the Hodges fund, which opened the next year.
After 15 years of work and much reworking of material, a much larger version of the El Potosi crystal cavern display reopened to the public (Fig. 5.7). This display was a large grotto of selenite and calcite crystals collected from the Naica and El Potosi Mines in Chihuahua, Mexico. Jack Murphy, who had been on several of the collecting trips to obtain minerals for this exhibit, began work on the exhibit in the mid-1960s, during summers while he was in college. The display’s walls and gross structure was finally finished by 1970, and it was wired for lights in 1971. When the display opened in 1975, it showed a large grotto with large euhedral selenite crystal formations covering the walls and extending into the cavern. A big mirror was placed in the back of the display to reflect the crystals near the viewing window, with the result that the cavern seems to extend much farther than the physical space allows. The exhibit was innovative within the museum community; as a ‘habitat group’ display, it nicely illustrated how natural crystals originally grew and occurred.

In 1975 and earlier, the renowned collector from Philadelphia, Paul Seel, began trading micromounts with Withers. Seel was an accomplished amateur mineral expert, and his favored working area was in micromounts. He continued to exchange micromount specimens with the Museum for the next few years. During the year, the mineral hall was closed to the public for a comprehensive cleaning and security upgrade. A display about the history of mining and minerals for the upcoming Colorado centennial was prepared and was ready when the mineral hall reopened later that year. When preparing for this exhibit, it became apparent that the classic 1958 Colorado mineral reference book, USGS Bulletin 1114, was no longer
known as “The Gold Boulder of Summitville”. It is the largest boulder of gold still remaining from the gold diggings of Colorado. After a suitable display case was constructed, the boulder was placed on exhibit in the mineral hall in 1976.

In 1975 Eleanor and A. Reynolds Morse, who were personal friends of the artist Salvador Dali, gave the Museum a giant topaz crystal (10,588 carats; Fig. 5.27). This topaz had been owned by Dali and can be seen in some of his artwork. A photograph of Dali in his workshop exists, and in the background on a bench is the crystal. The Morse family were connoisseurs of Dali’s work and maintained a collection and later on they created a museum of his art in Miami; Reynolds Morse was also a longtime Denver Museum trustee.

Morse was a strong supporter of Jack Murphy’s emphasis on Colorado mining and minerals, and also provided financial support to acquire 17 paintings by the Colorado artist Muriel Sibell Wolle. Wolle was author of Stampede to Timberline and the first chair of the Fine Arts Department at the University of Colorado at Boulder; her drawings and watercolor paintings show mines and mining camps in the Colorado mountains (Fig. 5.28) and were used to enhance the Museum’s rustic mining displays. These works

Figure 5.26. Left: Bob Ellithorpe (on left) and colleague with the Summitville gold boulder they found in the field (the boulder is behind the small pine tree). Right: The boulder in its display at the Museum.
Figure 5.27. Giant faceted topaz (left) formerly owned by the artist Salvador Dali (right).

Figure 5.28. Left: Artist Muriel Sibell Wolle. Right: Two of her paintings of Colorado mining camps and mines.
are now in the Museum’s image archives collection. Wolle was a well-known western artist, and one of the art buildings on the University of Colorado campus in Boulder is named after her. Other acquisitions of note were the continuing donations from Shorty Withers and Thomas Addenbrooke. At this time Colorado Springs geologist and mineral collector John H. Alexander began to donate part of his large, fine collection of minerals.

By 1977 the donations from Florian Cajori amounted to 800 specimens and the Alexander collection donation reached 275 specimens. The meteorite collection held by the Colorado Scientific Society was donated to the Museum, including 27 specimens from 21 falls. The Museum also received a large (200-plus-pound), optically clear quartz specimen, on long-term loan from the National Bureau of Standards (now the National Institute of Standards and Technology) in Boulder (Fig. 5.29). Large quartz crystals from the Minas Gerais province of Brazil were collected to provide piezoelectric quartz crystals for military radios during World War II. Since the war, synthetically grown crystals have superseded naturally formed crystals in radios, and it was thought that these large quartz crystals would make good display specimens, hence the loan to the Museum. By 1977 it was becoming apparent that a major overhaul of the mineral hall should be undertaken, and planning was initiated. At this time, the Colorado Chapter of Friends of Mineralogy was created, and meetings have been held at the Museum ever since (Fig. 5.30).

Florian Cajori passed away in 1978 after a long career working with minerals and geology. Through his efforts the mineral catalog was brought to a high state of accuracy and numbered about 12,450 specimens. The Salvador Dali topaz was placed on display in a purpose-built high-security display case. The crystal, which was faceted in a large, round brilliant cut, sat on a Plexiglas base and rotated slowly under a single overhead light source, sending refracted light dancing across the display hall. The motor only lasted a short time, however, and has never been replaced. Murphy made trips to the Eagle and Idarado Mines in Colorado and collected much pyrite and a couple of quartz pockets. Also collected from the Idarado Mine were
several fine calcite specimens. The collection of Denver mining geologist Russell M. Honea arrived at the Museum, comprising some 250 specimens.

The planning for a new mineral hall bore fruit when work was begun in 1979. The old mineral hall in the south part of the Museum was gutted for renovation. The El Potosi cavern display was in the more central part of the building, where the paleontology material was displayed, and was not disturbed. As the hall was being torn out, plans for the new hall were finalized and new labels were produced. The new Exhibits Department had an important role in designing and building the new displays. Wolle's paintings of Colorado mining were displayed in the Bailey Lounge on the west side of the second floor. Although work on the new hall precluded fieldwork, several mineral lots were donated to enhance the new exhibit, including two fine Sweet Home Mine rhodochrosite crystals from the Charles Gates family, of Gates Rubber Company fame, and a faceted smoky quartz crystal, from the Morse family, which was also once the property of Salvador Dali.

By 1980 the construction of the new mineral hall, to be called the Coors Hall of Minerals (but later renamed the Coors Hall of Gems and Minerals), was completed and installation of the minerals began. Some new donations arrived that could be fit into the new hall such as a large amethyst geode from Minas Gerais, Brazil, donated by Museum trustee Alvin Cohen and his wife Gerri. Withers was appointed honorary curator of geology in appreciation of his exceptional work with the collections. The remainder of the John Alexander collection was donated by his wife (approximately 275 minerals and more than 180 micromounts), and retired University of Michigan geology professor E. William “Bill” Heinrich promised his personal collection of western minerals to the Museum. This donation eventually amounted to about 1,030 specimens, including many that Heinrich collected while prospecting for sources of war-necessary minerals in the mining areas of Colorado.

By 1981 the installation of the Coors Hall of Minerals was sufficiently advanced that the gem alcove, near the east entrance to the hall, opened to the public. Shorty Withers passed away, and his estate donated nearly 2,000 micromount minerals to the Museum. The donation of the Phillip Andrews collection began at this time (approximately 400 specimens). Fieldwork continued with the aim of confirming data for the revision of the Minerals of Colorado book. A unique opportunity presented itself when longtime Colorado mineral collector Jerry Heuranic discovered a spectacular amazonite and smoky quartz pocket just outside of Lake George, Colorado. The Heuranic family wanted their discovery to be visible in the museum as it was found in the field, so that visitors experience the thrill of discovery associated with finding an in situ mineral pocket. After funds were raised, the pocket was installed with an accompanying diorama painting of Pikes Peak by Kent Pendleton (Fig. 5.31).

The Coors Hall of Minerals opened in the summer of 1982. The hall is still a part of the Museum, and consists of three sections. The initial part,
in the western two-thirds of the area near the El Potosi cavern exhibit, is a series of displays organized systematically that show representative and attractive minerals from the mineral groups according to the Dana System of Mineralogy. The western third of the area contains displays of representative minerals from the major mining areas of Colorado; a display of the state gem, aquamarine; and an alcove devoted to gold and silver. This alcove holds the Summitville gold boulder, Tom’s Baby, gold and silver ores and nuggets from around Colorado, and a display of a large amount of the Campion gold, kept in a large safe with a glass front. The gem alcove, mentioned above, remains and holds the Hodges gem display, the Dali topaz, representative gems from around the world, a collection of carved opal from Australia, and a collection of glass replicas of famous diamonds of the world.

After the opening of the mineral hall (Fig. 5.32), the department focused more attention on the research collection and on the new specimens that had been donated by Addenbrooke, Alexander, Andrews, Honea, Heinrich, and Withers. The minerals were cleaned, repaired, and had their identifications confirmed before they were cataloged. Other smaller donations were treated in the same fashion. One larger donation in 1983 was the Wyoming jade collection of James E. Keenan, which included much potential exhibit material that was later sold. The reasoning was that the excess material was primarily of artistic merit, and after culling the specimens demonstrating geologic and mineralogic value, this artistic material
did not fit the Museum’s mission. Selling the excess was intended to generate revenue to purchase other minerals.

By 1984 the amazonite pocket diorama (Fig. 5.31) was finished, and this nearly brought the displays in the mineral hall to completion. In this year Hilde Seel donated her late husband Paul Seel’s large (approximately 10,500 specimens) micromount collection and smaller hand sample collection (approximately 650 pieces). Included in this were a large number of small diamonds acquired by Seel from his many friends and colleagues around the world. Jack Murphy handled the physical acquisition, traveling to Pennsylvania to pack the material and drive it back to Denver. Included in the material were a large number of unprocessed minerals that could be made into micromounts as Seel had intended and an antique petrographic
microscope. This 1876 Zentmayer Centennial microscope was originally on loan to Seel from the Leidy Microscopical Society and now is on loan to the Denver Museum until 2095 (Fig. 5.20).

Although the mineral hall was complete and open to the public, the next few years saw additions and enhancements to the hall. For a time the Museum became associated with research in Colorado Springs’s Cave of the Winds, which was discovered by local cavers digging in and working through small passages adjacent to existing commercial trails. Facilitated by Pat Jablonsky, who was an avid caver as well as the departmental collections manager, from this work came a photographic display and DVD of the cave formations and dripstones called Silent Splendor. Silent Splendor was installed in an alcove of the mineral hall set aside for such exhibits. Two other display cases were added to the mineral hall in 1985. They show minerals from and old photographs of mining operations in the central Colorado mountains and the San Juans. The Pohndorf gem collection was added to the gem alcove after that area was refurbished in 1986. A meteorite display was placed in an alcove outside the mineral hall; it showed the various classes and origins of meteorites plus discussions of the latest theories on the origin of the solar system. Additional meteorites were also on display in the lobby of Gates Planetarium, including the large Canyon Diablo specimen, which weighs about 250 pounds.

Minerals continued to be donated during this time and if considered appropriate, were added to the displays in the mineral hall. They included a specimen of the mineral mesolite, a fibrous white mineral that in this example, donated by Bill Warren, resembled a small fountain of white. The remainder of the Addenbrooke collection was received from his estate, including about 250 hand specimens and several hundred micromounts. The final donations arrived from the Seel estate in 1986, and a collection of fluorescent minerals from the classic site in Franklin, New Jersey, were received. A suite of 144 industrial diamonds were received from the Union Pacific Railroad in 1988.

In 1989 the Geology Department was reorganized as the Earth Sciences Department with the hire of Richard K. Stucky as department chair, with Murphy remaining as curator of geology. The department emphasis broadened to include a much larger paleontologic component. In the geology section of the department, work was focused on getting the recently acquired specimens properly identified and cataloged, as well as on fieldwork and new acquisitions. Funds donated to the department by the Seels helped with acquisitions, because the increase in popularity of mineral collecting had led to an increase in the cost of fine minerals. The funds from the Seels allowed the purchase of a gold nugget called the Turtle nugget (Fig. 5.33). This is considered the largest known single placer gold nugget from the state of Colorado. The Reynolds Morse family, donors of the Dali topaz, donated
a substantial amount of money in 1991, and interest generated from this
donation was slated for the purchase of geologic specimens. This fund was
later augmented by longtime Museum volunteers and mineral enthusiasts
Robert and Bernice Woodhams, and it has been used to purchase specimens
over the last two decades.

Jack Murphy continued fieldwork in the Colorado mining areas.
Together with Museum photographer and videographer Dave Baysinger, who
was filming work in the Sweet Home Mine near Alma, Murphy was present
when local mineral dealer and mine leaseholder Bryan Lees discovered
the large rhodochrosite crystal later dubbed the Alma King (Fig. 5.34) in
September 1992. The Sweet Home had long been a source of rhodochrosites
after its production of silver declined; Lees had been working the mine for
some years to extract rhodochrosite specimens to sell to mineral collectors.
The Alma King and the Alma Rose, another large rhodochrosite crystal, were
originally bought by the Richard and Helen Rice (of Washington State’s Rice
Museum) at the Tucson Gem and Mineral Show in 1993. The Rices were only
interested in the Alma Rose, but the two were sold as a pair, so they bought
both and then sold the Alma King to the Museum in 1994 via a grant from
the Coors Foundation. A modern display case was built, and the specimen,
mounted on a slab with small quartz and fluorite crystals, was placed on
display outside of the mineral hall at the south end of the paleontology hall.
The paleontologic specimens that had occupied that space were removed
and reinstalled in the new paleontology hall on the third floor of the north-
east wing of the Museum. This paleontology exhibition, called Prehistoric
Journey, opened in 1995. The old paleontology hall was emptied of fossil
displays, and a temporary exhibition called Passion for Discovery took its

Figure 5.33. The Turtle nugget from
Pennsylvania Mountain, near Fairplay,
Colorado. This is Colorado’s largest
known placer gold nugget.
Passion for Discovery focused on the research of each of the curators of the Museum. Besides the Alma King, the geology displays in this exhibition comprised samples of various building stones from Colorado quarries that were used in many historic Denver buildings, the focus of Murphy’s research at the time.

From 1995 to 1997 approximately 600 mineral and rock specimens from the collection of local photographer and jewelry collector Verne Reckmeyer were received from his estate. Reckmeyer had donated some minerals to the Museum before and had also donated artifacts to the Anthropology
Department. Improvements to the collections were enabled by a grant from the Institute of Museum and Library Services, received in 1996, to rehouse the oversized minerals on the second floor. The grant allowed the purchase of metal cabinets and shelves to replace the older wooden cabinets and funded production of archival storage boxes and mounts for the large minerals and meteorites. The work continued until 1998. Because the best practices for cataloging specimens involve an adequate collections database, the mineral collection data was moved into the Museum's main cataloging database, ARGUS. This was the first time, that the mineral collection was inventoried and catalogued digitally. Jack Murphy and Bart Weis led this effort. Part of the collection was already entered into ARGUS, part was in an older program called PFS, and part was in a locally built BASIC database. Many volunteers, such as longtime museum supporter James A. “Jim” Englehorn, spearheaded efforts to digitize the museum’s mineral collections data. Placing the entire catalog in one database allowed much more efficient searching of specimens, and the ARGUS database was easier to maintain and upgrade efficiently.

The Coors Hall of Minerals had begun to look somewhat dated, so a partial overhaul began in 1997. Part of the reason for the overhaul was to create a display space for a spectacular new rhodochrosite pocket that was discovered in the Sweet Home Mine, source of the Alma King. A replica of an actual underground mine was created at the western entrance to the hall and included a six-foot by ten-foot rhodochrosite- and quartz-bearing wall that closely replicated the spectacular pocket of minerals from the Sweet Home Mine. The minerals for this display, including the rhodochrosite wall, were acquired via a donation from the Coors Foundation. The case for the Alma King was moved to a place near the entrance of the virtual mine. During the reconstruction phase, all of the display minerals and gems were removed from the hall and then placed back in the new or old cases. The space requirements for the replica of the Sweet Home Mine necessitated nearly total elimination of the fluorescent mineral display. The hall reopened in 1999.

The meteorite collection was enlarged during these years by purchases and donations. Among several specimens of meteorites acquired in the 1990s were slices and thin-sections of the Zagami meteorite, which was proven by noble gas inclusion analysis to have originated on Mars. Blaine Reed donated 35 thin-sections from meteorites from around the world in 1998, and later the Museum purchased 57 thin-sections of worldwide meteorites from him. The Morse funds were used to purchase a large polished slice of the Guffey meteorite, and later a fragment of the Cañon City meteorite was purchased to complement the punctured roof and ceiling pieces donated to the Museum right after the initial impact event. By 2000 the meteorite collection numbered 597 specimens from 237 falls.

Local mineral collector Bruce Oreck and his family began to donate high-quality minerals to the Museum starting in 2001, including gold,
tourmaline, vanadinite, rhodochrosite, and aquamarine (Fig. 5.35). The installation of the All-Sky Camera Network of fireball tracking video detectors began (Fig. 5.36). Eleven high schools became involved with this project where meteorite tracks were recorded by video camera gear pointed at oriented convex mirrors. The direction and height of the meteorite fireball could be calculated, as could probabilities of the meteor reaching the ground and where it would land. The system was designed by Museum volunteer Frank Sanders and promoted by museum educator Gianna Sullivan and astronomer, teacher, and Museum research associate Chris Peterson. Where possible, Murphy led crews of volunteers into likely areas of impact to search and retrieve potential meteorite specimens.

Rhodochrosite was voted the state mineral by the Colorado legislature in 2002, partly due to the prominence of the Alma King in the mineral community and partly in recognition of the abundance of the minerals retrieved from the Sweet Home Mine. Work on meteorites continued in the department, and four meteorites were acquired, including two pieces of the recently found and named Elbert meteorite. In 2004 Jack Murphy retired and was appointed emeritus curator of geology, a title he still retains.
New Directions

In 2004 Logan Ivy was appointed acting curator of geology and the Museum began to reorganize and refocus its geologic work. Donations continued to come in, including three large pockets of amethyst, fluorite, and quartz-replaced anhydrite from Minas Gerais, Brazil. These were donated by Laurens Tartasky, a local rock-shop owner. In 2005 a fragment of the Eads meteorite was purchased, and in 2006 the Sidney meteorite was purchased; the latter is historically interesting because this meteorite was known to Harvey Nininger, but he was unable to convince its owner to part with in the 1940s.

Paul Morgan was hired as curator of geology in 2006, and he began to reorganize and clean up the geology collection in anticipation of the construction of a new geology display hall and moving the research collection to a planned new collection storage facility. A large plate of about 120 aquamarine crystals and more than 100 smoky quartz crystals was purchased with funds donated by Bruce Oreck, and it was placed on display in the Coors Hall of Minerals. This material is from a claim called Diane’s Pocket on Mount Antero, Colorado, and is considered one of the finest specimens of its kind (Fig. 5.37). The Museum purchased a large fulgurite found in granitic soil in Boulder Canyon, Colorado, and Laurens Tartasky donated a large (764-pound) copper mass from northern Michigan. The Summitville gold boulder was loaned to the American Museum of Natural History for a

Figure 5.36. Frank Sanders working on an All-Sky camera station, used to track the atmospheric entry of meteors.
display on gold, along with some pieces of the Campion gold. This was the first time the Summitville gold boulder had been displayed elsewhere than the Denver Museum.

Paul Morgan left the Museum in 2008, and Ian Miller was appointed acting curator of geology. Steve Brancato, a local mineral collector, donated several very large smoky quartz specimens that same year. Mineral dealer Adam Sotomayor sold the Museum a large plate of microcline and smoky quartz crystals from his mining claim near Pikes Peak, and local mineral collector Quentin H. Good donated large microcline and smoky quartz crystals from his claim.
In 2010 Whitey Hagadorn was hired as curator of geology. New departmental volunteers were recruited, and together with staff they commenced inventorying the rock, mineral, meteorite, and micromount collections and rehousing them in archival or stable materials in anticipation of moving the collections into new cabinets and racks in the Museum’s soon-to-be-built Education and Collections Facility. In 2011 the entryways to the *Prehistoric Journey* and *Coors Hall of Gems and Minerals* exhibitions were redesigned (Figs. 5.16, 5.38), and the geology group facilitated installation of nearly a dozen large, touchable, and iconic rocks, minerals, and fossils in each of these exhibitions. These include the largest piece of lapis lazuli from North America, collected from Colorado’s own Italian Mountain, as well as a giant polished slab of banded ironstone that documents the last preoxygenated vestiges of Archean Earth.
Perhaps one of the most significant events of 2011 was the donation to the Museum of funds by Museum trustee and geologist Tim Ryan and his wife Kathryn. This gift was to create the Museum’s first endowed position, the Tim and Kathryn Ryan Curator of Geology (Fig. 5.39). Although Hagadorn holds the title to this position, funds from interest on the endowment are used to support the entire department, including research, development, collections, and other geology-related activities that would not be supported by normal departmental or Museum funding. This gift marked another exciting upturn in departmental history.

Over the 2011–2012 interval, all uncataloged, unaccessioned, and miscellaneous materials in geology collections spaces were assessed and either integrated into departmental or education collections, or deaccessioned or transferred elsewhere based on their scientific and educational value. Notable among these materials was the rediscovery in 2012 of significant 19th- and early 20th-century collections of cobbed rocks from the U.S. Geological Survey, R. C. Hills, and the Colorado Scientific Society. These were repatriated with comparable collections at the U.S. Geological Survey and Colorado School of Mines Geology Museum. In the same year, the department’s scattered map collections were reassembled into one cohesive collection. The collection comprises more than 20,000 flat topographic maps and approximately 6,000 flat, folded, or rolled geologic maps (Fig. 5.40). The collection was electronically inventoried and sorted by volunteers Daniel “Dan” Winester, Donald “Don” Brandborg, and Marcus Lieberman in anticipation of integrating the material into the Museum’s library upon arrival of new Museum librarian.
Brent Wagner in December 2012. During the course of 2012, volunteers Thomas “Tom” Garner and Fritz Koether, together with Hagadorn and the Building Operations team, constructed a new departmental thin-section facility (Fig. 5.41). This freed up space from the old thin-section closet in the Schlessman Family Foundation Earth Sciences Laboratory. The thin-section lab was built along the north wall of the third-floor geology collections area, and in the last half of 2012, facilitated production of more than 200 thin-sections of rocks, minerals, and fossils for departmental staff, research associates, and citizen-scientists.

Looking Forward

Today, the department continues to collect, archive, and interpret geology. But it also is strongly focused on providing service to the community, whether as translators of science pertaining to global warming, as K–12 teacher trainers, or simply through identification of rocks, meteorites, and other “whatsits” that people bring into the Museum on a weekly basis. The department’s citizen-scientists, research associates, and curator are actively conducting new research in Colorado and elsewhere, and together with collections managers and volunteers, are all committed to bringing the excitement of geology to the public while shepherding the archives of earth history ad infinitum for society and for science.
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PALEONTOLOGY
Discovering the Ancient History of the American West

Kirk Johnson and Richard K. Stucky

Overview

The history of paleontology at the Denver Museum of Nature & Science can be seen as two bursts of research productivity separated by a long period of intermittent exhibit development and research inactivity. The first period lasted from 1915 to 1948. It was led by Jesse Dade Figgins, Philip Reinheimer, Harold Cook, Harvey Markman, and Robert Landberg, and was characterized by extensive exploration in the Western Interior states in search of skeletons of extinct animals that were suitable for mounting in Museum exhibitions. During this time, the Museum's scientists had close ties with the American Museum of Natural History, collaborating with its scientists, being supported by its funders, and trading specimens and localities with the American and other institutions. This was a time of many publications in the Proceedings of the Colorado Museum of Natural History and the development of new exhibits that highlighted the vertebrate paleontology of the Western Interior. In-house research and publication essentially ceased when Cook left the Museum in 1930. Reinheimer was a master craftsman at the art of mounting and displaying fossil skeletons, and he continued this work until his retirement in 1947.

Between 1930 and 1988, there was minimal publication and very little planned fieldwork in paleontology. Some important specimens were acquired as gifts, trades, purchases, and salvages, and the six curators of this period—Harvey Markman, John Roberts, John “Jack” Murphy Jr., Charles “Chuck” Crockett, and K. Don Lindsey—focused primarily on the development of paleontology and geology exhibits.

The second period of high research productivity began in 1988 with the hiring of Richard Stucky who, between 1989 and 1990, hired Kirk Johnson, Kenneth Carpenter, Elise Schloeder, and Bryan Small. By 1992 the team had grown with the addition of Logan Ivy (who replaced Schloeder), Jerry Harris, Jennifer Moerman, Karen Alf, and Jon Christians. This new team built the Schlessman Family Foundation Laboratory of Earth Sciences, collaborated to dismantle the Dinosaur Hall and build Prehistoric Journey, started the
Paleontology Certification program, and launched a renaissance of paleontological research at the Museum. Between 1996 and 2011 curators Russell Graham, Greg Wilson, Ian Miller, James “Whitey” Hagadorn, and Joseph Sertich joined the staff, bringing additional research skills and interests.

In the 25 years since Stucky arrived, the Museum has undertaken a number of significant research initiatives in paleontology, and Earth Sciences scientists have published 20 scientific books and more than 200 scientific papers. The research initiatives have been broad and multidisciplinary and have made excellent use of citizen-scientists. The larger of these initiatives include the Denver Basin Project, the Porcupine Cave Project, the Cedar Mountain Project, the Wind River and Bridger Basin Projects, the Williston Basin Project, the Kaiparowits Basin Project, the Patagonia Paleobotany Project, and most recently, the Snowmastodon Project.

Figgins, Reinheimer, Cook, and the Early Years

When Jesse Dade Figgins arrived at the Colorado Museum of Natural History in 1910, he brought with him a wealth of contacts from his former employer, the American Museum of Natural History. The American was then in the middle of its golden years of paleontology. Led by the aristocratic Henry Fairfield Osborn, the New York museum was fielding teams across the American West that were revisiting and expanding the fossil sites that had been pioneered during the great Marsh-Cope bone wars of the 1870s and 1880s. In 1899 they discovered the Bone Cabin Quarry on Como Bluff near Medicine Bow, Wyoming, and in 1902, Barnum Brown discovered a partial *Tyrannosaurus rex* skeleton in the badlands north of Jordan, Montana. Osborn had been a student at Princeton in the 1870s, and he was seeking to fulfill his dream to make the American Museum of Natural History the most impressive museum in the world. He was not alone. Andrew Carnegie was bankrolling expeditions to fill his newly created Carnegie Museum of Natural History in Pittsburgh, and Marshall Field was doing the same thing with the Field Museum of Natural History in Chicago. In addition to Osborn and Brown, the American Museum also employed several great mammalian paleontologists: William Diller Matthew, William King Gregory, and Walter Granger. Figgins was in contact with all of these men, and his new position in Denver gave them a friendly foothold in the American West. Figgins formally formed the Paleontology Department in 1914 at the Colorado Museum of Natural History.

Philip Reinheimer was a Pittsburgh steelworker who had moved to Denver for his health. He was hired by the Museum to maintain its coal-fired furnaces, but he had an abiding interest in fossils. Figgins saw the potential and promoted Reinheimer to assistant preparator in 1913 and chief preparator in 1920. He would become one of the Museum’s strongest assets.
The Museum began locally with digs in Florissant and Cañon City, Colorado, in 1915. The Florissant fossil beds had been discovered by the Hayden surveys of the western territories in 1867 and were already well known and extensively published. The Museum purchased a plot of land north of the town of Florissant and dug a 25-foot-long trench into the fossil-bearing deposits, eventually collecting about 800 specimens of fossil plants and insects. Although a few of these specimens eventually became types in Harry MacGinitie’s 1953 monograph on the flora, it appears that the Museum quickly lost interest, and no subsequent collections were made at Florissant until the mid-1980s. It is unclear what ever happened to the property purchased by the Museum.

In the summer of 1914, a Cañon City man named William Dallas “Dall” DeWeese discovered portions of a large dinosaur in the Jurassic Morrison Formation. DeWeese was a nurseryman who had moved from Ohio to Cañon City in 1884. In 1897 he went to the Klondike for the gold rush and ended up becoming obsessed with rumors of a giant moose. He eventually shot a huge trophy moose and began collecting large mammal specimens for the U.S. National Museum in Washington, D.C. By 1914 he was 57, back in Cañon City, and married to his third wife, Emma. Between the summer of 1914 and the spring of 1915, DeWeese and his wife scoured the hills near Garden Park, eventually discovering a long string of vertebrae from a dinosaur now known to be Diplodocus (Fig. 6.1). DeWeese agreed to donate the fossil and his labor to the Museum. In this way Denver got its first
Figgins intended to obtain the missing pieces of this animal from the American Museum and mount the skeleton, but this never happened and the bones remain in storage today.

In 1916, through the graces of W. D. Matthew at the American Museum, Figgins was invited to visit Harold Cook at the Agate Springs Ranch near Agate, Nebraska. This was the site of a major early Miocene rhinoceros bone bed that had been quarried by the American and Carnegie Museums of Natural History. For the next two years, teams from Denver worked alongside American Museum teams with fossils going to both institutions. Denver acquired a 4½-foot-by-6½-foot slab of this material, which contained eight skulls of the Miocene rhinoceros *Menoceras*. In 1918 Reinheimer mounted one of the *Menoceras* skeletons with reconstructed skin on one side of the animal. These “half mounts” were to become a Denver Museum standard because they showed both the skeleton for the professionals and the animals for the Museum visitors (Fig. 6.2). But the big find at Agate Springs was Cook himself. He formed a relationship with the Museum, becoming an honorary curator in 1925 and a curator in 1928. Cook was the great-grandson of the famous British sea captain James Cook and son of one of the last great frontiersmen. He had studied for two years, 1909 and 1910, at Columbia University and worked at the American Museum at the same time. His relationship with Denver would continue to strengthen the Museum’s relationship with New York. The Agate Springs fossils are the evidence for the Nebraska Woodland diorama in *Prehistoric Journey*.

In the fall of 1916, Reinheimer and Figgins traveled to Hat Creek Valley in northwestern Nebraska in search of Eocene and Oligocene fossil
turtles. They found turtles and were delighted to discover 30 mammal skulls and the lower jaw and partial skull of a titanothere before being pushed out by heavy snow in early November (Fig 6.3).

In March 1918 the Museum received a letter from Mr. H. D. Boyes of Wray, Colorado; he had found bones along the Arikaree River. Investigation of these sites yielded Pliocene bones of rhinoceroses (Teleoceras), elephant-like gomphotheres, camels, bear-dogs, peccaries, horses, and saber-toothed cats. These finds inspired the famous prehistoric muralist Charles R. Knight to create murals for the American Museum. The American supplied spare parts of Teleoceras that allowed Denver to mount a skeleton by 1920. Cook continued to show interest in the activities of the Museum and began to contribute scientific papers. He realized that the Yuma County gomphothere was a new species and named it *Amebelodon hicksi* after Mr. S. N. Hicks, who had been making donations to support the fieldwork.

In 1920 the Museum began fieldwork near Grover in Weld County, Colorado, and discovered nearly complete remains of a late Eocene female titanothere (Fig. 6.4) as well as the skeleton of a giant piglike *Archaeotherium*. Later in the summer, Harvey Markman, a former student at the University of Colorado who would later become a Museum curator, discovered a bone bed that contained thousands of bones of a rare rhinoceros (*Trigonias*) near Horsetail Creek in Weld County. Reinheimer described this discovery in the 1942 annual report:

Then on a hot Sunday afternoon Markman climbed a little barren hill near camp in search of a breeze and some relaxation. The hilltop was a network of deeply cut gullies all of which had been scanned carefully many times before. Here and there a crumbling specimen of rhinoceros bone...
remained in the hard, limy walls, none of them worth taking out. Presently it began to dawn upon the meditating man that things were not reasoning out as they should. On the flat, immediately below, there was surface bone of much better quality than anything weathering out of that hill, yet there was no other elevation from which the supposed “float” could have been carried. There could be only one good explanation: the softer formation at the base of the hill was undergoing slow erosion at the surface, mainly by the wind, and the loose scrap had not been transported at all. Any remaining source of supply had to be underneath and at no great distance.

Results of the first digging were not too encouraging and it began to look as if the argument would not sustain itself. However, a few scattered bones were eventually uncovered and in every case they were in excellent condition. Perseverance was rewarded sometime later when the first string of articulated vertebrae was uncovered. Next a skull was found and from then on the going was fine.

This quarry was operated for a number of years with the most gratifying results. On the side of luck may be mentioned the fact that when Mr. Figgins said the quarry ought to produce some titanothere material, in addition to the abundance of rhino skeletons, it was only a short time until titanothers were on the assembly line; and when the request came for entelodonts, there was little delay—entelodonts were produced forthwith.

Figgins immediately realized the potential for this site to yield duplicate material that could be used for trade with other museums. This assessment proved to be quite accurate, and the Museum set up a large-scale excavation in 1921 to exploit this opportunity.

By that year the Museum was displaying mounted skeletons of fossil mammals in its main building. In 1922 Reinheimer headed to Corson County in central South Dakota in search of Late Cretaceous dinosaurs, particularly Triceratops. He failed to find a good Triceratops, but he was able to collect a considerable number of Edmontosaurus bones. By 1923 the Museum had completed mounting a number of skeletons from the Horsetail Creek Site and received from the American Museum a nearly perfect and complete skeleton of the bizarre chalicothere Moropus from the Agate Springs beds.
In 1924 Markman led a team to the Sand Wash Basin in Moffat County, Colorado, in search of Eocene mammals. Conditions were awful, with terrible rains and flooded rivers giving way to no water at all. They had hoped to find specimens of the unusual mammal known as a uintathere, and much to the Museum’s delight they recovered a large and complete skull that became the type of an animal now known as *Eobasileus cornutus* (Fig. 6.5).

The Museum’s relationship with the American Museum of Natural History remained strong, and in 1925 Osborn and Brown visited the Museum. Osborn gave the Museum casts of dinosaur eggs from the famous Roy Chapman Andrews expeditions to Mongolia. Cook formalized his relationship with the Museum by accepting an honorary curatorship and began collaborating on Denver specimens with William K. Gregory of Columbia University. Childs Frick, a philanthropist and vertebrate paleontologist in his own right who bankrolled a vast collecting effort for vertebrate fossils and who would eventually leave his huge collection to the American Museum, also began to share casts of his collections with Denver. Cook added tremendous legitimacy to the Museum by publishing many papers on the recent discoveries (Cook 1922a, 1922b, 1926a, 1926b, 1926c, 1927, 1928a, 1928b, 1930a, 1930b; Abel & Cook 1925; Gregory & Cook 1928; Hay & Cook 1928, 1930) (Fig. 6.6). In 1930 Cook published a paper in the journal *Science* that announced the discovery of giant bison and mammoths in glacial deposits at high elevation near Montrose, Colorado. Looking back from 2013, this discovery shares a curious similarity to the Snowmass discovery of 2010.

From 1926 to 1928 Figgins was much involved with the discovery of Pleistocene bison skeletons and associated spear points from Folsom, New Mexico. Interestingly, Brown, the American Museum’s dinosaur man, oversaw much of the excavation at Folsom even though the fieldwork was supervised by Denver Museum technician Peter Kaisen. Cook also visited the site and surveyed the surrounding area for additional finds. Skeletons of the
Folsom bison would join Weld County *Trigonias* as some of the Museum’s more popular trade skeletons.

In 1927 a party from the Museum working in Brown County, Nebraska, with Frick discovered a nearly complete gomphothere skeleton. Senator Lawrence C. Phipps facilitated the acquisition of the skeleton in a joint deal that saw material going to both Denver and New York. Cook named the new species *Trilophodon phippsi* (now *Amebelodon phippsi*) (Cook 1928b). The skeleton was rapidly mounted and was on display by 1928 (Fig. 6.7). This skeleton is presently on display in *Prehistoric Journey*.

By 1928 Reinheimer was 64 and he turned his energies to fossil preparation. From then on the Museum would be responsive to new discoveries, but it would not initiate expeditions. Its early efforts at planned fieldwork were over.

The Museum began to assemble a group of skeletons from the famous La Brea tar seeps in Los Angeles. Some of the specimens were obtained by exchange with the University of California, Berkeley, and others were purchased from Harold Cook. The trade with Berkeley was facilitated by...
Matthew, who had recently moved there from the American Museum. Matthew died on September 24, 1930. In 1930 the Museum completed its La Brea acquisitions with a trade between the Denver Museum and the Los Angeles Museum of History, Science, and Art. Denver received skeletons of a giant sloth, horse, bison, and condor in exchange for a titanothere and *Trigonias* rhino from Weld County. This acquisition rounded out the group that also included dire wolves and saber-toothed cats.

The Museum also did work in New Mexico, where they discovered a nice Pleistocene fauna, including records of the enigmatic glyptodonts. Among those specimens was a mammoth skeleton excavated from near Tucumcari, New Mexico, in 1930.

Cook and Figgins had a falling out in 1930 and Cook left the Museum. He had been the Museum’s most prolific scientific researcher, and it would not be until the late 1980s that Museum paleontologists began publishing again.

The next few years saw several significant acquisitions, but many of these were purchases and trades. The field-collected specimens were obtained by Reinheimer’s assistant Robert Landberg. In 1932 Landberg was sent to Angus, Nebraska, to collect the magnificent Angus mammoth (Fig. 6.8). When mounted later in the same year, this skeleton was 14 feet at the shoulder and one of the Museum’s most impressive mounts. Later in 1932, Father Conrad Bilgery of Regis College alerted the Museum to a mammoth site at Dent, near Longmont, Colorado. This site produced parts of more than

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Figure 6.8. By 1932 Reinheimer had stopped going to the field, so the gigantic Angus mammoth (DMNH #1359) was collected by his younger colleague Robert Landberg. In this photo Reinheimer is on the far left, Figgins is to his right, and Landberg is on the left under the beast’s belly.
a dozen mammoth skeletons in association with spear points (Fig. 6.9). In Cook’s absence, Figgins failed to capitalize on this find and lost his opportunity to name what would shortly come to be known as Clovis points.

In 1935 the Museum, with funds from Senator Phipps, purchased a mastodon skeleton that had recently been discovered in a bog in Indiana, traded with the American Museum for a complete *Edmontosaurus* skeleton from northeastern Montana that had been collected by Brown, and bartered two Dent mammoth skeletons with the Carnegie Museum to receive a largely complete *Diplodocus* dinosaur skeleton from Dinosaur National Monument. By the end of 1935, the Museum was well on its way to owning a world-class fossil collection.

**Paleontology Goes on Display**

In 1936 Alfred M. Bailey replaced Figgins as the director of the Museum. Bailey, a vertebrate zoologist, was mostly interested in ornithology and modern mammals. He lacked Figgins’s interest in archaeology and paleontology. Under Figgins’s leadership, the Museum had been displaying mounted mammals and birds in habitat groupings. Bailey began a long-standing effort to collect, build, and display habitat groups from around the world as dioramas. Meanwhile, the focus of the Paleontology Department shifted from discovering new fossils to displaying them.

Reinheimer remained a stable force in paleontology, devoting much of his work to preparing, mounting, and displaying skeletons. In 1936 the effects of the Depression were apparent at the Museum, and Reinheimer supervised more than 40 Works Progress Administration (WPA) workers. The WPA workers were focused on mounting the *Edmontosaurus* and *Diplodocus* skeletons (Figs. 6.10, 6.11, 6.12). With this huge workforce, Reinheimer was able to remove the bones from the incredibly hard matrix that encased the *Diplodocus* and mount the skeleton in record time. The 1936 annual report states, “As compared with the time required to do similar work in other museums, Mr. Reinheimer and his assistants have broken all previous records by a wide margin.” Newly collected rhinoceroses and other animals were mounted and traded in following years to the U.S. National Museum, Harvard University, and other institutions. The Museum also sold some specimens to other institutions. In 1936 the Museum made a brief foray into the Bridger Basin of southwestern Wyoming and collected a number of very fine Eocene fossil turtles.
Figure 6.10. Virgil Lorenzettiat (left) and Philip Reinheimer at work on Diplodocus longus skeleton (DMNH # 1494) in 1937.

Figure 6.11. The 1936 Museum exhibit of the nearly complete Edmontosaurus annectens (DMNH # 1493) that had been collected by Barnum Brown from the American Museum of Natural History and traded to Denver.
In 1937 Frank Kessler, a Cañon City high school teacher, was leading a natural history class on a hike up Felch Creek in Garden Park about ten miles north of Cañon City when he found a site with abundant dinosaur bones. Thirty-year-old Landberg led an early summer investigation of the site and recovered a nearly complete *Stegosaurus* skeleton. The Museum’s annual report described this animal as “a clumsy, vegetarian quadruped with a short neck and small skull.” Reinheimer and his crew had the skeleton mounted and on display by early 1939. This skeleton would eventually become the official Colorado state fossil, in 1982.

In 1938 construction of Alameda Parkway exposed bedding plane surfaces of the Dakota Sandstone near Morrison, Colorado. The steeply dipping surfaces were covered with obvious dinosaur tracks that were exposed and not noticed for more than a year, until Museum curator Harvey Nininger recognized what they were. The Museum began to cooperate with the Colorado Department of Highways (CDOT) to expose and describe the tracks. To this day, the site confuses people who think that the dinosaurs were walking up steep hills. In actuality, the layers of rock were tilted after the dinosaurs made the tracks. This site is now known as Dinosaur Ridge (Fig. 6.13).

Reinheimer completed the mounting of the *Diplodocus* skeleton in 1938 (Fig. 6.14), and this signature specimen would remain on permanent display on the ground floor until it was moved to *Prehistoric Journey* in
1993. Moab rock shop owner Lin Ottinger recalls visiting the Museum in 1938 and seeing this skeleton. In 2002 he told Curator of Paleobotany Kirk Johnson, “I took one look at that skeleton and decided that I would devote my life to rocks and fossils.”

In 1939 WPA highway workers found a large skeleton on a creek bank in Baca County, Colorado. Pritchett High School science teacher Andrew Weresch alerted the Museum about the find some months after it was made. The delay gave local souvenir hunters ample time to visit the site and take bones back to their homes. Landberg and Markman went house to house in Pritchett and Springfield to recover the scattered specimens. The skeleton turned out to be a nearly complete long-necked plesiosaur and one of the finest known examples in the world. Sam Welles from University of California, Berkeley described the skeleton and named it *Thalassomedon haningtoni* in honor of Charles Hanington, the president of the Museum board (Welles 1943). Reinheimer had it on display by 1940 (Fig. 6.15). Another partial plesiosaur was found near Fort Collins, Colorado, in 1941.
Landberg had been exploring the chalk beds of western Kansas with the intent of acquiring marine fossils. He found a number of fossil fish. The famous fossil hunter George Sternberg was also working the chalks, and in 1939 the Museum purchased an 18-foot-long mosasaur from Sternberg. This specimen is on display in Prehistoric Journey, still exhibited in its original mount. Other acquisitions from Sternberg included a marine turtle (Protostega) in 1945 (Fig. 6.16) and an amazing fish within a fish (Xiphactinus) in 1946 (Fig. 6.17). Additional fish from the Kansas chalk were later acquired from Marion Bonner, another commercial collector from western Kansas. The Museum now had dinosaurs and marine reptiles to complement its fossil mammals.

In 1943, the American Museum’s Brown named a new species of bone-headed dinosaur Pachycephalosaurus reinheimeri, in honor of Reinheimer’s many contributions (Brown & Schlaikjer 1943). In 1944 the Museum traded a complete Edmontosaurus skeleton to the South Dakota School of Mines Museum of Geology in Rapid City. The skeleton, which is still on display in 2012, was apparently collected by Reinheimer in South Dakota around 1922, but documentation of its discovery and the trade are lacking.
Reinheimer (Fig. 6.18) retired in 1947 and died less than a year later, on April 16, 1948, at the age of 84. He had been a part of many expeditions between 1916 and 1927, but it was his skill as a preparator that left the Museum with a serious collection and reputation. His mounted skeletons are still some of the most artful in the world, and he made his mounts with blinding speed. On August 19, 1949, Landberg, a veteran of the D-Day landing and Reinheimer’s heir apparent, passed away unexpectedly of a heart attack brought on by viral pneumonia. He was only 41, and his shocking demise effectively ended the Museum’s first period of paleontology.
The Doldrums and a Bunch of Smart Teenagers

In 1936 Harvey Markman (Fig. 6.19) became the curator of geology and paleontology, but his primary allegiance appears to have been to the geology collections. During his tenure, fossils that were discovered and reported to the Museum by the public were transferred to the U.S. Geological Survey, where paleontologist G. Edward Lewis would investigate the sites. Markman did write two popular publications on fossils and fossil mammals (Markman 1938, 1952) that were illustrated with many photographs of the Museum’s outstanding collections. Markman also worked to completely revise the exhibits in geology and paleontology. Included as part of those exhibits was a series of murals by Mary Chilton Gray, a Museum artist; her paintings were reconstructions of the ancient habitats of Colorado and the West. These murals, which were painted from 1941 until the mid-1950s, can still be seen above the old diorama shells in the storage area now known as the Big Bone Room. The annual report for 1969 noted that “her paintings on display will be of educational value to Denver citizens, young and old, for generations to come.”

In 1954 Markman retired and became curator emeritus, and John Roberts became the curator of geology and paleontology in 1955. Roberts worked to complete exhibits planned by Markman. This task was continued by John Murphy, curator of geology, who was the son-in-law of Director Bailey. His work was facilitated by Arminta “Skip” Neal, who completed Life through the Ages, case exhibits on the formation of Earth and the continents that were displayed at the entryway to Dinosaur Hall.

In 1966 three teenagers, Jody, Kristi, and Rick Jurick, were out hunting deer with their dad Frank in the Snowmass Creek Valley near Aspen when they came across the imprints of a giant ribcage in the Mancos Shale. They contacted the Museum, and Henry (Wichers) Inchumuk, curator, Division of Mammals, and Bob Akerley, chief preparator, were sent to investigate the next summer. The imprints turned out to be a 13-foot-long skeleton of the Cretaceous seaway fish known as Xiphactinus.

In 1887 the first Triceratops ever found was discovered in Lakewood Gulch, just a few miles west of downtown Denver. That specimen eventually ended up in the U.S. National Museum, leaving Denver, the home of Triceratops, without a skull to call its own. The Museum managed to acquire a
Montana *Triceratops* skull in its original field jacket from the Los Angeles County Museum (formerly the Los Angeles Museum of History, Science, and Art). Pictures in the 1968 and 1969 annual reports show Curator of Geology Jack Murphy (who was also Director Bailey’s grandson) and the skull on a truck outside the Museum. Sadly, the skull met an untimely demise during its transport into storage. Apparently it was too heavy for the moving equipment, and it fell to the ground (by one account, it fell three times). It wasn’t until the 1990s that Ken Carpenter, then chief preparator, opened the damaged jacket to discover that the skull was completely shattered and not salvageable. In 1975 a partial *Triceratops* was discovered in an old clay mine pit near Leyden, Colorado. The Museum acquired the specimen, but it was too fragmentary to display.

Charles “Chuck” Crockett became the curator of paleontology in 1969 and served for one year before being promoted to the position of assistant director. Crockett’s major accomplishment in his one year of tenure was to bring all of the fossils together into one storage facility. During this year a Harlan’s ground sloth pelvis and other bones were discovered and donated by a Colorado Springs high school student named Ken Carpenter (Fig. 6.20). Unfortunately, the Museum did a poor job of preparing and curating the specimen, and only a few fragments remain intact. Carpenter, however, began a long relationship with the Museum.

In 1971 the Museum hired K. Don Lindsey as assistant curator of paleontology. Lindsey had grown up in Sterling, Colorado, and received his master’s degree in biology at the University of Colorado, where he had met Crockett. In 1971 Richard Stucky began volunteering for Lindsey. Within a year, Stucky was hired as a fossil preparator. Lindsey and Stucky visited old Markman sites in the Sand Wash Basin, Moffat County, Colorado, and Reinheimer sites in Corson County, South Dakota (Fig. 6.21). The work in Moffat County resulted in the discovery of a fine skeleton of an early titanothere. Lindsey also led several expeditions to new localities that he had visited as a youth and began work at Fremont Butte, near Akron, Colorado, where he and Stucky collected an enigmatic tiny insectivore called *Apterodontus* and several exceptional skulls of titanotheres and rhinoceroses. In 1975 Stucky left the Museum to pursue graduate work in anthropology at the University of Colorado.

In the late 1970s, Lindsey visited sites in northeastern Colorado, near Cañon City, and on the Western Slope. In 1979 he collaborated with Ken Carpenter (then at the University of Colorado Boulder) to describe the jawbone of *Brachychampsia montana*, a Cretaceous alligator (Carpenter & Lindsey 1979).
The jaw had been collected by Reinheimer in South Dakota in 1922. This was the only peer-reviewed scientific paper on paleontology published by Museum personnel between 1934 and 1988.

The most important discovery of Lindsey’s tenure came in 1982. The story began in 1979, when India Wood, a 13-year-old girl, discovered a dinosaur. As she tells the story, Wood spent the summer months on a ranch in Moffat County, Colorado, not far from Dinosaur National Monument. She was aware that the ranchers had seen dinosaur bones, and she decided to find one for herself. After some searching, she did find a partially exposed skeleton and began to dig it by herself. She dug the skeleton for three summers, keeping the bones under her bed at her home in Colorado Springs. In 1982 her mother finally convinced her to contact the Museum. Audiovisual producer Dave Baysinger and Lindsey visited her home, and the Museum has amazing video footage of beautiful *Allosaurus* bones emerging from beneath the bed of the then 17-year-old girl. The annual report for 1982 mentions the *Allosaurus* but not the girl.

Lindsey hired Wood as a field assistant, and along with his son, Jim, collected about half of a skeleton of an *Allosaurus*, part of a *Stegosaurus*, and other small vertebrate remains on the site where Wood found her *Allosaurus* (Fig. 6.22). Lindsey told Wood that there was no future in paleontology, a statement that ended up being more true for him than for her. Wood’s bones were quietly stashed away in a cluttered collection room, and she went off to college at Dartmouth. Thirteen years would pass before credit was given where credit was deserved. Today Wood’s *Allosaurus* specimen stands as the iconic centerpiece in *Prehistoric Journey*, in combat with the *Stegosaurus* found in 1937 near Cañon City. Wood’s name appears prominently on the interpretive panel.

In 1983 the Museum became the
agent of sale for an Edmontosaurus skeleton collected near Faith, South Dakota, by commercial paleontologist Peter Larson of the Black Hills Institute of Geological Research. Larson later became famous as the collector of the Tyrannosaurus rex named Sue. Larson sold the Edmontosaurus to the Museum, which in turn sold it to the Toyohashi City Museum in Japan. Larson had paid $1 to landowner Ruth Mason to collect unlimited hadrosaur materials for a period of 25 years. Jack Murphy, who was then the head of the Department of Geology, worked with Director Crockett on the transaction but did not initially include curator Lindsey in the conversation. Despite Lindsey’s memo protesting the arrangement, the Museum proceeded with the $330,000 sale to Toyohashi. The profits went to offset the cost of a minerals of Colorado book. Interestingly enough, this was called a “special paleontology project.” Lindsey left the Museum in 1984 under strained circumstances. He passed away in 2011 without ever turning over his field notebooks to the Museum.

In 1987 the Museum worked with Robert Bakker to mount a cast of the famous American Museum Tyrannosaurus rex skeleton in the Denver Museum’s newly renovated entryway. Bakker was a brilliant and flamboyant scientist who, as an undergraduate at Yale in the 1960s, studied with John Ostrom and helped trigger the dinosaur renaissance. Bakker and his Montana counterpart, Jack Horner, were later combined into the single central character of the 1993 film Jurassic Park. Bakker saw dinosaurs as dynamic acrobatic animals, and the resulting mount shows the Denver Museum’s T. rex balanced on one foot in a pose that has alternately been described as dancing, kicking a soccer ball, and peeing on a fire hydrant. Regardless of Bakker’s intentions or any of the many interpretations, the lively mount has become as much an icon of the Museum as the bronze grizzly that stands at the northwest corner of the Museum. Bakker also named one of the armored dinosaurs collected by Reinheimer in South Dakota in 1922 Denversaurus schlessmani (Bakker 1988). In the early 1990s, Carpenter, then the Museum’s chief preparator, rejected this name as invalid because it represented a previously described animal.
The Rebirth of Paleontology and Prehistoric Journey

Stucky was rehired in 1988 (starting on January 1, 1989) as the curator of paleontology and department chair in geology to develop a new research program in paleontology and a plan for renovating the old Dinosaur Hall and Fossil Mammal Hall into a new exhibition. Between Reinheimer’s death in 1948 and Stucky’s return in 1989, the Museum had let its reputation in paleontology melt away. That was about to change.

Stucky had been working as a collections manager and curator at the Carnegie Museum of Natural History in Pittsburgh, Pennsylvania, where he studied the Eocene fauna of Wyoming’s Wind River Basin and the Oligocene fauna of the Pawnee Butte area in northeastern Colorado. Several of Stucky’s colleagues warned him that a move to Denver would not be a smart one because of the institution’s lack of support for science since the 1930s. But with his four years of experience at the Denver Museum in the early 1970s and his six years in Boulder in pursuit of his doctorate in anthropology with a specialization in paleontology, Stucky felt that both Denver and the Museum were primed for a renaissance in paleontology.

When Stucky returned in 1989, the vertebrate fossil collections were crowded into a small storage room adjacent to the Dinosaur Hall. Fewer than 2,700 specimens were cataloged. The collections were stored in old wooden cabinets. Field jackets and bones of dinosaurs collected in the 1920s and 1970s in South Dakota were piled in boxes on top of the wooden cabinets. Warped wooden drawers were filled beyond capacity, with skulls and bones piled on top of more bones. Metal cabinets had housed some of these bones in the 1970s, but they had been switched out with inferior wooden cabinets from the rock and mineral collections. One particular set of cabinets housed a number of poorly labeled, mislabeled, damaged, and assorted fossils. In short, the collections were a disaster and very little remained of the Museum’s fine reputation from the 1930s.

The task that greeted Stucky was straightforward: inventory the collections and check data on poorly labeled or unlabeled specimens to determine their importance. The cabinets contained all manner of errors: numbered specimens without labels, field labels that were undecipherable, unnumbered and unlabeled specimens, and specimens that had labels noting localities the fossils could not have been from. The fossil collection ledger was handwritten. Stucky used a grant from NASA to work on remote sensing and paleontological mapping to acquire the department’s first computer. It was an IBM 8086 with a 10 MB hard drive, all of which was advanced for its time. This computer later became the first object accessioned into the Museum’s scientific instruments collection.
The task of inventorying the fossil vertebrate collections did not seem daunting because only 2,700 cataloged specimens needed to be examined. Stucky soon discovered that thousands of specimens from Folsom, New Mexico, and the rhinoceros quarries at Torrington, Wyoming, and Horsetail Creek, Colorado, had never been cataloged. He assembled a catalog of the type specimens from the early years (Wood & Stucky 1992), and he instituted a new rule that vertebrate fossil collections collected by Museum staff during any one year would be cataloged and computerized before the end of that year.

Stucky also began to build new collections based on four objectives: (1) begin expeditions into new areas with high research potential, (2) re-explore some of the Museum’s historical sites where premier discoveries had been made, (3) investigate new sites that were brought to the attention of the Museum by the public, and (4) explore sites that had high potential for exhibition-quality fossils.

While at the Carnegie Museum, Stucky had worked with Leonard Krishtalka in a long-term investigation of the paleontology and geology of the Wind River Basin in central Wyoming. In 1985 they discovered a site known as Buck Springs that yielded a trove of tiny Eocene rainforest mammal skulls and skeletons (Krishtalka et al. 1990; Stucky et al. 1990; Beard et al. 1991). The high species diversity from this site had also led Stucky (1990) to begin studies of species diversity and extinction and their relationship to climate change. Stucky brought this research to Denver, creating a partnership between the two museums that persisted for 15 field seasons. In 1986 the site was featured in Time magazine and on the television show Good Morning America, giving Stucky the insight that media attention to fossil discoveries was an effective way to grow public interest in science and museums. He worked with the Denver Museum marketing staff to make sure that the Museum would take advantage of this opportunity.

In the summer of 1989 a local fossil discovery highlighted the potential of the media to enhance the Museum’s mission. Workers at the site of the future Denver International Airport reported the discovery of giant fossil fish tails. These fish tails, upon examination, were actually fronds of extinct Paleocene palm trees. Stucky had contracted with paleobotanist Gary Upchurch to collect fossil plants from the airport site and to talk with the media. The Denver International Airport was a huge project and much in the news. The fossil discovery put the Museum back on the map as a place that was actually doing science.

In 1989 Stucky joined a local hobbyist fossil club known as the Western Interior Paleontological Society. At the first meeting he attended, Stucky saw a pair of fossil hunters come in and dump the treasures they had found onto the table. The fossils had no labels and no indication of where they were from. The club was popular, and it was apparent that there
was a lot of local interest in fossils. Stucky noted this interest and realized the scientific potential that could be derived from professionalizing amateur collectors. This insight led him to develop a program at the Denver Museum based on an earlier model developed by Harley Armstrong at the Museum of Western Colorado. The format of the course included a two-week field experience and introductory courses in paleontology, geology, stratigraphy, local fossils, collection management, fossil preparation, scientific research methods, and report writing. Stucky designed the program to collaborate with local land management agencies and scientists. The Paleontology Certification program was an immediate hit, and the first group of students became dedicated paleontology volunteers. Within a year of Stucky’s arrival, paleontology was strong and growing.

Paleontology Certification Program

The Museum offers a certification in paleontology to adults 17 years and older who want to learn more about paleontology and develop skills in the collection, preparation, curation, and study of fossils. The program began in 1990 with the support of the Colorado State Office of the Bureau of Land Management, the Office of the State Archaeologist of Colorado, and the University of Colorado Boulder. Now it is run solely through the Museum, managed by Adult Programs and taught by Earth Sciences Department staff and research associates. The basic course consists of eight required classes that provide students with an introduction to the history of life as revealed in the fossil record and a basic knowledge of the theories and techniques of paleontology. After completing the mandatory classes and review by Earth Sciences staff members, students receive a certificate of competency. Beyond the basic certification, students may take further coursework to specialize in either lab work or fieldwork. Graduates of these specialties work alongside Museum staff as they discover, prepare, and research fossils. As of 2012, 291 people have graduated from the program, and 89 of these are current Earth Sciences volunteers.

This is a rewarding program. How many people can say they discovered a new type of dinosaur or mammal? Billy Kinneer and Tony Dicroce can talk about their discovery of new dinosaurs—two, in fact: one sauropod from Utah unearthed on a dig in 1998 and another in 2002. The first was named Cedarosaurus weiskopfae after Museum volunteer Carol Weiskopf, and the other, Venenosaurus dicrocei, was named in honor of Dicroce. Another Paleontology Certification program graduate, Virginia Tidwell, researched and wrote the primary description of these two new dinosaur species. Tidwell is the poster child, or perhaps poster adult, for the certification program. She received her certification in 1995 and has subsequently published 12 scientific papers. She coedited Thunder-Lizards: The Sauropodomorph Dinosaurs (2005) with Ken Carpenter and authored several chapters. Currently she is working with the U.S. Forest Service supervising the preparation of an Apatosaurus from southern Colorado. She has led field expeditions and taught paleontology classes at the Museum.

Tidwell is extraordinary, but not unique. Dozens of other Paleontology Certification graduates have published abstracts and papers, usually coauthored with Museum staff. Another exciting discovery was a new genus of carnivore that is very close to the ancestry of dogs. Dawsonicyon was discovered by Ron Horst and Tom Hardy during one of the field courses of the certification program in 1992. The accomplishments of certification program graduates in the field and lab have earned a national reputation for the program.
In 1990 Stucky initiated fieldwork in the Sand Wash Basin in northwestern Colorado, where he took the first 25 certification program students on their inaugural field trip. They discovered important middle Eocene fossils from the Washakie Formation, and the program was up and running. Research collaboration with Donald Prothero from Occidental College resulted in a publication that brought the fauna up to date and included paleomagnetic studies of the earliest Uintan Land Mammal Age (Stucky et al. 1996). Other fieldwork led to the investigation of the Cretaceous Cloverly Formation in northern Wyoming and Paleocene rocks in central Wyoming. Stucky led subsequent excursions to the Bridger Formation in the Green River Basin of southwestern Wyoming, where rich fossil beds yielded many outstanding discoveries of middle Eocene primates, ungulates, rodents, and carnivores. One of the most significant discoveries made by the certification students was the earliest known doglike animal. Stucky named this animal *Dawsonicyon* in honor of Carnegie Museum paleontologist Mary Dawson (Spaulding et al. 2010).

The major impetus for bringing Stucky to the Museum had been to develop a new dinosaur hall. Championed by trustees Irving “Bud” Shwayder and C. Neil Norgren, this new hall would highlight the Museum’s dinosaur collection. Only a few months after Stucky arrived, the Museum opened a temporary exhibition called *Destination Dinosaurs*. In early planning meetings, the exhibit developers had come up with a fanciful approach to show dinosaurs and humans together in an exploratory environment, sort of a precursor to the 1993 movie *Jurassic Park*. Stucky objected to this approach because it trivialized the science, and he argued for changing the exhibition’s focus to the paleobiology and science of dinosaurs. The resulting exhibition was a big success. During opening week, lines stretched around the Museum. *Destination Dinosaurs* received media attention, including a ten-part series of two-minute spots on the biology of dinosaurs developed by Channel 9 News. Local CBS Channel 4 anchor Ed Greene worked with Stucky to visit key dinosaur fossil sites in the Denver metropolitan area, showcase the skeletons in Reinheimer’s Dinosaur Hall, and highlight the science behind them.

By the end of 1989, Stucky had convinced the administration that a new dinosaur hall was not enough and that the Museum should do a comprehensive exhibition on the history of life on Earth, telling the entire story from the perspective of the fossil record of the Western Interior. He argued that this approach would use the rich fossil collections gathered by the Museum between 1915 and 1946.

Based on this shift, the Museum shaped three major learning objectives for the exhibit: (1) show the history of life through time, (2) show how each of the sciences was used in paleontology to unveil the evolution and origin of past life, and (3) demonstrate how the past had relevance to
the issues of the modern world (such as climate change). An empty and cavernous warehouselike space on the third floor of the north wing was designated as the exhibition’s future location.

Alan Esplenlaub, director of exhibits, suggested a triad approach where science, exhibits, and education would have equal voice in the design and construction of the hall. He selected Brian McLaren as overall project manager, Merry Dooley to represent education, and Richard Stucky as the lead scientist. It was clear that Stucky would need a team of paleontologists and preparators to cover the breadth of the fossil record.

His first hire was Ken Carpenter as chief preparator. Carpenter was the Colorado Springs high school student who had discovered the Harlan’s ground sloth pelvic bone in suburban Colorado Springs when he was a teenager back in 1969. Carpenter went to college at the University of Colorado where, under the tutelage of paleontologist Peter Robinson, he became a skilled field worker, searching Colorado and Wyoming for Cretaceous fossils. He recovered fish, mosasaurs, and pterosaurs from the Pierre Shale and microvertebrates and a beautiful *Triceratops* skull from the Laramie Formation in Weld County. While in Boulder he became a friend and colleague of Bob Bakker. He went on to apprentice with Arnold Lewis at the Smithsonian Institution and took jobs as a preparator in Mississipp, Montana (at the Museum of the Rockies in Bozeman, where he worked with Jack Horner), and Pennsylvania (at the Carnegie Museum of Natural History and the Academy of Natural Sciences). By 1988 he was a respected authority on dinosaur paleontology and an accomplished preparator who had the ability to mount large skeletons. With Stucky and Carpenter, the Museum once again had a Figgins and a Reinheimer. Stucky was a visionary scientist and savvy administrator, and Carpenter was a solid field man and a gifted preparator. The Museum was poised for round two. Carpenter hired Bryan Small from Texas Tech as his assistant.

The first step in the building of the exhibition, named *Prehistoric Journey*, was the construction of a new fossil lab. The Schlessman Family Foundation donated funds and Carpenter designed the Schlessman Family Foundation Laboratory of Earth Sciences. From its opening the lab provided a literal window for the public to see the many preparation activities that were necessary to fill the new hall with fossils. In addition to being able to look into the lab’s window to watch bones being prepared and readied for exhibition, visitors were allowed into the construction area to see the progress of the space itself.

Stucky was given license to hire an additional curator to help with the project. Knowing that life in terrestrial habitats was made up of a lot of plant biomass, Stucky decided to hire a paleobotanist. The fossil plant world was very poorly represented in paleontology exhibitions, and by hiring a paleobotanist the Museum would be moving in an innovative direction.
In addition, by hiring an active field paleobotanist who was interested in developing a collection of fossil plants, Stucky felt that the Museum could build a premier paleobotany collection.

Kirk Johnson was completing a postdoctoral position in botany at the University of Adelaide in South Australia when he received a fax from Denver announcing the position. Originally from Seattle, he had volunteered at the Burke Museum at the University of Washington as a teenager. As an undergraduate he worked at the Pratt Museum of Natural History at Amherst College before taking a job with the U.S. Geological Survey in Alaska. In 1981 he met Leo Hickey from the Smithsonian Institution and joined him on two paleontological expeditions to the Canadian High Arctic. Hickey became the director of the Peabody Museum of Natural History at Yale, and Johnson followed him there, eventually receiving his PhD from Yale for a study that assessed plant extinction at the Cretaceous-Tertiary (K-T) boundary in Montana, Wyoming, and the Dakotas. He was an aggressive digger known for finding new fossil sites and making large collections. The position was a good fit, and he joined the Museum on January 1, 1991.

Johnson had studied art as an undergraduate and had a lifelong mentor in the form of Seattle artist and amateur paleobotanist Wesley Wehr. This art and science combination was compelling to Stucky, so he hired Johnson in a split position: 50 percent content developer for Prehistoric Journey and 50 percent paleobotany curator. Johnson immediately noticed that ideas for the exhibition were slanted toward vertebrate life through time, and he quickly added plants and invertebrates to the mix.

By early 1991 the Prehistoric Journey team was in place and consisted of a pair of triads: a management team of Stucky, McLaren, and Dooley and a content development team of Johnson, Dooley, and exhibit developer Frances Kruger. Dooley left the Museum shortly thereafter and was replaced by Rebecca Smith.

In 1990 the team had written a proposal to the National Science Foundation requesting funds to support the exhibition’s development. The proposal laid out the exhibition sequentially by geological time period and was fairly traditional in its approach. In January 1991 the proposal was rejected. A second proposal, this one successful, was written by Kruger. She provided a story line and walk-through of the exhibition from the visitor’s perspective. The new approach focused on major events in the history of life including the origin of life, explosion of life in the seas, the first life on land, the evolution of terrestrial ecosystems, the rise of the dinosaurs, the diversification of mammals in a subtropical world, and the development of grasslands and ice ages. The team decided to develop several prehistoric habitat dioramas with adjacent mini-museums. Like the Museum’s modern habitat dioramas, each prehistoric diorama would be based on a specific fossil site. This was a big shift from the general industry practice of lumping...
fossil organisms from many locations into a single diorama. The mini-
museums adjacent to each diorama would show real, spectacular fossils and
present different aspects of the science of paleontology.

Johnson took the task of selecting the fossil sites that would become
the dioramas. In the end, the list included the Vendian Ediacara Hills of
South Australia, the Cambrian Burgess Shale of British Columbia, the Silu-
rarian reefs of Racine, Wisconsin, the Devonian Beartooth Butte Formation
in the Beartooth and Bighorn Mountains of Wyoming, the Pennsylvanian
Hamilton Quarry in the Flint Hills of Kansas, the Triassic Petrified Forest
near Flagstaff, Arizona, the Late Cretaceous Hell Creek Formation of North
Dakota (Johnson’s primary research area), the Eocene badlands near Lost
Cabin, Wyoming (Stucky’s primary research area), the Miocene bone beds
of Agate Springs, Nebraska (Harold Cook’s home ranch), and the fossil
hominid–bearing beds in Ethiopia’s Afar Depression (home of Lucy, the
first nearly intact early hominid skeleton). With the exception of Ethiopia,
Johnson visited all of these sites to collect fossils and data to inform the
diorama construction.

The challenge for the new hall was to disarticulate all of the skeletons
of dinosaurs and fossil mammals exhibited on the first floor and move
them to the new gallery on the third floor. Carpenter had to dismantle
Reinheimer’s mounts and remount them in the new location. In some cases
the skeletons were small enough to move intact. In other cases, Carpenter
remounted the skeletons in more dynamic poses. This allowed him to take
advantage of new ideas about dinosaur behavior that had emerged as part of
the dinosaur renaissance of the 1960s and 1970s. He was also able to reuse
much of Reinheimer’s original steelwork and to preserve the grace of those
original mounts.

One of Carpenter’s most impressive efforts was the extraction of two
_Coeolophysis_ dinosaur skeletons from matrix blocks collected at Ghost Ranch,
New Mexico, by the Carnegie Museum. Traditionally, _Coeolophysis_ skeletons
were left in the matrix because of their small size and delicate bones. Karen
Alf and Carpenter spent more than two years removing the soft bones from
the hard rock before mounting them as a pair of dynamic skeletons.

It became clear that there was not enough room on the third floor to
showcase the Museum’s entire collection of skeletons, so the team decided to
edit out some of the Eocene, Pliocene, and Pleistocene skeletons. As a result
much of the Museum’s ice age collection went into storage. This included
the entire La Brea collection as well as horses, Folsom bison, the Angus
mammoth, the Indiana mastodon, and many others. Initially there were
plans to building out _Prehistoric Journey Part 2: The Ice Age_ in the old
Dinosaur Hall on the first floor, but these plans evaporated when it became
clear that _Prehistoric Journey_ would consume the entirety of its $6 million
budget on the third floor.
In 1993 Carpenter’s team disassembled the Baca County plesiosaur and made a mold of every single bone. The original skeleton went into storage and two new casts of the skeleton were mounted in the north atrium above the gift shop. They were positioned in dynamic poses, swimming through the sky in pursuit of fish on their way into the entrance of Prehistoric Journey. Bruce and Marcie Benson funded the skeleton’s molding, casting, and mounting.

Although the Museum used many of the skeletons that had been acquired in the Figgins and Reinheimer years, there were still many gaps in the collections. Stucky, Johnson, and Carpenter devised a three-part strategy to fill these gaps. The preferred approach was to find new fossils. Stucky, Johnson, Carpenter, and Small all led teams to search for specific fossils. In other cases it was clear that it made more sense to purchase fossils from reputable dealers. The team devoted $250,000 to the budget for acquisition of new specimens, and Johnson took the lead on purchasing them. The Museum also issued a broad appeal to the commercial paleontology industry, and a number of dealers responded with generous donations. These were heady times as the Museum rapidly acquired a splendid collection of fossil plants and invertebrates to complement its already excellent vertebrate collection.

Stucky, Johnson, and Carpenter all realized that they had a wonderful opportunity for wide-open exploration in paleontology. Stucky focused on the Eocene mammals from the Bridger and Wind River Basins of Wyoming. Carpenter revisited the classic Jurassic sites in Garden Park, and there he discovered the first complete Jurassic dinosaur eggs and nests in North America. He then shifted his efforts to eastern Utah, where exposures of the Early Cretaceous Cedar Mountain Formation had tremendous potential for the discovery of new dinosaur species. Johnson saw an opportunity to build the finest Cretaceous, Paleocene, and Eocene fossil plant collection in the nation, and he ranged far and wide from New Mexico to Saskatchewan and from Kansas to Washington to create it (Fig. 6.23).

Serendipity in fieldwork led to many fine discoveries. On an expedition to Garden Park near Cañon City led by Carpenter in 1992, Small noticed a small piece of black bone while walking along a creek bed. The bone was a neck vertebra of a Stegosaurus, and it soon became apparent that the entire skeleton of the animal was present. Resembling splattered roadkill, the skeleton was not only complete but its bones were in anatomical articulation. This provided the first evidence for bony scutes in the throat region of the animal and showed without ambiguity how the four spikes were attached to the end of the tail. This discovery fundamentally changed how Stegosaurus skeletons were imaged and mounted: with the tail lifted off the ground and the spikes rotated to a horizontal orientation. Carpenter used this information to rearticulate Reinheimer’s 1939 mount of Kessler’s 1937
skeleton. Curiously, it turned out that Small had found his Stegosaurus only a few hundred yards from where Kessler had found his. Small devoted the remainder of the field season to excavating and removing the 25-foot-long skeleton. This involved the removal of more than 20 feet of rocky overburden and help from Cripple Creek miners to tunnel under the skeleton in order to place a framework of massive beams below it that were then bolted together to provide a portable platform. Small’s team encased this entire structure and the overlying rock and bone in burlap and plaster, creating a five-ton block. The U.S. Army at Fort Carson flew in a double-rotor helicopter to hoist the block onto a flatbed tractor trailer (Fig. 6.24). It was then taken to the Garden Park Paleontological Society facility in Cañon City, where Museum volunteers Donna Engard and Pat Monaco led a team of volunteers to reduce the size of the block and prepare the specimen. Carpenter decided to keep the skeleton intact and articulated, and the resulting block now resides in the Figgins storage area.

In 1991 Stucky and Johnson visited Patagonia at the invitation of Rosendo Pascual of the Museo de La Plata in Argentina. Stucky was interested in mammal evolution and Johnson was curious about the global reach of the K-T boundary asteroid impact (Fig. 6.25). This trip was productive in many ways. On that first trip Johnson and Stucky met Pablo Puerta, an intensely charismatic young fossil preparator from the Museo Paleontológico Egidio Feruglio in Trelew. When they returned to Denver,
they decided to hire him for a summer. Puerta’s field skills and enthusiasm were contagious, and he participated in several expeditions in the summer of 1993. On an expedition to southwestern Wyoming, Puerta and Bill Higbee, a bona fide mountain man from Steamboat Springs, found a very fine skull and fairly complete skeleton of a *Smilodectes* primate, a lemur-like animal that lived in tropical rainforests 50 million years ago. Later that summer on an expedition with Johnson at Cottonwood Canyon in the Bighorn Mountains of Wyoming, Puerta opened a quarry that produced the claw of a giant pterygotid eurypterid.

In 1992 Johnson received a National Geographic Society grant to search for the K-T boundary in New Zealand. He discovered a number of Cretaceous and Paleocene leaf sites but failed to locate the boundary itself. The work occurred on the west coast of South Island, where high rainfall stimulated the growth of a modern temperate rainforest that made paleontological exploration exceedingly difficult (Johnson 1993). They were working in the rainforest, in the rain, and often had to wear headlamps in the middle of the day to see the black fossils on the black rocks. Johnson and his field assistant, Charlie Hanson, were sitting a few feet away from each other in the adit of an old coal mine when a 200-pound chunk of rock fell off the ceiling and landed on the ground between them.
In 1992 Charles Fickle, a Littleton resident, was walking his dog across a house lot in Littleton when he discovered a large bone. Small's subsequent excavation proved this discovery to be a partial *Tyrannosaurus rex* skeleton. Two years later, eagle-eyed contractors working on the construction of Coors Field in downtown Denver spotted a dinosaur rib bone near what would be the Colorado Rockies’ home plate. This discovery led the Rockies to create Dinger the *Triceratops* as their mascot.

These discoveries, in addition to a number of other fossil leaf discoveries, launched a focus on the Denver Basin itself. Johnson organized a group of volunteers who would prepare fossil leaves in the prep lab every other week. This group, known as the Leaf Whackers, grew into a powerful force of more than 35 citizen-scientists who were soon accompanying Johnson on field trips around the American West (Fig. 6.26). Volunteers Howard and Darlene Emry were amazing fossil plant collectors in their own right who began to donate vast numbers of fossil leaves from Idaho, Oregon, Washington, and Colorado that the Leaf Whackers then prepared. Volunteer Madeline Harrell became Johnson’s full-time assistant, preparing fossils, coordinating the Leaf Whackers, and doing library research. This allowed Johnson to begin to publish on the flora of the Hell Creek Formation (Johnson 1992, 1996) and open new explorations in North and South Dakota, Wyoming, Montana, New Mexico, and Utah (Figs. 6.27, 6.28). He also partnered with Wes Wehr and Don Hopkins to acquire extensive collections from Washington State. In short order, the Museum paleobotany
collection was growing to national stature. While hunting for fossil leaves in the Bridger-Teton National Forest south of Yellowstone National Park, Johnson fell down a hill and landed in a pile of boulders. After cleaning the dirt out of his bloodied palm, he realized that he was looking at a group of dinosaur footprints from an undescribed species. Preparator Jerry Harris and Johnson later named this species *Saurexallopus lovei* after David Love, the renowned Wyoming geologist who was featured in John McPhee’s classic book *Rising from the Plains* (Harris et al. 1996).

In 1994 Colorado Department of Transportation paleontologist Steve Wallace discovered a deposit of immense fossil leaves along the side of I-25 in Castle Rock. Some of the leaves were two feet long, and many of them had elongate drip tips that are diagnostic of leaves that grow on trees in tropical climates.
rainforests. Johnson initially thought that the site was Eocene in age, but research associate Doug Nichols, a palynologist, thought it was older. The Museum, led by engineer and citizen-scientist Beth Ellis, would excavate the site extensively from 1994 to 2002, eventually collecting more than 10,000 fossils from the single outcrop. In the end this site would be dated to 64 million years and be recognized as the oldest known tropical rainforest in the world. It is one of the Museum’s most significant fossil discoveries (Johnson & Ellis 2002).

Stucky received and implemented a National Science Foundation Collections Improvement grant for the vertebrate collections, and Prehistoric Journey progressed smoothly forward. The exhibition opened on schedule in the fall of 1995 (Figs. 29, 30, 31, 32). The opening of Prehistoric Journey was celebrated by a party, a parade, a popular book (Johnson & Stucky 1995), and a symposium. Titled A Symposium on the Evolution and Ecology of Life on Earth, the meeting on November 11, 1995, featured the leading international figures in paleontology, including Stephen J. Gould, Lynn Margulis, Adolf Seilacher, William DiMichele, Elisabeth Vrba, and Philip Currie. The exhibition made a strong statement that Denver was back in the paleontology business and that the entire team was diving headlong into fieldwork, collections work, and publication.
Figure 6.30. The entire Prehistoric Journey exhibition team in front of the rearticulated Barnum Brown hadrosaur Edmontosaurus annectens skeleton (DMNH # 1493). Picture taken circa 1993.

Figure 6.31. By 1994 the new Prehistoric Journey mounts were taking shape, including India Wood’s Allosaurus fragilis (DMNH # 2149) (left) and the Carnegie Diplodocus longus (DMNH # 1494) (right).
Big Projects and Low-Hanging Fruit

In 1996 Stucky became the chief curator and director of collections and research, joining the senior staff of the Museum. In 1996 the Museum hosted the annual meeting of the Society of Vertebrate Paleontology, and in 2000 Stucky became the president of the society, serving until 2002. In 2001, he was promoted to vice president of research and collections at the Museum. Russell Graham, a Pleistocene paleontologist with the Illinois State Museum, replaced Stucky as the Earth Sciences Department chair and curator of vertebrate paleontology upon his 1996 promotion. Graham had made his mark in paleontology through the development of FAUNMAP, a database that contained all of the known records of Pleistocene mammals from North America. Graham began work on the middle Pleistocene Porcupine Cave Site in South Park (Barnosky 2004). Graham also was very interested in taphonomy, and he soon began to revisit Museum sites in Weld County. He opened up a site known as Bones Galore that was quite close to the original Trigonias quarry on Horsetail Creek. In 2000 Graham developed a highly successful exhibition on ice age mammals and published a book on cave paleontology (Schubert et al. 2003). Graham left the Museum in 2004 to become the director of the Earth and Mineral Sciences Museum at Pennsylvania State University. Johnson replaced him as chair and also took on his role as chief curator.

Following Stucky’s lead, Johnson received a National Science Foundation grant to improve the quality of the now rapidly growing paleobotany
collections in 1996. Using these funds, he was able to purchase steel cabinets and hire Amanda Ash and Laura Carsten to oversee a team of interns who labeled and boxed more than 20,000 specimens. In 1998 Charles Miller, a paleobotanist and renowned expert on the evolution of conifers, retired from the University of Montana. He agreed to donate his collections to the Museum. The National Science Foundation recognized the importance of this collection and supplied an additional grant to move it to Denver.

While working on Prehistoric Journey, Carpenter had been working on his PhD in paleontology at the University of Colorado, completing it in 1995. For his entire career at the Museum, Carpenter had been a prolific writer and an aggressive editor, eventually compiling eight edited volumes between 1990 and 2008 (Carpenter & Currie 1990; Carpenter et al. 1994; Carpenter 2001, 2005, 2007; Tanke & Carpenter 2001; Tidwell & Carpenter 2005; Larson & Carpenter 2008). He was especially interested in working with the many volunteers in the paleolab and made sure that they had the opportunity to publish scientific papers about their research.

Carpenter began doing fieldwork in the Cedar Mountain Formation of eastern Utah and engaged many volunteers who had worked in the fossil lab. This effort resulted in the discovery of a number of new dinosaur species (Tidwell et al. 1999; DiCroce & Carpenter 2001; Tidwell et al. 2001). In 1995 Cliff Miles, a commercial collector from Utah, discovered a new species of Jurassic ankylosaur from Wyoming. He donated the specimen to the Museum and Carpenter, Miles, and Cloward (1998) described the new species, *Gargoyleosaurus parkpinorum*. Carpenter also described a new species of pterodactyl-like flying reptile with Jerry Harris (Harris & Carpenter 1996).

In 1996 Johnson began to collaborate with Alaskan artist Ray Troll. This led them to excavate the famous but never studied giant ammonite site near Kremmling, Colorado in 1998 (Fig. 6.33), create the Colossal Fossil Vacation temporary exhibition in 1999, and publish the award-winning book *Cruisin’ the Fossil Freeway* in 2007. In many ways this was a logical extension of Johnson’s work with the artists who had worked on Prehistoric Journey. Paleontology and art are closely linked since it takes artists to reconstruct the lost worlds that paleontologists discover. Johnson had worked closely with muralists and artists Kent Pendleton, Jan and Deborah Vriesen, Greg Michaels, Marjorie Leggitt, John Gurche, Gary Staab, and Jeff Wrona to envision these worlds for the Prehistoric Journey exhibition. He had followed up with the Ancient Denvers and Ancient Colorado projects with Jan Vriesen, Donna Braginetz, and Gary Staab to rebuild the ancient landscapes of Colorado. Now his work with Troll was reaching a more regional level

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Figure 6.33. Part of the team at the Kremmling ammonite site in 1998. From left to right: Alan Keimig (seated), Emmett Evanoff, Logan Ivy, Don McCuan, Bill Bateman, Mark Hildebrand, Kirk Johnson, and Ray Troll. The specimen is *Placenticeras meeki* (DMNH # 16926).
and was becoming more playful. Troll is more of a surrealist than a realist, and his images aren’t constrained to reconstructions. Instead, he leavens his work with humor and quixotic juxtapositions. The *Cruisin’ the Fossil Freeway* map that Troll created presented a whole new view of paleontology of the American West. For the first time, kids could contemplate what the paleontologists knew: that fossils are everywhere. In 2010 Troll and Johnson were awarded a joint Guggenheim Fellowship to write a book and create maps about the paleontology of the west coast of North America.

By 1996 it was clear that the Castle Rock site was of international significance, but the Museum was still unclear about precisely how old it was. Robert “Bob” Raynolds, a petroleum geologist with a big curiosity, wandered into Johnson’s office one day in 1996 with the idea of drilling and coring a well in the middle of the Denver Basin. His premise was that a single core could be the Rosetta stone for dating all the fossils in the entire basin. The more Johnson listened, the more it made sense, and the two decided to try to seek funding to turn the idea into a reality. This chance meeting grew into the Denver Basin Project, which continues to this day. Together, Raynolds and Johnson raised nearly $1 million and cored the well in the Elbert County Fairgrounds in Kiowa in March and April of 1999. The well was 2,226 feet deep and produced the desired results (Figs. 6.34, 6.35). The core is presently stored in the USGS core facility in Lakewood, Colorado, where it is routinely visited by researchers. This project has produced a large number of popular and scientific books and papers (Johnson et al. 2002, 2003; Johnson & Raynolds 2002; Raynolds et al. 2007).
In 1999 Denver Basin intern Richard Barclay discovered a superb example of the K-T boundary at the West Bijou Site of the Plains Conservation Center (Fig. 6.36). The team collaborated with Frank Asaro at the Lawrence Berkeley National Laboratory to measure the anomalous iridium at the site and with Glenn Izett of the U.S. Geological Survey to identify the shocked mineral grains that fingerprinted the layer as originating with an asteroid impact. This outcrop also contained abundant volcanic ash beds that bracketed the iridium-bearing K-T boundary. This discovery led Johnson to forge a collaboration with Sam Bowring at the Massachusetts Institute of Technology; his work with U-Pb dating of zircon crystals has revolutionized the field of geochronology. The site is still the subject of active research.

Johnson had also amped up his search for the K-T boundary globally (Fig. 6.37, 6.38). These trips took him to France, Italy, Egypt, India, Patagonia, and Mongolia. In 2000 and 2008 he worked in Manchuria.
these trips he often partnered with Doug Nichols, and the two of them edited a volume about the K-T boundary in North Dakota (Hartman et al. 2002) and a global summary (Nichols & Johnson 2008). Johnson also worked with Dean Pearson of the Pioneer Trails Regional Museum in Bowman, North Dakota, Peter Wilf at Pennsylvania State University, and Conrad Labandeira and Brian Huber, both at the National Museum of Natural History, to flesh out various aspects of the K-T boundary story, including what happened to the insects, microvertebrates, and climate when the dinosaurs went extinct (Pearson et al. 2001; Labandeira et al. 2002; Wilf & Johnson 2004; Wilf et al. 2000, 2003b, 2006). In 2010 Johnson was part of a 41-author paper in Science that definitively tied the Chicxulub impact crater to the K-T ejecta debris and extinctions (Schulte et al. 2010).

The work in Patagonia blossomed into a large project that was co-led by Johnson, Wilf, and Ruben Cúneo. This project has received nearly $2 million of National Science Foundation support and has produced a great number of South America graduate students and significant publications (Wilf et al. 2003a, 2005a, 2005b; Iglesias et al. 2007). The results of this work have shown an amazing connection between South America and Australia across a now severed land bridge through Antarctica. The team has discovered Patagonian duck-billed platypuses and a host of plants such as eucalyptus that were previously thought only to have occurred in Australia.

In 1991, soon after Small was hired, he began working in the Chinle Formation of Eagle Basin, Colorado. He found various localities that have produced some of the earliest dinosaurs and their closest relatives, along with other archosaurs such as aetosaurs and rauisuchians. In 1997 Small started work in the Eskridge Formation of Nebraska. The age of the formation is earliest Permian, and the fossils represent the oldest Permian terrestrial fossils in the midcontinent region. The Eskridge Formation sites are providing information on the faunal and climatic transitions at the Pennsylvanian-Permian boundary. In the 2000s Small began exploration of the Temple Canyon localities near Cañon City, Colorado, which produced a unique lake paleoecology for the Late Jurassic Morrison Formation with numerous fish, one of the largest Morrison plant collections, aquatic invertebrates, and the first insect from the Morrison Formation.

In addition to its productive staff, the Museum was blessed with dozens of research associates, PhD scientists who partnered with staff to dramatically increase the Museum’s scope and reach. Some, like Raynolds, were fixtures around the Museum, effectively serving as full-time staff. Others, like Emmett Evanoff and Lou Taylor, were extremely active teaching courses for the certification program, leading field trips, and publishing articles and books. For example, in 2001 Evanoff edited a volume about Florissant Fossil Beds National Monument in the Proceeding of the Denver Museum of Nature & Science.
Some volunteers became so integral to the program that they were hired as staff. Ellis was initially hired to run the Castle Rock excavation, but she remained on staff to spearhead the study of modern plant taphonomy and leaf architecture as a method to interpret the Castle Rock site (Fig. 6.39). Her efforts led to papers on modern tropical rainforests (Burnham & Johnson 2004) and a book about leaf architecture (Ellis et al. 2009). Together, Johnson and Ellis were able to forge a very productive partnership with the Smithsonian Institution, Yale University, Pennsylvania State

Figure 6.38. On August 31, 2000, Kirk Johnson and Ray Troll discovered a superbly preserved K-T boundary impact layer at Mud Buttes, North Dakota.

Figure 6.39. Michele Reynolds, Regan Dunn, and Beth Ellis at the Castle Rock rainforest site on the eastern edge of I-25 in 2002.
In 2005 Stucky relinquished his post as vice president and took the title of curator of paleoecology and evolution. In 2006 Johnson took on Stucky’s vice president role. During the first year of his new curatorship, Stucky began to work with high school students, collaborating with Paul and Harriet Rosen, who were interested in funding opportunities for youth in science (Fig. 6.40). Together they conceived the Teen Science Scholars program, which now brings more than 20 high school youth into the Museum as summer employees each year. The program looks for students in underrepresented groups in the sciences—women and minority students—who will be first-generation college students and who will become future leaders and mentors in their community in science. The program originally started in paleontology and now serves anthropology, health sciences, and zoology. Through the Teen Science Scholars program, Stucky was able to enlist teenagers to help renew his research in the Wind River Basin of Wyoming.

Stucky resumed his research work in mammalian paleoecology and evolution. He collaborated with colleagues Michael Woodburne, a retired professor from the University of California, Riverside, and Gregg Gunnell from the University of Michigan on the first papers on mammalian extinction and origination that demonstrated a relationship between climate warming during the Early Eocene Climatic Warming event and increasing species diversity (Woodburne et al. 2009a, 2009b). Like Stucky, Johnson began to focus his efforts more on paleoclimate, eventually serving on a National Academy of Sciences panel on deep time climate change (Montanez et al. 2011) and producing a children’s book on the carbon cycle (Johnson & Bonnell 2007).

Greg Wilson joined the department in 2005 as the curator of vertebrate paleontology. He had completed his PhD at the University of California,
Berkeley, and studied the Late Cretaceous mammals of the Hell Creek Formation. This made him a good fit with the Museum, and he quickly initiated work in the Denver Basin. His research led him to explore the Cretaceous of India and various sites in Montana (Fig. 6.41) and Wyoming (Wilson 2005; Evans et al. 2006). Wilson left the Museum in December 2007 to take a position at the Burke Museum at the University of Washington. He continues to work on fossil mammals with the Denver Basin Project.

Wilson was replaced by paleobotanist Ian Miller, who had just completed his PhD at Yale University. Miller’s thesis and subsequent papers focused on Early Cretaceous floras from Washington State (Miller & Hickey 2010), and he came on board initially as a postdoctoral researcher to support Johnson’s promotion to vice president. Miller and Johnson apparently came from the same mold. Both were big guys from Washington State who had been lured into paleobotany by Wesley Wehr at the University of Washington. Miller met Johnson when he was an undergraduate at Colorado College, and Johnson had introduced Miller to Johnson’s PhD advisor at Yale.

Miller spent his first few years working on the Denver Basin Project with Ellis and Johnson before taking over the Kaiparowits Basin Project, a rapidly growing collaboration with the University of Utah (Figs. 6.42, 6.43). This collaboration grew even stronger when the project leader, Utah paleontologist Scott Sampson, joined the Museum’s board of trustees as its first official scientist. Also known as Dr. Scott to the millions of young viewers of the PBS show *Dinosaur Train*, Sampson is a dinosaur paleontologist with extensive experience in Canada, the United States, and Africa, particularly Madagascar.

In September 2009, teenagers Jake Carstensen and Tyler Kellett were playing in a gulley behind their home in Ken Caryl Ranch subdivision near Littleton, Colorado, after a rainstorm and found a large jawbone. The consulted the Internet and determined that the jaw belonged to a mastodon. This diagnosis did not seem likely to Museum archaeologist Steve Holen, who observed that only two fragmentary mastodon teeth had ever been found in Colorado and that it was much more likely the find was a mammoth. The boys brought the jaw to the Museum, and it was clearly a mastodon, Colorado’s third. Holen visited the site with the boys and excavated a partial tusk and a horse tooth. Plans were made to revisit the site the next year, but those plans have not yet come to fruition.
In 2010 Carpenter left the Museum to become the director of the Prehistoric Museum at the College of Eastern Utah in Price. Miller had succeeded him as department chair in 2009, just in time to welcome paleontologist James “Whitey” Hagadorn, who joined the staff in 2010 as the Museum’s first invertebrate paleontologist. Hagadorn had been hired to replace geologist Paul Morgan, but his skill set was wide. For the first time, the Museum had a full complement of paleontologists representing vertebrates, invertebrates, and plants. Hagadorn’s first task was the redesign of the Prehistoric Journey entryway.

Snowmastodon and the Future of Paleontology at the Denver Museum of Nature & Science

On October 14, 2010, bulldozer operator Jesse Steele’s discovery of a mammoth in Snowmass, Colorado, provided an opportunity to demonstrate how strong and nimble the paleontology program at the Museum had grown. With a staff of four paleontology curators (Stucky, Johnson, Miller, and Hagadorn), a trained support staff, and more than 200 volunteers and 68 research associates, the Museum was able to respond to the Snowmass discovery with overwhelming force. Within days of the find, the Museum had more than 40 workers on site. As the significance of the site grew, the
Museum added research associates and researchers to the mix, eventually building a team of 43 scientists from 19 universities in 4 countries (Fig. 6.44). The project also included Stephen Nash, curator of archaeology; John Demboski, curator of vertebrate zoology; Steven Holen, curator of archaeology; and Frank Krell, curator of entomology.

Sampson’s former student Joe Sertich had just completing his PhD on Malagasy dinosaurs with David Krause at Stony Brook University on Long Island. In February 2011 he took over Carpenter’s position as the Museum’s dinosaur specialist.

During the spring of 2011, the Museum prepared to launch the largest excavation in its history. Sertich arrived on the first day of the dig and worked for 51 straight days, demonstrating skill, stamina, and enthusiasm (Fig. 6.45). More than 250 volunteers worked with more than 40 staff to move more than 8,000 tons of dirt by hand and recover more than 5,400 bones of mastodon, mammoth, bison, horse, camel, sloth, and deer. The effort received over 1,000
media stories, was featured on the NOVA special Ice Age Death Trap, and appeared in National Geographic. Miller and Johnson coauthored the book Digging Snowmastodon: Discovering and Ice Age World in the Colorado Rockies (Johnson & Miller 2012). No longer was there any doubt about the potential of paleontology at the Museum (Fig. 6.46).

As word of the Snowmastodon discovery spread, it triggered other new discoveries in Colorado. People watching the news realized that they, too, had seen giant bones that might be mammoths. Two of these discoveries proved to be significant. In the winter of 2011, a site was discovered near Villa Grove, Colorado, in the San Luis Valley that contained a partial mammoth skeleton. The site was investigated by Holen and Stucky, and proved to be quite interesting. The site was 25,000 years old and contained bones of a camel, mammoth, small rodents, and rabbits.

Another site was found by a gravel pit operator, Don Marr, of the Yuma County Road and Bridge Department. Marr had run across several tusks in a gravel pit east of Holyoke near the Nebraska border. Holen investigated the site as a potential archeological site, but he soon realized that the bones were of neither a mastodon nor a mammoth but rather were those of a Stegomastodon, an extinct large proboscidean that became extinct more than 1.2 million years ago.

In July 2012, fresh from Snowmass, Stucky commenced excavations and soon unearthed an entire Stegomastodon spinal column. Two Teen Science Scholars visited the site with Stucky, and in the final hour of the dig Dalton Meyer found a small piece of bone in the wall of the excavation. When Stucky returned the next month with Lesley Petrie, Billy Doran, and Sarah McCracken, they followed Dalton’s bone into the wall and soon exposed an entire Stegomastodon skull. As they worked to trench around the skull, they uncovered two tusks and a scapula. All told, the site has produced parts of 17 tusks (Fig. 6.47). Other fossils include bones from a large bird, gophers, deerlike animals, camels, and horses. The landowners, Darlene, Randy and Renee Weis, worked along side Denver Museum scientists and excavators and generously donated the specimens.
Although the Denver Museum of Nature & Science was founded in 1900, its paleontology program did not begin until 1914. This means that we are still two years away from celebrating a century of paleontology in Denver. In 2014 the Museum will open its brand-new collection preservation facility and for the first time in its history, it will be able to care for that century of collections, now numbering 120,000 specimens, with the best practices of the industry.

Though the Museum has experienced stops and starts in its paleontology program, by all counts it has been a successful century, and rightfully so. The Museum is located in the capital of the Rocky Mountain West, in the center of what is arguably the finest fossil field in the entire world. We know that the best fossils are still in the ground waiting to be discovered, and those discoveries will move the science of paleontology forward even more. In addition, paleontology is well suited for citizen science. Dinosaurs and other prehistoric creatures are extraordinarily popular with the Museum’s primary audience, families, and the Snowmastodon discovery demonstrated their overwhelming interest in new discoveries. In addition, fossils are messages from past worlds, and as we move forward into the Anthropocene, these messages will have increasing relevance. All of these observations add up to the fact that the Denver Museum of Nature & Science is uniquely positioned to take a leadership role in paleontology as it moves into its second century (Fig. 6.48).

Figure 6.48. The Department of Earth Sciences, December 13, 2011.
Literature Cited


