



LIBRARY  
 ROYAL ONTARIO MUSEUM





PHYSICAL SCIENCES

ROYAL ONTARIO MUSEUM  
UNIVERSITY OF TORONTO

CONTRIBUTION 70

L. S. RUSSELL

JAN 3 1987



# ROM

## *Dinosaur Hunting in Western Canada*

ROYAL ONTARIO MUSEUM - UNIVERSITY OF TORONTO

ROYAL ONTARIO MUSEUM LIBRARIES



3 1761 05013 7835





*Dinosaur hunting in western Canada*

Digitized by the Internet Archive  
in 2011 with funding from  
University of Toronto



*Contribution No. 70*

LIFE SCIENCES

ROYAL ONTARIO MUSEUM

UNIVERSITY OF TORONTO

LORIS S. RUSSELL

*Dinosaur hunting  
in western Canada*

LORIS S. RUSSELL is Chief Biologist of the Royal Ontario Museum and Professor of Geology, University of Toronto.

PRICE: \$1.00

© The Governors of the University of Toronto, 1966

PRINTED AT THE UNIVERSITY OF TORONTO PRESS

# *Contents*

Introduction, *1*

Geological History of the Canadian Prairies  
Since Mid-Cretaceous Time, *3*

Early Explorations, 1873 to 1901, *4*

The Golden Age, 1910 to 1917, *13*

The Search Continues, 1917 to 1965, *21*

The Future, *35*

References, *35*



# *Introduction*

The fossil fields of Alberta and Saskatchewan are justly famous for the wealth of excellent specimens that they have yielded, particularly the relics of those extraordinary reptiles collectively known as dinosaurs. Mounted skeletons of dinosaurs from the Red Deer River badlands are outstanding exhibits in some of the world's great museums. Much has been written about these ancient monsters, their anatomical peculiarities and their probable appearance and life habits. But how their bones came to be preserved and discovered in the rocks of western Canada, and who it was who found and collected them, are subjects about which little has been written. The book by C. H. Sternberg, *Hunting Dinosaurs in the Badlands of the Red Deer River, Alberta, Canada* (1917), and a few popular articles by Barnum Brown (1919) and C. M. Sternberg (1946), are about all that has been published on this aspect of dinosaur study. The rest is buried in scientific and administrative reports, and in the field notes of the collectors, many of whom are no longer with us. It seems important that a summary account, at least, of these explorations be published, especially while some of those with first-hand knowledge of the events are still available for consultation.

Information on which this account is based has been derived from a variety of sources in addition to those already mentioned. Most useful, perhaps, have been the annual reports of the Geological Survey of Canada and the National Museum of Canada. The American Museum of Natural History provided brief statements of palaeontological field work in the annual reports and in the annual compilations of research in vertebrate palaeontology. Data on sites and dates of discovery were obtained from the scientific descriptions of the various specimens, and from the "Steveville Sheet" (Geological Survey of Canada, Map 969A). Old newspaper and magazine articles have been consulted. The few biographies or autobiographies that have been written on persons concerned in these events have been primary sources, but other biographical information has been found in the obituaries published by the Royal Society of Canada and the Geological Society of America. Data from these various sources have been supplemented and expanded from the writer's own knowledge of events and areas, and from conversations with some of the participants. Parts of the resultant narrative have been read critically by Dr. C. M. Sternberg and Mr. L. Sternberg. Their suggestions and corrections have been incorporated, but any errors that remain are the responsibility of the writer.

The illustrations are mostly from photographs in the files of the Geological Survey of Canada and the National Museum of Canada, and the permission to use them which has been granted by those institutions is gratefully acknowledged. An effort has been made to show not only the conditions under which the discoveries were made, but also how the protagonists appeared in the field. For more formal portraits the reader is referred to the biographies and obituaries listed among the references.

# *Geological History of the Canadian Prairies Since Mid-Cretaceous Time*

The dinosaur hunter is accustomed to many questions regarding his vocation, but perhaps the commonest one is "How do you know where to dig?" A variant of this is "Why are dinosaurs found in Alberta and nowhere else?" Of course dinosaurs are found elsewhere, even in Canada, but the hunting in the prairie provinces has been particularly good. To understand the reasons for this we have to know something of the geological history of the region.

The story begins about 90 million years ago. At that time the region that is now the Canadian prairies was beneath the water of a great interior sea (the Colorado sea), which stretched from the Arctic to the Gulf of Mexico, and lapped on the west over much of the area now occupied by the Rocky Mountains. To find uplands in those days one would have had to go to what are now the Selkirk Mountains and other interior ranges of British Columbia. This sea was muddy, and in it a great thickness of sediments accumulated, which today constitutes the widespread Alberta shale and related formations. These carry the fossils of sea shells and the occasional bone of a marine reptile or fish, but dinosaur remains are absent as these animals were of a terrestrial or aquatic habitat, but never, as far as we know, marine.

Eventually this interior sea was broken in the region that is now central and northern Alberta, probably by gently unwarping or tilting of the land. The same movement drove back the western margin, so as to establish a broad coastal plain, with deltas, lakes, and lagoons. This kind of country, probably something like parts of Florida or the Mississippi Delta area today, was a favourite with the dinosaurs, and they moved in with both quantity and variety. The carcasses of those that died here may have been devoured by flesh-eaters, or destroyed by decomposition, but some were buried in the sands and clays that were accumulating in the flood plains and estuaries. Here, along with the remains of other life of the time, they were reduced to skeletons which gradually became mineralized. The sea margin advanced and retreated, producing alternations of marine and fresh-water deposits, but the coastal plain persisted, sometimes restricted to what is now the foothills belt of Alberta, sometimes spreading far into the future area of southern Saskatchewan. The final withdrawal of the sea from the Canadian plains region dates from late in the Cretaceous period, just before the extinction of the dinosaurs. But conditions on the land did not change much at first; the subtropical, well-watered lowlands persisted for millions of years into the Tertiary period, or Age of Mammals. Towards the end of the Eocene epoch, about 45 million years ago, the land began to rise, and as a result of compressive forces, great blocks of the earth's crust buckled and overrode each other. In this way the Rocky Mountains, as we know them today, were formed. Swift rivers from the new mountains carried

coarse gravel eastward, to be deposited as thick accumulations over the Cretaceous and early Tertiary sediments. New levels of land surface were established, to be eroded in turn as the result of further elevation, and renewed gravel accumulation.

The final great geological event was the Ice Age. Massive sheets of ice advanced from the northwest to lap against the edge of the foothills. Valley glaciers came down from the mountains. The plains were deeply eroded in places, while elsewhere thick deposits of glacial debris were deposited on the older sediments. Finally the ice withdrew for the last time, and streams re-established themselves, sometimes in their preglacial channels, sometimes in valleys newly cut. The climate became drier, and the vegetation more sparse in places. The lack of protection permitted erosion to cut down through the glacial deposits and expose the Cretaceous rocks, and those that were soft and clayey were readily weathered into the intricate form of landscape that we call badlands. Patches of badlands occur in Saskatchewan, in Big Muddy and Willowbunch valleys, along Frenchman River, and in an area south of Wood Mountain. In Alberta almost all of the major streams in the south, from Battle River to Milk River, have stretches of valley where the sides have been eroded into badlands. It is along the Red Deer River, however, that such areas are most extensive and spectacular. Northeast of Brooks is the famous Steeple-Deadlodge Canyon area, now incorporated in the Dinosaur Provincial Park. The rocks exposed here belong to the Oldman formation, or as they are known in the older publications, the Belly River series. Above these Oldman sandstones and clays, and forming the valley walls from Steeple to Rosebud, are the dark marine shales of the Bearpaw formation. These contain fossil sea shells and the occasional bones of sea reptiles. Above the Bearpaw shales, and appearing in the northern area of badlands from Rosebud to beyond Big Valley, is the Edmonton formation. The rocks of this formation resemble those of the Oldman formation, but contain numerous coal seams, which are mined at various centres, especially Drumheller. Dinosaur fossils occur in the Edmonton rocks, but are not as numerous nor as varied as in the Oldman formation.

## *Early Explorations, 1873 to 1901*

These were the events that shaped the region in which the early geological explorers of the Canadian plains made their pioneer discoveries. The first geologist here was Dr. James Hector, of the Palliser Expedition of 1857–60. He collected the fossil shells of mollusks, but did not report fossil bones. The honour of being the first to discover dinosaur remains in Canada belongs to Dr. George Mercer Dawson, along with many other “firsts” in the scientific exploration of our west. Dawson (Harrington and Ami, 1902) was the second son of Sir William Dawson, also a great Canadian geologist and first Principal of McGill University. George Dawson was born in Pictou, Nova Scotia, in 1875, and was educated at McGill and at the Royal School of Mines in London where his teachers included Murchison and Huxley. In 1873 he was appointed geologist and naturalist to Her Majesty’s North American Boundary Commission, which was set up to collaborate with a similar body from the United States to survey and mark the 49th parallel of latitude from the Lake of the Woods to the Rocky Mountains. Dawson’s task was to survey and map the geology of a belt of unspecified width, but extending from east to west over 800 miles, most of it in uninhabited and largely unexplored country.

To appreciate what George Dawson did as geologist of the Boundary Commission, and later in his many explorations of the Canadian west, one should realize something that is glossed over in his biographies. Dawson

*Dr. G. M. Dawson (third from left) and field party, Fort McLeod, British Columbia, 1879. Geological Survey of Canada, No. 311-C2.*





was, in common parlance, a hunchback. In group photographs in which he appears standing with others, he seems to have been not much more than four feet six inches in height. Along with this deformity went a delicate constitution, and he suffered much illness as a boy. In spite of this great handicap he did not hesitate to undertake most arduous explorations, of which the first was his survey of the international boundary. Although he is said to have made copious records in the field, his publications on this exploration give little information on the manner of working. Recently a very interesting account (Parsons, 1963) has been published on the work of the 49th parallel survey, and from this it appears that Dawson had his own assistant and light wagon, but that he camped with Captain Anderson, the Chief Astronomer of the British party. In addition to making geological observations and collecting pertinent specimens, he also made large collections of modern animals and plants.

At the close of the field season of 1873 a reconnaissance by British surveyors had reached the vicinity of Wood ("Woody") Mountain. It was from here that the exploration was resumed in May, 1874, and it must have been soon afterwards that Dawson found his first dinosaur bone. He gives the locality as 20 miles south of Wood Mountain settlement, in badlands associated with valleys draining from the south side of Wood Mountain plateau (Dawson, 1878, p. 103). The main area is adjacent to what was long known as Rocky Creek but which appears on modern topographical maps as Morgan Creek. Today the village of Killdeer, on the Canadian Pacific Railway, and Saskatchewan Highway No. 2 are about 6 miles to the east. Dawson's detailed description of the succession here can be equated readily with the stratigraphy as we now understand it. Starting at the top, his Division  $\alpha$  and the upper part of his Division  $\beta$  belong to what is now called the Ravenscrag formation, of Paleocene age. The lower part of Division  $\beta$ , below the lowest lignite bed, is the Frenchman formation, and was recognized by Dawson as the source of the dinosaur fossils. Below this are the yellowish sands of his Division  $\gamma$ , which are the local equivalent of the Eastend formation, transitional to the marine shales of Division  $\delta$ , the Bearpaw formation. The fossil bones found by Dawson were subsequently referred to E. D. Cope, who recognized four species of turtle, the gar-pike, and a hadrosaurian dinosaur.

By July of 1874 the boundary survey had reached what is now southwestern Saskatchewan, and Captain Anderson had reconnoitred the gorge of the Milk River, south of the present Comrey district of Alberta. We may presume that Dawson was nearby, and that it was at this time that he made his second discovery of dinosaurs. The section here exposes parts of the Foremost and Oldman formations, which are of Cretaceous age, but older than the Frenchman formation in which Dawson found bones near Morgan Creek. On Milk River Dawson (1875, pp. 118, 119) noted the conspicuous sandstone, later called the Comrey sandstone, and recorded that his vertebrate fossils occurred below this, in fact well down in what is now mapped as Foremost formation. The bones were large, but dissociated; Cope later identified them as "portions of the sacrum and long-bones of a Dinosaurian".



*G. M. Dawson's field party in southern Alberta, 1881. The tall figure in the centre is presumably McConnell.*  
G.S.C., No. 398-C3.

In 1875, after completion of the boundary survey, Dawson joined the Geological Survey of Canada, and carried out explorations in British Columbia. In 1881 he returned to southern Alberta to begin his geological survey of the "Bow and Belly River Region". By this time the North-West Mounted Police had established some order in the area, the Canadian Pacific Railway was building westward from Winnipeg, and freight was coming in to Fort MacLeod and Coalbanks (Lethbridge) by wagon from Montana. Dawson was now one of the distinguished officers of the Survey, and he rated a well-qualified assistant. The assignment went to Richard George McConnell (Hanson, 1942), who was born at Chatham, Quebec, in 1857, and graduated from McGill University in 1879. McConnell rose to succeed Dawson as Director of the Geological Survey of Canada, but in 1881 he had just been appointed. Physically he was a contrast to his chief, for he was tall and thin, and in later years, at least, wore an imperial beard. Strenuous exertion did not bother him, which was a good thing, because Dawson spared neither himself nor his assistants.

During the summer of 1881 Dawson and McConnell explored the valleys of the St. Mary, Oldman, and Bow Rivers by canvas canoe and visited many other localities in what is now southern Alberta by wagon or saddle horse. Fragments of dinosaur bones were found along Belly (Oldman) River in the "Sub-Pierre rocks" (Dawson, 1883, p. 8). At the end of the field season Dawson returned to Ottawa, while McConnell settled in Calgary for the winter, to be on hand for an early beginning in 1882. Dawson did not come west that year, and McConnell filled in the observations and extended them into the foothills of the Rocky Mountains. The discovery of fossil bones during this season is definitely recorded (Selwyn, 1883, p. 13). This was at a low escarpment known as Scabby Butte, north-east of Fort MacLeod, and about three miles east of the present village of Nobleford. In a small area of badlands here, in the lower part of the St. Mary River formation, McConnell obtained "a large and interesting collection . . . of reptilian bones, probably of Dinosaurs, some of which are now exhibited in the museum" (*loc. cit.*). This was the third discovery of dinosaurs in western Canada and the second in what is now Alberta.

One of the specimens was the thighbone of a duck-billed dinosaur, which was collected in pieces, and mended together back in Ottawa. At the end of the season McConnell stored the equipment at Fort MacLeod, and it is interesting to note that the transport consisted of one wagon, two carts, one buckboard, and a canvas canoe, with seven horses of which at least three were used for riding.

When Dawson returned to the west in 1883, McConnell was assigned to his own survey of the Cypress Hills region, in what is now southeastern Alberta and southwestern Saskatchewan. It was during this exploration that he discovered the Oligocene mammalian fossils of the Cypress Hills formation (McConnell, 1885). Meanwhile, Dawson's new assistant was J. B. Tyrrell, of whom more later. However, the responsibility for collecting fossils was assigned to another member of the Geological Survey, Thomas Chesmer Weston. His interesting autobiography (Weston, 1899) tells us much about the staff and the work of the Geological Survey of Canada during the 60s, 70s, and 80s. Weston was born in Birmingham, England, in 1832, and grew up as an assistant in his father's jewellery and lapidary shop. This experience qualified him for the position of lapidary for the Geological Survey of Canada, which he joined in 1858, under the first Director, Sir William Logan. Weston not only prepared polished specimens and thin sections of rocks and minerals, but he developed into an enthusiastic field collector, and travelled extensively in eastern Canada, adding to the mineral and fossil collections of the Survey. In 1883 he was assigned



*R. G. McConnell  
in the field, 1902.  
G.S.C.,  
No. 9485-B6.*

to Dawson's party, with his own assistants and equipment to enable him to operate independently. The combined parties travelled by train to Maple Creek, and from there set out by wagon across the Cypress Hills and westward to Fort MacLeod. There they separated and Weston spent some time in the foothills near Pincher Creek and Waterton Lakes. It was not until he returned to the plains in late July that he began finding dinosaur fossils. Two brief visits to Scabby Butte were cut short by lack of water, but did permit the collection of large specimens of fossil wood. The remainder of the season was spent along Oldman ("Belly") and South Saskatchewan Rivers, and here many fragments of dinosaur bones were found, which Weston thought represented the flesh-eating kind (Carnosauria). In modern stratigraphical terms, Weston was collecting in the Oldman and Foremost formations, the northern extension of the rocks in which Dawson found dinosaur bones on Milk River in 1874.

In 1884 Weston was in the Cypress Hills, collecting mammalian remains from the Oligocene conglomerate, discovered the previous year by McConnell. At the close of the season Weston took a quick trip by train, accompanied by the botanist McCoun, to Irvine, just east of Medicine Hat. In the small area of badlands in adjacent Ross Coulee he found dinosaur bones, but was not particularly successful in collecting them, in spite of a hike by McCoun to Medicine Hat to get some hardening material. The rocks here, in modern terms, are the upper part of the Oldman formation, and have yielded important specimens in more recent years.

This same year Tyrrell began an independent survey of the country north of Dawson's Bow and Belly River area. Joseph Burr Tyrrell (Loudon, 1930) was born in Weston, a suburb of Toronto, in 1858. He graduated from the University of Toronto in 1880 in expectation of a legal career. The threat of ill health, however, diverted him into outdoor work, and he joined the Geological Survey of Canada in 1881. In 1883, as we have noted, he served as Dawson's assistant in southern Alberta. Tyrrell was tall and of rugged build, a physique that was later to see him through rigorous explorations of the Arctic tundra, seven years as a mining geologist in the Yukon gold rush, and a life expanse of 99 years. In 1884, at the age of 26, he was leading a field party of three assistants in the geological exploration of what is now central Alberta. About a month after leaving for the field, Tyrrell was in the valley of the Red Deer River, near where the city of Drumheller now stands. Here he found the rich coal deposits that have made this area so important. Soon he began to find fossil bones; the date of this, the first discovery of dinosaur fossils on the Red Deer River, was June 9, 1884. A few weeks later he came upon what was probably a large bone bed, on Kneehills Creek. Among the specimens that he discovered was the incomplete skull of a flesh-eating dinosaur. With crude tools the specimen was removed more or less intact from the rock. It was a struggle for Tyrrell and his assistants to get this heavy and fragile fossil to the top of the valley. In a drizzling rain it was all three horses could do to get the empty wagon to prairie level. So the skull and a few other bones went up on the backs of the horses. Then came the 100-mile drive to Calgary, over the roadless prairie, travelling slowly to try to save



J. B. Tyrrell (extreme left) and field party at Fort Edmonton, 1886. G.S.C., No. 809-C4.

the precious load from damaging jolts. Tyrrell's prize finally reached the Survey museum in Ottawa, and subsequently it was studied by E. D. Cope, who identified it as *Laelaps incrassatus*, a flesh-eating dinosaur previously known from New Jersey. In later years good skulls and partial skeletons of this dinosaur were found in the Red Deer River valley, and we now know it as *Albertosaurus sarcophagus*, the carcass-eating dinosaur of Alberta.

Tyrrell's discovery of the *Albertosaurus* skull aroused much interest at the Geological Survey headquarters, and in 1888 Weston was sent to the western plains for the purpose, among others, of exploring the valley of the Red Deer River. It had been suggested to him by the Rev. Leo Gaetz of the town of Red Deer that the proper way to see the valley was to float down the river in a boat. So Weston arranged to have a boat made at Red Deer, and he arrived there early in August to make the trip. But the boat was poorly made, and Weston's two pick-up assistants were inexperienced in river navigation, and about eight miles downstream the craft was wrecked. Weston reached the farm of a Mr. McKenzie, who advised the collector to abandon his plans for this year and to come back the next, when he, McKenzie, would take Weston down the river in a properly made boat. Weston was greatly impressed by McKenzie and agreed to his proposal. So in June of 1889 the collector and his new friend met in Calgary and drove to the McKenzie farm near the mouth of Blindman River. On June 17 Weston, McKenzie, and McKenzie's son Joe launched two boats and started downstream, the first of a succession of fossil collectors to navigate the Red Deer River. After an exciting run through the canyon,





*T. C. Weston's expedition on the Red Deer River, 1889. The two boats may be seen to the left of centre, with a member of the party fishing. G.S.C., No. 1090-C5.*

they passed from the part of the valley occupied by the Tertiary Paskapoo formation to that of the Cretaceous Edmonton formation. Here they found thick coal seams, and were soon exploring the badlands, in which they obtained another incomplete *Albertosaurus* skull. So far Weston had been duplicating the discoveries of Tyrrell.

Continuing their downstream journey, Weston and the McKenzies soon passed out of the northern area of badlands (Edmonton formation) and into a stretch of gentle slopes and grassy river flats. This is the part of the valley formed in the marine Bearpaw shale. Eventually they came to another and more extensive area of badlands, which Weston recognized as belonging to the older Belly River series, which he had explored on the South Saskatchewan. This area would be in the vicinity of the future village of Steveville. Almost immediately dinosaur vertebrae and limb bones were discovered, the first finds to be made in what has proved to be one of the world's richest fields. Weston does not record the date, but it must have been during the last week of June, for a few days later he was celebrating Dominion day (July 1) in the midst of the badlands. Next he came to the fantastic Deadlodge Canyon area, which was to yield many fine skeletons to Weston's successors. By July 7 the explorers had drifted out of the badlands, and a week later had reached the confluence of the Red Deer River with the South Saskatchewan. They continued down the main stream to the crossing of the Battleford-Swift Current trail, and from here they travelled south by wagon to the railway. McKenzie and his son returned by train to Calgary, while Weston set off for another visit to the fossil beds of

the Cypress Hills. Weston's expedition of 1889 is especially important because it was the first to use the river as a means of travel, and it resulted in the discovery of the extremely rich fossil field of the Steeveville-Dead-lodge Canyon area. What is more, Weston himself recognized the importance of his discovery.

Lawrence Morris Lambe (McInnes, 1920) was the next to explore the Red Deer River badlands for fossils. Unlike his predecessors, who were geologists or collectors, Lambe was a palaeontologist, but he had come into the profession by an unorthodox way. He was born in Montreal in 1863 and graduated in 1883 from the Royal Military College in Kingston with the career of an Army officer in mind. While waiting for an appointment he worked as assistant construction engineer on the Canadian Pacific Railway in the Rocky Mountains, and contracted typhoid fever. This impaired his health so that he had to give up the hope of a military career and turn to something else. He was an artist of some merit, and he secured a position as scientific artist with the Geological Survey of Canada in 1885. His chief, J. F. Whiteaves, encouraged him to study as well as to draw fossils, and for a time Lambe was active in research on fossil corals. But fossil vertebrates were more to his liking.

In 1897 the Canadian Government were financing the drilling of a test boring in northern Alberta, and Lambe was sent out to observe the progress of this project. This, no doubt, was the excuse for the trip, but the real reason was the boat trip that he was permitted to make down the Red Deer River, following the example of Weston. He started from Red Deer town on July 31, with two assistants hired locally; by August 31 he had reached the juncture with the South Saskatchewan, and by September 3 had completed his trip at Saskatchewan Landing, north of Swift Current. Such a quick trip was little more than a reconnaissance, but it gave Lambe an idea of the location of the richer fossil fields. Next year, 1898, he was back to concentrate on the "Belly River" field. Hiring a wagon and assistants at Medicine Hat, he drove to the Red Deer River and on July 24 camped opposite the mouth of Berry Creek. This would be across from what was to be the site of Steeveville Village. Lambe found it more difficult to get into the badlands by wagon than by boat, and he confined his fossil hunting to the vicinity of Berry Creek, working for about a month on both sides of the river. His combined collections for the two seasons included representatives of the flesh-eating, duck-billed, and horned dinosaurs, as well as turtles and crocodiles. But the collecting of fossil vertebrates in Canada was still based on crude techniques, and Lambe was less informed on the art than some of his contemporaries. So his specimens were fragmentary, and not very valuable in the light of later discoveries. His knowledge of the fauna was also still imperfect, and he referred his specimens to genera which we now know do not occur at this stage.

By 1900 we find Lambe busily working on his collections and visiting the American Museum of Natural History to learn more about dinosaurs and the methods of preserving vertebrate fossils. Professor H. F. Osborn took an interest in his work, and for a time became Honorary Vertebrate Palaeontologist for the Geological Survey of Canada. Lambe's last expedi-

tion to the Red Deer River was in 1901. Again he drove north from Medicine Hat, but this time he explored the badlands downstream from Berry Creek, as far as Deadlodge Canyon. He remained in the field from early July until well into September, and his collection of this year was the best so far made from the Cretaceous of Western Canada.

Lambe's studies culminated in his monograph, *On Vertebrata of the Mid-Cretaceous of the North West Territory* (Osborn and Lambe, 1902). Professor Osborn wrote the introduction, and clearly pointed out that this "Belly River" fauna was distinctly older than that of the "Laramie" or Lance, the best known Cretaceous vertebrate fauna up to that time. Lambe's descriptions were meticulous, and many of his illustrations exquisite. His work marks a very important advance in the study of vertebrate palaeontology. Unfortunately, due to the nature of his collection, some of his genera and species were established on inadequate material, and these have plagued succeeding workers in their efforts to identify the better preserved specimens collected later.

*Lawrence Lambe's camp on Red Deer River, 1901. G.S.C., No. 31832-B44.*





## *The Golden Age, 1910 to 1917*

While the Canadian collectors and palaeontologists were painfully gathering the fragments of dinosaur skeletons from which they endeavoured to piece together a picture of these ancient faunas, a revolution in collecting methods was taking place in the United States. The use of liquid cements, such as gum arabic and shellac, and particularly the technique of bandaging the fossils in their rocky matrix with plaster and burlap, had made it possible to bring back to the laboratory many skulls and skeletons that would otherwise have crumbled at the first attempt to remove them. Such collectors as John B. Hatcher, Walter Granger, and Charles H. Sternberg had brought these techniques to a high level of effectiveness. Another very successful user of these methods was Dr. Barnum Brown of the American Museum of Natural History in New York.

Barnum Brown (Lewis, 1964) was born in Osage County, Kansas, in 1873, the son of pioneer settlers. After graduation from the University of Kansas, where he studied under S. W. Williston, he joined the staff of the American Museum of Natural History, beginning an association, active and honorary, that was to last for 66 years. After taking part in an expedition to Patagonia, Brown began in 1902 to explore the Hell Creek formation of eastern Montana, the northern equivalent of the famous Lance formation of Wyoming. This work continued with minor interruptions until 1909 and the magnificent collection that resulted included the skeleton of the giant flesh-eating dinosaur (*Tyrannosaurus rex*) and those of the two duck-billed dinosaurs (*Anatosaurus*) that dominate the exhibits of Cretaceous dinosaurs in the American Museum of Natural History. By 1908 the end of the work in Montana was in sight, and Brown was looking for new fossil fields. He was, of course, aware of the discoveries on Red Deer River through the writings of Lambe, but these did not suggest an unusually rich occurrence.

In 1909 a rancher from the Red Deer River valley, visiting the American Museum of Natural History, reported that fossil bones similar to those on display were common on his Alberta ranch. The story was so convincing that Brown, after further work in Montana, travelled to Calgary and north to Didsbury; from here he was driven 90 miles to the Red Deer River valley. Sure enough, the bones were there, so next summer he went to the town of Red Deer with his experienced Montana assistants, prepared to follow the watery road of Weston and Lambe. But it was not a simple boat that Brown had built but a large, flat-bottomed scow, big enough to carry not only the men and their equipment, but also the specimens that they might obtain. With this they set off down the river; as usual the run through the canyon was exciting, and at the lower end they swept through a deep narrow channel where a big landslide from the north side had almost dammed the river. The party landed on this slide and examined sandstone blocks containing fossil shells. In one of these they found the jaws and teeth of fossil mammals, the first discovery of Paleocene mammals in Alberta.



*Expedition from the American Museum of Natural History under Dr. Barnum Brown, in the Edmonton badlands of the Red Deer River, 1912. The fossil hunters wear nets for protection against mosquitoes.*  
A.M.N.H., No. 18547.

Soon the scow was floating between badland exposures of the Edmonton formation. Brown, used to the extensive badlands of South Dakota and Montana, thought of the valley as a canyon. Before the short season ended the scow was piled with specimens wrapped in the plaster and burlap casings, the first from Canada to be collected in this manner. In 1911 Brown continued his prospecting of the upper or Edmonton part of the Red Deer section with an equally successful field season. The first part of the summer of 1912 was also spent here, before moving south to the Steeple area. Among the finds made during these two and a half field seasons were the skeleton of a new duck-billed dinosaur (*Saurolophus osborni*), the skull of a new horned dinosaur (*Anchiceratops ornatus*), the incomplete skeleton of another new, and unusually small, "horned" dinosaur (*Leptoceratops gracilis*), partial skeletons of armoured dinosaurs (*Ankylosaurus*), skulls of the flesh-eating dinosaur (*Albertosaurus sarcophagus*), and an incomplete skeleton of a plesiosaur (*Leurospondylus ultimus*), geologically the youngest member of the group discovered up to that time.

Later in the summer of 1912 Brown transferred his operations to the lower or Steeple-Deadlodge Canyon area. Here he must have found the much wider badlands more to his liking. He continued working here each summer until 1915, and gathered an even more impressive collection than that obtained in 1910 and 1911. Highlights of this included two skeletons of the hooded duck-billed dinosaur (*Corythosaurus casuarius*), skeletons of a small duck-billed dinosaur ("*Procheneosaurus*"), the incomplete skull of



Dr. Barnum Brown and the skeleton of a duck-billed dinosaur (type of *Corythosaurus casuarius*), Oldman formation, Red Deer River, 1912. *A.M.N.H.*, No. 18552.

another new duck-billed dinosaur (*Prosaurolophus maximus*), the skull of a new horned dinosaur ("*Monoclonius*" *flexus*) and the complete skeleton of another ("*Monoclonius*" *nasicornus*), the skull and portion of the skeleton of a small armoured dinosaur, two skeletons of the large flesh-eating dinosaur (*Gorgosaurus libratus*), and a fine skeleton of the bird-mimic dinosaur (*Struthiomimus altus*). Some of the dinosaurs obtained from these "Belly River" beds were obviously closely related, and probably ancestral, to those previously found in the younger Edmonton formation, the first convincing demonstration of dinosaurian evolution. The collections obtained by Brown along the Red Deer River from 1910 to 1915, together with those made previously from the Hell Creek beds of Montana, made it possible for the American Museum of Natural History to set up the finest display of Cretaceous dinosaurs in the world.

Brown worked in Alberta with the complete knowledge and approval of the Geological Survey of Canada, but long before his series of expeditions had ended, there was grumbling about the foreigners who were robbing Canada of her prehistoric treasures. This was carping criticism from citizens of a country that had known of these treasures for 26 years before Barnum Brown appeared on the Red Deer River. But the complaints had at least one good result. The Director of the Geological Survey of Canada, Dr. R. W. Brock, rightly decided that the proper course was to compete with, rather than prohibit, the American expeditions. However, there was no one in Canada with the technical skill and experience to equal that of Brown and his colleagues. So the Survey sought the help of C. H. Sternberg

and his three sons, who had achieved fame as the discoverers and collectors of many outstanding fossil vertebrates from the western United States.

Charles Hazelius Sternberg has left us two most valuable accounts of his experiences as a fossil hunter (Sternberg, C. H., 1909, 1917). The first of these deals with his early years and his work before coming to Canada, the second mainly with his expeditions to the Red Deer River in Alberta. He was born in Otsego County, New York, in 1850, the son of a Lutheran clergyman and teacher. When he was 15 years old his family moved to Iowa and later to Ellsworth County, Kansas. Here the future fossil hunter grew up in the exciting environment of the frontier, with herds of wild buffalo not far away, and emigrant wagon trains moving west daily. His first fossil collection was of plants from the Dakota sandstone but in 1876 he became field assistant to Professor E. D. Cope of Philadelphia, then well launched into his brilliant career as a vertebrate palaeontologist and arch-rival of Professor O. C. Marsh of Yale University. After a productive but strenuous period in the Niobrara chalk of Kansas, Sternberg and his assistant, J. C. Isaacs, joined Professor Cope in an expedition to the Judith River badlands of the Missouri River valley of north-central Montana. It was here in 1855 that F. V. Hayden had made one of the first discoveries of dinosaur fossils in North America. A good account of the extraordinary expedition of 1876 has been given by Cushman (1962). Among other incidents, the party just missed being caught by the Sioux and their allies in their retreat from the Little Big Horn battlefield to the sanctuary of Canadian territory. The important thing about this expedition for present purposes is that it introduced Sternberg to dinosaur fossils in a formation and a type of country similar to those in which he was to operate many years later in Alberta.

During the next 35 years Sternberg worked almost exclusively as a collector of fossil vertebrates and his finds became the prized possessions of many museums in the United States and Europe. From about 1900 on he was assisted in the field by one or more of his three sons, of whom we shall hear more later. In the spring of 1912 Sternberg spent some weeks in Ottawa with his son George, mounting specimens that he had sold to the Geological Survey. Subsequently he was appointed to the staff as Chief Collector and Preparator under Lawrence Lambe. In July he began his first field season on the Red Deer River, assisted by his second and third sons, Charles and Levi. Sternberg wisely decided to use both land and water transportation, bringing with him from Kansas his field wagon, and having a row boat built in Calgary. The first camp was set up near Drumheller, and soon his party found their first dinosaur bones.

Later work has shown that the Drumheller vicinity is just outside the richest area for vertebrate fossils in the Edmonton formation. A number of incomplete skeletons were found by the Sternberg expedition of 1912, but the prize was a nearly complete skeleton of a duck-billed dinosaur (subsequently named *Anatosaurus edmontoni*), which was discovered about five miles up Michichi Creek, a stream that comes into the Red Deer at Drumheller from the northeast. Farther up the river, opposite the mouth of Threehills Creek, the skull and part of skeleton of another large duck-billed dinosaur was found (type of *Edmontosaurus regalis*).

In the summer of 1913, Sternberg, accompanied by his sons Charles and Levi and another assistant, Jack McGee, went to Drumheller, where he acquired a motor boat and had a scow built, big enough for two tents. With the scow in tow and son Charles at the tiller of the boat, they set off for the Steeveville area, which they reached after two days of rather exciting travel. At the Steeveville ferry they tied up the scow and had barely started to unload when a preliminary reconnaissance disclosed the skeleton of a large flesh-eating dinosaur (type of *Gorgosaurus libratus*). This discovery, actually made by C. M. Sternberg, was an amazing and promising start. A few days later Levi Sternberg arrived with the wagon and equipment, and in July George joined the field party.

Contacts between the Sternberg and Brown field parties were friendly, but Brown soon moved his camp downstream to the Little Sandhill Creek area. Sternberg would have liked to follow but already he had enough finds near Steeveville to keep his party busy for the summer. In addition to the flesh-eater's skeleton, the discoveries of the year included two fine skulls of duck-billed dinosaurs (one of them the type of *Gryposaurus notabilis*), the skull of a fantastic new horned dinosaur with a frill of spikes (*Styracosaurus albertensis*), a skeleton of a horned dinosaur with skin impressions (*Chasmosaurus belli*), the skull of another new horned dinosaur (*Centrosaurus apertus*), and the shell of a new species of turtle (*Boremys pulchra*). Lambe visited the field camp in September and was greatly impressed with the wealth of material that had been found.

At the beginning of the field season of 1914, Sternberg and his son Charles accompanied a Survey geologist, Dr. D. B. Dowling, to the Judith River badlands of Montana, which he had explored with Cope 38 years before. Oil had been discovered in Alberta, and the pioneer geological work of Dawson was being revised by Dowling and his associates, hence the visit to the classical Cretaceous section along the Missouri. Sternberg enjoyed seeing the changes that had occurred in the region since his previous

Lawrence Lambe and C. H. Sternberg collecting a fossil turtle, Oldman formation, Red Deer River, 1912. National Museum of Canada, No. 25436.

C. H. Sternberg and skull of a horned dinosaur (*Chasmosaurus belli*), Oldman formation, Red Deer River, 1913. N.M.C., No. 25421.







*C. H. Sternberg and G. F. Sternberg setting out on a reconnaissance of Dead Lodge Canyon, 1913. It was on this trip that the elder Sternberg found the skull of the spike-crested dinosaur (*Styracosaurus albertensis*). N.M.C., No. 25441.*

visit, but found no vertebrate fossils worth collecting. However, he did observe bones that proved the presence of hooded duck-billed dinosaurs in the Judith River formation. This led him to some sound comments on the true nature of Leidy's *Trachodon mirabilis* (Sternberg, C. H., 1917, p. 112), which might have been noted with profit by some of the contemporary palaeontologists. After about two weeks he joined his other two sons, who were already at work in the Red Deer River badlands. The first task was to recaulk the seams of the scow. After that, camp was moved to a location below the mouth of "Sand" (Little Sandhill) Creek, in the heart of that part of the badlands known as Deadlodge Canyon. Here George

*L. Sternberg collecting a dinosaur skull (*Prosaurolophus*) in the heart of the Little Sandhill Creek badlands, Red Deer River, 1914. The excavation can be seen just to the right of centre. N.M.C., No. 29056.*



found another, even finer skeleton of the same horned dinosaur (*Chasmosaurus belli*) as had been discovered the previous year near Steeveville. Years later these two skeletons were mounted side by side in the National Museum of Canada. Other outstanding finds of the 1914 season were the well-preserved skull of a duck-billed dinosaur (*Prosaurolophus maximus*), the skull of another horned dinosaur (*Centrosaurus apertus*), the skeleton of a duck-billed dinosaur lacking the skull but showing excellent skin impressions, the incomplete skeleton of an armoured dinosaur (*Euoplocephalus tutus*), and the tail club of another armoured dinosaur.

June of 1915 was spent by Sternberg and his two sons Charles and Levi along Milk River in southern Alberta. Also with the party was Gustav



C. M. Sternberg and L. Sternberg starting to uncover the skeleton of a horned dinosaur (*Chasmosaurus belli*), Oldman formation, Red Deer River, 1914.

N.M.C., No. 29055.

Lindblad, of whom more later. The first World War was on, and C. M. Sternberg had the amusing experience of being mistaken for a law officer searching for deserters along the International Boundary. The first disappointment of the trip was the discovery that the richly fossiliferous patch of badlands exposing rocks of the Two Medicine formation was actually on the Montana side of the Boundary. From Coutts the party moved eastward to the Milk River valley in what is now the Comrey district. It was here that Dawson had found dinosaur remains in 1874. Sternberg's description (Sternberg, 1917, pp. 123–125) of the rocks exposed here, which we now assign to the Foremost and Oldman formations, is excellent, but he found no specimens worth collecting. Years later some good dinosaur material was obtained northeast of here, but the area searched by Sternberg has so far yielded nothing but dissociated bones.

By the end of June Sternberg was back on the Red Deer River. High water delayed the start of operations, but eventually camp was set up. Prospecting was carried out along almost the whole length of Deadlodge

Canyon, from One Tree Creek to Jenner Ferry. The most important discoveries were the skeleton of a duck-billed dinosaur (*Corythosaurus casuarius*), another fine duck-billed dinosaur, but without the skull ("headless wonder"), and some excellent armoured dinosaur material.

On May 31, 1916, before the start of the field season, Sternberg resigned from the Geological Survey of Canada. He may have been getting restless, but the immediate cause of his leaving was a disagreement with Lambe over the plans for field work. His youngest son Levi came with him but George and Charles remained with the Survey. That summer the elder Sternberg, with Levi, worked the badlands immediately southeast of Steveston on behalf of the British Museum (Natural History). Two remarkably well preserved skeletons of duck-billed dinosaurs were found, and with much labour removed and packed. Sternberg's justifiable pride in these fine specimens was turned to sorrow and anger when they were lost in the war-time sinking of the S.S. *Mount Temple*. Some material of minor importance did reach the British Museum in another shipment, a sorry remnant of a rich collection.

Sternberg returned to the Red Deer badlands for the last time in 1917, this time on his own resources and with the assistance of his son Levi. This time they worked the area along Little Sandhill Creek, and again they were fortunate. The collection included the skeleton of a medium-sized flesh-eating dinosaur (type of *Gorgosaurus sternbergi*), the skeleton of a hooded duck-billed dinosaur, and a skull and part of skeleton of a small armoured dinosaur ("*Palaeoscincus*"). Sternberg offered to sell the collection to the British Museum to replace that lost at sea, but the Trustees were discouraged with the results of the previous year and declined the offer. So the flesh-eater and the armoured dinosaur were sold to the American Museum of Natural History, and the duck-billed dinosaur went to the San Diego Museum of Natural History in California, where it was mounted under Sternberg's direction.

With the departure of C. H. Sternberg from the Red Deer badlands, and with Barnum Brown having completed his work there in 1915, the most exciting period for dinosaur hunting in Canada came to a close. From now on the collectors had to search much harder to find things that their predecessors had missed. With one or two exceptions nothing remained to be found that was as spectacular as the specimens discovered between 1910 and 1917. For some years after leaving Canada Sternberg made his home in California, from which base he continued to make expeditions to the fossil fields. His most notable were several trips to the Upper Cretaceous of the San Juan Basin, New Mexico. In later years he came back to Canada and lived with his son Levi in Toronto, where he died in 1943, at the age of 93.



## *The Search Continues, 1917 to 1965*

The two elder sons of Charles H. Sternberg, i.e., George F. Sternberg and Charles M. Sternberg, remained with the Geological Survey of Canada after the departure of their father and younger brother. It will be more convenient to describe separately the explorations of these two brilliant fossil finders, even though this will mean some chronological repetition.

George Friar Sternberg had already begun independent field work in 1915, working in the Edmonton formation, but north of the area visited by his father and brothers in 1912. He began west of Rowley, and continued in the field for four months. At the end of the season he examined the miniature badlands along Battle River, southeast of Camrose, but found nothing important. The large collection obtained this year from the Red Deer River valley included the fine skull of a hooded duck-billed dinosaur (*Hypacrosaurus altispinus*), previously known from the skeleton without skull found by Barnum Brown. Also obtained were two skulls of a small duck-billed dinosaur, which Lambe made the types of a new genus and species (*Cheneosaurus tolmanensis*).

In 1916 George Sternberg returned to the Edmonton beds, extending his search farther south. He obtained the skeleton of a large, flat-headed, duck-billed dinosaur; this and the skull collected in 1912 were made the types of another new genus and species (*Edmontosaurus regalis*). Also found this year was the skeleton of a bird-mimic dinosaur (type of *Ornithomimus edmontonicus*) and some armoured dinosaur material.

George remained in Ottawa in 1917, preparing specimens collected during the previous years. With no prospect of field work in 1918 he resigned about the middle of the year. In 1920 he returned to the Red Deer River on his own resources, working in the Oldman formation near Little Sandhill Creek. His finds this year included the skull of a hooded duck-billed dinosaur (*Corythosaurus excavatus*), the skull of a horned dinosaur (*Chasmosaurus kaiseni*), and a beautifully preserved skeleton of a soft-shelled turtle (*Aspideretes allani*). At the close of the season Professor John A. Allan of the University of Alberta arranged to purchase the collection for the Department of Geology of that institution, and to engage George's services for the year to prepare the specimens for exhibition. He remained at Edmonton during the academic year 1920–21, and the following summer he returned to the Red Deer River valley and the badlands around Little Sandhill Creek. This year he collected a nearly complete skeleton of a hooded duck-billed dinosaur (*Corythosaurus*) and the skull and incomplete skeleton of a flesh-eating dinosaur (*Gorgosaurus libratus*), but the most important specimen was the beautifully preserved skull and incomplete skeleton of a small dinosaur with enormously thickened cranial bones. This thickened mass had been turning up as an isolated fossil for years and had been described by Lambe (*Stegoceras validus*), but now for the first time the appearance and relationships were revealed of this astonishing little dinosaur.

This season of 1921 George Sternberg became the first dinosaur collector on the Red Deer River to have his work recorded in motion pictures. This happened by a curious error. The Dominion Motion Picture Bureau, predecessor of the National Film Board of Canada, had decided to make a short motion picture based on the work being done by the Geological Survey of Canada in the collecting and displaying of Canadian dinosaurs. The camera party sent to Alberta was naturally supposed to visit the Geological Survey party under Charles M. Sternberg, but local directions sent them to the camp of George Sternberg. So this excellent little film records field work by the University of Alberta party and preparation being done at the National Museum of Canada in Ottawa.

That winter George Sternberg continued the preparation of the specimens obtained during the two preceding field seasons, but in the spring he resigned to accept a position with the Field Museum of Natural History of Chicago, under Elmer S. Riggs. The summer of 1922 was the last time that the eldest of the Sternberg sons worked on the Red Deer River, his collection going to Chicago. However, he returned to Edmonton for several months in 1935, to complete the preparation of the collection that he brought together in 1920 and 1921.

When George Sternberg left the Geological Survey of Canada in 1918, the only one of the four Sternbergs remaining at Ottawa was Charles Mortram Sternberg, the second son of C. H. Sternberg. Actually, Charles had his first independent expedition to the Red Deer badlands in 1917,

*C. M. Sternberg and G. E. Lindblad working on the skull of a horned dinosaur (Centrosaurus sp.), Oldman formation, Red Deer River, 1917. N.M.C., No. 39994.*



when he worked in the Little Sandhill Creek area. Principal finds of that year were the skull of a hooded duck-billed dinosaur (type of *Lambeosaurus lambei*) and of a horned dinosaur (type of *Centrosaurus longirostris*), and the incomplete skeleton of an armoured dinosaur (type of *Panoplosaurus mirus*). He was back in the Little Sandhill Creek area in 1919. Most of the finds of that year were of duck-billed dinosaurs (*Corythosaurus excavatus*, *C. intermedius*, type of *Lambeosaurus magnicristatus*).

Lawrence Lambe, in charge of vertebrate palaeontology for the Geological Survey of Canada, died on March 12, 1919. The administration of his programme was taken over by Dr. E. M. Kindle as Chief of the Palaeontology Section. But more and more C. M. Sternberg began to assume the role of scientist as well as of collector and preparator. His first scientific paper appeared in 1921, a supplement to Lambe's unfinished description of an armoured dinosaur (*Panoplosaurus mirus*).

Sternberg resumed field work in 1921 with a visit to the Morgan ("Rocky") Creek badlands south of Wood Mountain, Saskatchewan, where he relocated the fossiliferous "Lance" beds (Frenchman formation) discovered by Dawson in 1874, and obtained remains of the characteristic horned dinosaur (*Triceratops*), as well as the fine skull of a new duck-billed dinosaur (type of *Anatosaurus saskatchewanensis*). After shipping the collection he moved back to the Little Sandhill Creek area of the Red

*Personnel of four expeditions gathered at the camp of C. M. Sternberg, Little Sandhill Creek, Red Deer River, 1917. STANDING, LEFT TO RIGHT: R. L. Rutherford, assistant to Allan, P. A. Taverner, ornithologist, C. M. Sternberg, C. H. Young, assistant to Taverner, C. H. Sternberg, Dr. J. A. Allan, geologist. SEATED LEFT TO RIGHT: cook (C.H.S.), assistant (C.H.S.), Bruce McKee, assistant to C. H. Sternberg. L. Sternberg, senior assistant to C. H. Sternberg, took the picture. N.M.C., No. 40000.*



Deer badlands. Discoveries listed for this part of the field season are the skull and incomplete skeleton of a flesh-eating dinosaur (*Gorgosaurus libratus*), the skeleton without skull of a small duck-billed dinosaur, the skull of a hooded duck-billed dinosaur (*Corythosaurus*) and the skull of a horned dinosaur (*Centrosaurus*). By the end of this season he had prospected most of the badlands from Little Sandhill Creek to the lower end of Dead Lodge Canyon. This year Sternberg used an automobile as well as a team and wagon, the beginning of the progressive replacement of the dinosaur hunter's traditional means of transportation.

After a year that included a reconnaissance of fossil localities in the Maritime Provinces, C. M. Sternberg returned to the Red Deer River in 1923, this time to the Edmonton formation as exposed north of Drumheller. An area northward from the Munson ferry was explored, and among the discoveries was a fine skeleton with skin impressions of the duck-billed dinosaur (*Edmontosaurus regalis*), unfortunately lacking the skull. Next summer (1924) he was back in the area, extending his prospecting to the vicinity of Morrin ferry and northward. Two more duck-billed dinosaurs (*Edmontosaurus*, *Anatosaurus*) were represented among the finds, as well as two horned dinosaur skulls (including type of *Anchiceratops longirostris*), an armoured dinosaur (type of *Edmontonia longiceps*) and a skeleton of the bird-mimic dinosaur (*Ornithomimus*).

By 1925 his exploration of the Edmonton formation had reached the vicinity of Tolman ferry, west of Rowley. In this area he was beginning to get into the upper Edmonton beds, which he later showed to carry a distinct (Lancian) dinosaur fauna, the last dinosaurian assemblage. From these beds he obtained the skeleton of a small dinosaur (*Thescelosaurus edmontonensis*) related to the ancestors of the duck-billed dinosaurs. The last season of this four-year programme, that of 1926, was spent in the Red Deer valley west of Big Valley, where the skulls of two duck-billed dinosaurs (*Saurolophus*, *Hypacrosaurus*) were found, as well as two incomplete skeletons of the bird-mimic dinosaur (*Ornithomimus*), and the incomplete skeleton of a flesh-eating dinosaur (*Albertosaurus*).

After an absence of one year, C. M. Sternberg returned to the west in 1928. First he went to southwestern Saskatchewan, where F. H. McLearn was mapping and measuring the late Cretaceous and early Tertiary formations. Following up a find by H. S. Jones of Eastend, an enthusiastic amateur fossil hunter, Sternberg obtained remains of the characteristic horned dinosaur (*Triceratops*) of the latest Cretaceous (Lancian) stage from the beds then known as Lower Ravenscrag (later renamed the Frenchman formation). From here he returned to the Red Deer valley, this time in the vicinity of Steeveville ferry, where he had begun his long run of discoveries in 1913. Many other excellent collectors had also been over this area of badlands, but by very careful and systematic coverage Sternberg and his assistants were able to find a number of important specimens, including the skeleton of a hooded duck-billed dinosaur (type of *Lambeosaurus clavinatalis*), the skull of a small hooded duck-billed dinosaur (type of *Tetragonosaurus cranibrevis*), and the skull and part of skeleton of a horned dinosaur (paratype of *Chasmosaurus russelli*). Also,

in a small area south of the Steeveville ferry he obtained the hind feet of two small flesh-eating dinosaurs (types of *Macrophalangia canadensis* and *Stenonychosaurus inequalis*).

In 1929 Sternberg was again in southern Saskatchewan, helping McLearn to date the late Cretaceous and early Tertiary formations. In 1930 he had a memorable trip to the canyon of the Peace River in north-eastern British Columbia, where a large number of dinosaur tracks had been found in the Lower Cretaceous rocks (Gething member of the Bull-head Mountain formation). It was not possible to quarry out many of the original footprints, but Sternberg made a number of plaster moulds in the field, from which replicas in plaster or concrete were subsequently cast.

From 1931 to 1935 the "Great Depression" was at its worst in Canada. Scientific projects were supported by governments only if they seemed to have direct economic importance, and hunting dinosaurs was not one of these. In 1935 it was decided that the occurrences of the many important specimens in the Steeveville-Deadlodge Canyon area ought to be more accurately recorded, and the Geological Survey of Canada undertook a detailed topographical survey of the area. The mapping was carried out with great skill by F. P. DuVernet, and Sternberg collaborated by finding and identifying sites of fossil discoveries. This work he continued in 1936. Each site was not only located by instrumental survey, but was permanently marked by a brass plate set in an iron pipe and concrete base. This project culminated in the publication of the Steeveville sheet (Map 969A, Geological Survey of Canada), which not only shows the location of the sites on the map but also gives an annotated list of the finds themselves, compiled by Sternberg. The field season of 1936 was not entirely devoted to locating sites. A number of fossils were collected, including the skull of a new duck-billed dinosaur (type of *Brachylophosaurus canadensis*).

The summer of 1937 was spent by Sternberg in the Manyberries and Comrey districts of southeastern Alberta, where, as noted below, L. S. Russell had found good vertebrate fossils in the upper part of the Oldman formation. Besides the skeleton of a large duck-billed dinosaur from east of Manyberries, Sternberg found two skulls of a horned dinosaur (*Monoclonius lowei*) of a type previously known only from the Judith River formation of Montana.

During the years of World War II, field work in vertebrate palaeontology was again suspended. But in 1946 Sternberg was able to return to the Red Deer River, this time to resume his explorations of the Upper Edmonton beds west of Big Valley. Here he definitely established the very late Cretaceous (Lancian) age of these beds by the discovery of a skull of the characteristic horned dinosaur (type of *Triceratops albertensis*). During this summer he also visited southwestern Alberta, and in beds corresponding to the lower part of the Edmonton formation, on Little Bow River east of Carmangay, he found the skull of an extraordinary dinosaur (type of *Pachyrhinosaurus canadensis*), related to the horned dinosaurs but having instead of horns a large oval platform on the top of the face. The summer of 1947 was spent in the Upper Edmonton beds. At a site 13 miles north-east of Elnora, just about the extreme northern end of the Red Deer

badlands, Sternberg and his assistant T. P. Chamney found three beautifully preserved skeletons of a small dinosaur (*Leptoceratops gracilis*) previously known from fragmentary material found by Barnum Brown. This little dinosaur was related to the horned dinosaurs but had no horns. It was a survivor of the generalized stock from which the horned dinosaurs were derived, and it is curious that there were several of these relics of earlier stages in dinosaur evolution still existing at the very close of the Age of Dinosaurs.

This was C. M. Sternberg's last expedition for the Geological Survey of Canada. In 1948 the responsibility for research and display in vertebrate palaeontology was transferred from the Geological Survey to the National Museum of Canada. At the beginning of 1950 there was a complete administrative separation of the two institutions that had been together in one form or another since 1842. Sternberg retired officially on October 16, 1950, but continued to prepare descriptions of dinosaur fossils in the Museum's collection.

About 1956 the Government of Alberta adopted the idea of creating a park out of the Steeple-Deadlodge Canyon badlands. Sternberg was engaged as a consultant, and by 1957 had seen most of his ideas accepted. Roy L. Fowler, an Alberta farmer and amateur palaeontologist, was appointed Park Warden, and in 1958 work on the installations was begun. That summer Sternberg located two incomplete skeletons near the mouth of Little Sandhill Creek, and these were prepared for display in place. Small houses were built over them, with windows to permit inspection by visitors. In 1965 Sternberg returned to the Park to supervise the collecting and setting up for display of a good skeleton of a hooded duck-billed dinosaur (*Lambeosaurus magnicristatus*), which had been discovered by Fowler.

Sternberg was elected a fellow of the Royal Society of Canada in 1949 and was awarded the degree of LL.D. in 1960 by the University of Alberta, Calgary. These honours were in recognition not only of his many remarkable discoveries in the fossil fields of Alberta and his scientific descriptions of the finds, but also of the fact that he had clearly recognized the biological and geological significance of his discoveries.

Before concluding this account of the work of C. M. Sternberg, mention should be made of three outstanding assistants who worked with him. Joseph Skillen was a permanent member of his staff and accompanied him in the field on several expeditions. However, his forte was laboratory work, and he skillfully prepared and mounted a number of dinosaur specimens in the National Museum of Canada. James E. J. Thurston of Calgary worked with Sternberg from 1923 to 1926. He was a keen student of vertebrate fossils and would have become a distinguished collector and museum worker but he died in 1932 after joining the palaeontological staff of the California Institute of Technology. Harold Lowe of Drumheller was a member of many of Sternberg's field parties from 1924 to 1937. Although not specially interested in palaeontology, he was a good fossil finder and a skillful field worker.

The youngest of the three Sternberg sons, Levi Sternberg, made many



important discoveries as a member of his father's expeditions up to 1917, but he is best known for his long and fruitful association with the Royal Ontario Museum, University of Toronto. This institution was late in getting into the field, but thanks to the dedication and skill of the persons concerned it has today the finest display of dinosaurs in Canada and one of the six or seven most important collections of Cretaceous dinosaurs in the world.

Palaeontological collections in the early days at the University of Toronto were assembled by both the Department of Biology and the Department of Geology (Fritz, 1939). In 1908 Professor B. A. Bensley, a distinguished zoologist, visited the Red Deer River badlands near Berry Creek and obtained what was for those days a fairly good collection, including the incomplete skull of a duck-billed dinosaur. Meanwhile Professor W. A. Parks, of the Department of Geology, was building up an impressive collection of invertebrate fossils, housed in the Mining Building. To this was added in 1910 the skeleton of a mosasaur (*Platycarpus coryphaeus*) from the Cretaceous of Kansas, purchased from C. H. Sternberg.

The Royal Ontario Museum was established in 1912 by the Provincial Government as an adjunct of the University of Toronto. For many years it consisted, in theory at least, of five separate museums housed in the one building, but each with its own Director. William Arthur Parks (Moore, 1937), the first Director of the Royal Ontario Museum of Palaeontology, was born in Hamilton, Ontario, in 1868, and graduated from the University of Toronto in 1892. In 1893 he joined the staff of the Department of Geology of that institution, beginning an association that was to last until his retirement in 1936. He did field work in Precambrian and Palaeozoic rocks, and wrote a monumental work on the building and ornamental stones of Canada. He was a fine teacher, and trained a number of graduate students who became distinguished geologists. As a palaeontologist he is best known for his research on that mysterious group of Palaeozoic fossils known as stromatoporoids, but his later work on Cretaceous dinosaurs contributed much to his reputation.

For some years the vertebrate fossils in the University of Toronto collection consisted almost entirely of fossil fishes, to which was added the mosasaur skeleton mentioned above. With the opening of the Royal Ontario Museum building in 1914 it became possible to plan for additional large specimens. Already in 1912 Dr. Parks had sent out one of his staff, Professor Alexander McLean, to collect in the Edmonton formation near Munson ferry. But Professor McLean was inexperienced in this kind of collecting and obtained only isolated bones or fragments, in spite of the large number of fine specimens that came out of this area subsequently.

In 1918, with the help of his friend, Sir Edmund Walker, Dr. Parks obtained a grant to permit him to conduct a modest expedition to the Red Deer River valley. Accompanied by an assistant, Robert Wilson, he prospected the area around Little Sandhill Creek, and discovered a short distance to the southeast the nearly complete skeleton of a duck-billed dinosaur (type of *Kritosaurus incurvimanus*). In spite of inexperience, Parks and Wilson took up the specimen without any serious damage. That winter the preparation of the specimen was begun, but it was soon evident

that someone with more experience would be needed to complete the work properly and in a reasonable period of time. So Levi Sternberg was engaged as head collector and preparator, working directly under Dr. Parks.

Sternberg joined the R.O.M. staff too late in 1919 to do much more than prepare for the new field season. Dr. Parks and he, with several assistants, set up camp five miles below Little Sandhill Creek. Although Parks was in charge, he and Sternberg each had his own assistant and prospected independently. Parks found an incomplete skeleton which turned out to be the skull with fore limb and part of the vertebral column of a horned dinosaur (*Centrosaurus apertus*). He was very pleased to have this representative of a second group of dinosaurs, and he and his assistant spent most of their time on the specimen. Meanwhile Sternberg's prospecting had located the skeleton of a duck-billed dinosaur (*Corythosaurus intermedius*) subsequently displayed as an open mount, the incomplete skeleton of another duck-billed dinosaur (*Lambeosaurus*), and the tail club of an armoured dinosaur. Parks returned to Toronto after collecting his horned dinosaur, and Sternberg operated on his own for the rest of the season.

During the winter of 1919–20 Sternberg, assisted by Wilson, completed the preparation and mounting of the skeleton obtained by Parks in 1918. This was placed on display with suitable ceremony, and such impressive evidence of results made it easier to obtain support for subsequent collecting expeditions. In the spring of 1920 Wilson left the Museum staff, and Sternberg was able to bring in his brother-in-law, Gustav Lindblad, who had worked with the Sternbergs on the Geological Survey of Canada since 1915, except for absence on war service. This year Sternberg was in charge of the expedition, an arrangement that continued from then on, although Parks visited the field camps when he could. It is interesting that the dignified and rather aloof professor of the campus became in the field the most congenial of campmates.

The expedition of 1920 worked the same general area as that of the previous year, about five miles east of Little Sandhill Creek. The outstanding find of this season was the nearly complete skeleton of a duck-billed dinosaur in which the hood was drawn out as a great scimitar-like crest extending back over the neck and shoulders (type of *Parasaurolophus walkeri*). The only other known relics of this strange dinosaur are a few skull fragments. This was a particularly good year for duck-billed dinosaurs, the collection also including the skulls or incomplete skeletons of four other individuals (*Lambeosaurus*, *Corythosaurus*, *Tetragonosaurus*). For variation, there was the incomplete skeleton with tail club of an armoured dinosaur (type of *Dyoplosaurus acutosquameus*).

In 1921 the technical staff was increased by the addition of Ralph R. Hornell, who is now the chief collector and preparator in vertebrate palaeontology at the R.O.M. Hornell was from Toronto, with little experience of camp life and none in palaeontology, but he quickly adapted himself to both and became not only a good field worker, but also a successful finder of fossils, not always the same thing. Once again the area east of Little Sandhill Creek was explored. Several more or less complete duck-billed dinosaur skeletons were collected, including one that was later placed on exhibition (*Prosaurolophus maximus*).





Royal Ontario Museum expedition of 1921, Red Deer River near Little Sandhill Creek.  
LEFT TO RIGHT: two assistants, Chinese cook, G. E. Lindblad, L. Sternberg, Dr. W. A. Parks (visiting).  
N.M.C., No. 46586.

Collecting was shifted to the Edmonton formation in 1922. A fourth man was added to the permanent staff, John Rickett of Toronto. The northern Red Deer River badlands were explored from the vicinity of Big Valley to the area around Morrin ferry. Specimens collected included the skull of a hooded duck-billed dinosaur (*Hypacrosaurus*), the incomplete skull of a horned dinosaur (*Anchiceratops*), and the almost complete skeleton of a small dinosaur related to the duck-billed dinosaurs (*Parksosaurus warreni*). The last is remarkable in that much of the backbone of the tail is reinforced by a lattice of ossified tendons, which must have made this appendage more or less rigid, a curious condition in a small dinosaur.

Levi Sternberg was given a year's leave of absence from the R.O.M. in 1923. His father, although 71 years of age, had begun in 1921 a successful programme of fossil collecting in the Upper Cretaceous of the San Juan basin, New Mexico. With his son's help he continued work here in 1923. Meanwhile the palaeontological expeditions of the R.O.M. were continued under the leadership of Lindblad. In 1923 and 1924 the area between Morrin and Munson ferries was explored. The best find of 1923 was the almost complete skeleton of a large duck-billed dinosaur (*Edmontosaurus regalis*). The type of a new horned dinosaur (*Arrhinoceratops brachyops*) was also found, and the skeleton of the hind limbs and pelvic region of a flesh-eating dinosaur (type of *Albertosaurus arctunguis*). In 1924 another duck-billed dinosaur skeleton was obtained (*Anatosaurus edmontoni*). Also noteworthy in the collection of that year was the skeleton of the hind legs and pelvis of a bird-mimic dinosaur (type of *Struthiomimus brevitertius*).

Sternberg returned to the R.O.M. in 1924 and in 1925 led an expedition to a Pleistocene locality in Saskatchewan. In 1926 he was back with his staff in the Red Deer River badlands, working the area around Steeveville. Here he collected an incomplete skeleton of a bird-mimic dinosaur (type of

*Struthiomimus samueli*), the nearly complete skull of which revealed for the first time the cranial structure of such dinosaurs. Also collected were the skull of a duck-billed dinosaur (*Lambeosaurus*) and three more or less complete skeletons of horned dinosaurs. One of these (*Chasmosaurus belli*) was subsequently prepared as an open mount, and another was later described as a new species (type of *Chasmosaurus brevirostris*).

In 1927 Sternberg and Rickett visited the Oligocene mammal-bearing localities of the Cypress Hills, but bad weather and poor results caused them to move back to Steveville. Here they collected a duck-billed dinosaur skeleton (*Lambeosaurus*), which was sent in exchange to the Los Angeles County Museum. Better success in adding to the Museum's collection of fossil mammals resulted from two field seasons in the Tertiary rocks of Nebraska and Wyoming. But in 1930 the R.O.M. field party was back on Little Sandhill Creek. This was a particularly successful season. The duck-billed dinosaur specimens obtained included the skull and part of skeleton of a new species (type of *Tetragonosaurus praeceps*). Two other incomplete skeletons were found, as well as skulls and parts of skeletons of two horned dinosaurs (*Centrosaurus*, *Chasmosaurus*).

A return to the Edmonton beds near Munson ferry in 1931 resulted in the collecting of skulls of a duck-billed dinosaur (*Edmontosaurus*) and a horned dinosaur (*Anchiceratops*), and a fine skeleton of a bird-mimic dinosaur (type of *Struthiomimus currellii*). But in 1933 the hunting in this area proved poor, so the R.O.M. party moved back to Steveville. Here they obtained the skeleton of a flesh-eating dinosaur (*Gorgosaurus libratus*), subsequently mounted for display, and the skull and part of a skeleton of a hooded duck-billed dinosaur (type of *Corythosaurus bicristatus*). Exploration of the Little Sandhill Creek area was extended farther south in 1934. Several skulls of duck-billed dinosaurs were obtained (*Corythosaurus casuarius*, type of *Corythosaurus frontalis*, *Kritosaurus*). Other finds were the skull of a horned dinosaur (*Centrosaurus*) and the disarticulated skull of a flesh-eating dinosaur (*Gorgosaurus*).

In 1935 the R.O.M. party worked the area several miles east of Little Sandhill Creek. A well preserved skull and incomplete skeleton of an armoured dinosaur (*Edmontonia rugosidens*) was one of the prizes, but the most remarkable discovery was of a dinosaur that was not new at all. In 1913, C. H. Sternberg, prospecting far afield from his main area of work, found the skull of the spike-frilled horned dinosaur (*Styracosaurus albertensis*), which became one of the most striking exhibits in the National Museum of Canada. Nearly 22 years later, Levi Sternberg prospected the same locality and found that in the interval the shifting of a small stream had exposed additional bones. When these were more fully uncovered they were found to represent the remainder of the skeleton of the same individual whose skull had been collected by the Geological Survey party. Even the missing lower jaw was with the new material. Some years later this specimen was exchanged with the National Museum of Canada for the skeleton of an armoured dinosaur found by George Sternberg in 1914, and the remains of this almost unique horned dinosaur are now together in the same institution, although only the skull is on display.

The retirement and death of Dr. Parks in 1936 brought to a temporary halt the programme of field work in vertebrate palaeontology. In 1937 the present writer was appointed Assistant Director, in charge of vertebrate palaeontology. Slowly a programme of field work was re-established, only to be halted again by the Second World War. It was not until 1948 that full-scale field work in vertebrate palaeontology in western Canada was resumed and 1950 before this was directed toward the search for dinosaurs. In that year Levi Sternberg, with Hornell and Allan Weare, reopened the bone bed in the Upper Milk River beds in Deadhorse Coulee, in the Milk River area. This site, as noted below, was discovered and worked by the writer in 1934. The results were not very exciting, and the expedition went on to examine the Oldman formation in the badlands near Lost River, which had been explored by the writer and by C. M. Sternberg. Again the finds were disappointing. Sternberg's last expedition to the dinosaur fields was in 1954. He was accompanied by Dr. A. G. Edmund, now Curator of Vertebrate Palaeontology, and by Hornell. Camp was first established on Little Sandhill Creek, and the area to the southeast was prospected. Later the base was moved to the edge of the badlands three miles to the east. Much wet weather interfered with prospecting and collecting, but four skulls of duck-billed dinosaurs were obtained, representing three different genera (*Corythosaurus*, *Tetragonosaurus*, *Prosaurolophus*).

Levi Sternberg retired from the staff of the Royal Ontario Museum in 1962 with the rank of Associate Curator. Since then, he has retained an interest in the display programme of the Museum and has participated in special projects where his talents and experience have contributed to the production of outstanding exhibits.

The work of William E. Cutler as a collector of dinosaurs belongs to both the pre- and post-1917 periods. He was an Englishman of some education who had a "homestead" near the Deadlodge Canyon area. In 1912 he began prospecting the adjacent badlands and discovered the incomplete skeleton of a horned dinosaur with good skin impressions (type of "*Monoclonius*" *cutleri*). When Barnum Brown arrived with his field party to work this area, Cutler offered the uncollected specimen to him in exchange for employment and an opportunity to learn the techniques of fossil collecting. It is also said he stipulated that if the specimen proved to represent a new species, it would be named "*cutleri*". This was actually done by Brown but without any dedication. It appears that Cutler, a somewhat eccentric person, did not get along well with Brown and his staff, and was not re-engaged in subsequent field seasons.

In 1913 Cutler persuaded a group of business and professional men in Calgary to organize the Calgary Syndicate of Prehistoric Research for the purpose of supporting his fossil collecting in the Red Deer River badlands. One of his finds that year was the skeleton of a small duck-billed dinosaur, which was partly prepared, and exhibited for some years in the original Calgary Museum. Not properly protected, it suffered much damage from the public, but was eventually obtained for the National Museum of Canada by an exchange for another skeleton more suitable for display (*Corythosaurus casuarius* collected by C. H. Sternberg in 1915). In 1914

Cutler found his most important specimen, the nearly complete skeleton of an armoured dinosaur with most of the armour in place (type of *Scolosaurus cutleri*). This was collected near the eastern end of the Deadlodge Canyon badlands and was sold to the British Museum (Natural History). Its preparation was delayed due to the First World War, but it was finally placed on exhibition in 1925 (Swinton, 1929). It is displayed so that one sees the skeleton on one side as if from below, and on the other side the dorsal armour as if seen from above. The arrangement of the armour in transverse rows, like the scutes of an armadillo, is very strikingly demonstrated.

Cutler was away on military service for several years, but he returned to the Steeple badlands in 1919. This time he was on his own resources. So when he found most of the skeleton of a horned dinosaur, he had to uncover it and take it up alone. He made camp nearby and worked on through autumn and winter. When he failed to appear at Steeple for supplies, the local people found him seriously ill in his tent and had to remove him to the village where he could recover. Eventually, however, he removed and boxed the specimen. It was stored for years in Calgary, and as far as I know was part of the residue of the Cutler collection acquired by the Calgary Zoological Society.

Cutler left Calgary for Winnipeg in 1922, and obtained a position in the Department of Geology, University of Manitoba. His rank was that of assistant, but he was popularly known as Professor Cutler, because of the lectures that he gave on dinosaurs. Early in 1924 he went to England, where he took charge of an expedition from the British Museum (Natural History) to collect dinosaur remains from the Lower Cretaceous deposits of Tanganyika. His assistant was a young Englishman from Kenya, L. S. B. Leakey. Cutler worked hard and scorned the recognized health precautions of tropical Africa, so it was not surprising that after eight months he came down with malaria and complications, from which he died in Lindi at the age of 42. W. E. Cutler was an enthusiastic and successful fossil collector, and it was unfortunate that his little eccentricities and pretensions prevented him from getting the support that his ability and dedication deserved.

The work of Lindblad has been mentioned in several of the preceding pages. Gustav Eric Lindblad was born in Norrbyskar, Sweden, in 1897 and came to Canada with his family in 1906. He joined the staff of the Geological Survey of Canada in 1915 as assistant to C. H. Sternberg and was in the field that year. He served in the Canadian Army during the First World War and after returning to the Geological Survey he transferred in 1920 to the staff of the Royal Ontario Museum. Here he served for years as senior assistant to Levi Sternberg, and accompanied him on most of his expeditions. As mentioned previously, Lindblad was in charge of the expeditions of 1923 and 1924, which successfully worked the Edmonton beds near Munson ferry. He left the Royal Ontario Museum in 1951 to become Chief Collector-Preparator in vertebrate palaeontology for the National Museum of Canada. His first expedition for this institution was to the Tertiary of Saskatchewan, but in 1953 he returned to the Red Deer River badlands with H. L. Shearman and Michael Herniak and

prospected the Little Sandhill Creek area. Principal finds were the skulls of a duck-billed dinosaur and a horned dinosaur. He extended his search in 1954 to the area southwest of Steeveville. The following year (1955) he was in the Munson ferry area, the scene of his expeditions of 1923 and 1924. But good specimens were no longer easy to find here and it was not until near the end of the field season that the skeleton of a large duck-billed dinosaur (*Edmontosaurus*) was discovered. It lay at the base of a steep cliff, high above the valley floor, and time did not permit collecting of more than the skull.

This was Lindblad's last season in the field. Ill health forced him to remain in the laboratory in 1956 and subsequent years, and to retire in 1962. He died in Toronto the same year. Although most of his discoveries were made while serving as assistant to others, he did lead six expeditions, and demonstrated an ability to organize and direct field parties as well as to find and collect important specimens.

Wann Langston, Jr., joined the staff of the National Museum of Canada as vertebrate palaeontologist in 1954. He had trained under J. W. Stovall at the University of Oklahoma and under C. L. Camp and R. A. Stirton at the University of California. During the summer of 1955 he accompanied Russell on a reconnaissance of the fossil vertebrate localities of western Canada. His first independent expedition in Canada was in 1956, to the Edmonton beds near Munson ferry, where he collected the duck-billed dinosaur skeleton found the previous year by Lindblad. Because of its position at the base of a cliff, and high above the valley floor, the collection of this specimen presented unusual difficulties. Much of the overburden had to be removed with the use of explosives, and the plastered sections lowered down steep slopes. Next year (1957) Langston worked the bone bed at Scabby Butte rediscovered by Russell in 1955. Much interesting but dissociated material was obtained, including additional skulls of the ram-headed dinosaur (*Pachyrhinosaurus*).

Tantalizing occurrences of bone in the Foremost and lower Oldman beds of southern Alberta led Langston in 1958 to explore these exposures but without important results. However, Mr. Luke Lindoe of Medicine Hat showed Langston a find in the upper Oldman beds near Irvine, the same locality visited by Weston in 1884. This turned out to be the articulated skeleton of a horned dinosaur (*Chasmosaurus*). The summer of 1959 was spent on the marine Bearpaw shales in the valley of the South Saskatchewan River, collecting incomplete plesiosaur and mosasaur remains. Next year (1960) a few weeks were spent in Alberta, following up leads of previous years. A trip the same year to the Permian of Prince Edward Island led to a full season of work there in 1961. Langston's last expedition for the National Museum of Canada was in 1962, when he worked the Frenchman formation (Lancian) of the Morgan Creek area of southern Saskatchewan. This is the area discovered by Dawson in 1874 and collected from by C. M. Sternberg in 1921. In spite of difficulties with weather, and vehicle breakdowns, Langston found and collected a good skeleton of the characteristic horned dinosaur (*Triceratops*). The following year he left the National Museum of Canada to join the staff of the Texas Memorial Museum in

Austin, but at this writing he is still working on the descriptions of some of his Canadian finds.

The field work of L. S. Russell, the writer of this account, has been concerned mainly with stratigraphy and mammalian palaeontology. In 1934, while working for the Geological Survey of Canada along Milk River in southern Alberta he discovered two bone beds in the Upper Milk River beds in Deadhorse Coulee. This stratigraphical subdivision lies well below the Oldman formation, separated by the brackish-water Foremost and the marine Pakowki formations. The specimens obtained gave a tantalizing glimpse of a dinosaurian fauna that both resembles and differs from that of the Oldman formation. The continuation of this geological survey eastward in 1935 and 1936 permitted some exploration of the Oldman exposures along Milk River and in the area adjacent to Lost River valley. At a locality near the top of the formation the skull of a new horned dinosaur (type of *Chasmosaurus russelli*) was found and collected (1936). This discovery led to the exploration of the area in 1937 by C. M. Sternberg, with results previously mentioned.

After joining the staff of the Royal Ontario Museum Russell led an expedition in 1939 to the Tertiary and Cretaceous of southwestern Saskatchewan. He was assisted by Lindblad and by Brian Hall. From the Frenchman formation southwest of Shaunavon the party collected the incomplete skeleton of a horned dinosaur (*Triceratops*), previously discovered by the farmer on whose land it occurred. Russell's reconnaissance of 1955 with Langston for the National Museum of Canada has been mentioned; during a visit to Scabby Butte he relocated the bone bed and uncovered a skull of the ram-headed dinosaur (*Pachyrhinosaurus*), which he and Langston collected. This is the site worked by Langston in 1957. Russell's current project is the examination of the Paleocene and Upper Cretaceous of the Swan Hills area of northern Alberta. Numerous occurrences of dissociated dinosaur bones and teeth offer some promise of significant discoveries yet to come.



# The Future

The story of dinosaur hunting in western Canada is not finished. Specimens are still waiting to be found. In 1965 a field party from the University of Alberta, under C. R. Stelck, found duck-billed and horned dinosaur remains near Tolman ferry. There must be hundreds of fine specimens lying just a few feet beneath the exposed surfaces of Oldman and Edmonton rocks, waiting for erosion to reveal them to the future fossil hunter. But discoveries will be infrequent, and luck, the circumstance of being at the right place at the right time, will play an important part in success.

Today we are at the beginning of a new pioneer period and perhaps a new golden age in the collecting of fossil vertebrates. The scene will be the western Canadian Arctic. The Upper Cretaceous rocks of the Mackenzie region and the Lower Cretaceous and Upper Jurassic of the Arctic Islands are known to contain good skeletal remains. The collector here will have to learn his business all over again. The logistics are peculiar and require much more careful planning. In transportation the airplane and the helicopter replace the team and wagon and the four-wheel-drive truck. The techniques that have worked so well in the south are not suited to permafrost and Arctic gales. But ingenuity and experimentation will solve the problems and in a few years there will be a whole new story to tell of collectors and their discoveries in the fossil fields of northwestern Canada.

## REFERENCES

BROWN, BARNUM, 1919

*Hunting big game of other days: A boating expedition in search of fossils in Alberta, Canada.* Natl. Geogr. Mag., vol. 35, no. 5, pp. 407-429, 25 figs.

CUSHMAN, DAN, 1962

*Monsters of the Judith: Dinosaur diggings of the West provided competitive arena for fossil discovery.* Montana, the Magazine of Western History, vol. 12, no. 4, pp. 18-36, 15 figs.

DAWSON, G. M., 1875

*Report on the geology and resources of the region in the vicinity of the forty-ninth Parallel, from the Lake of the Woods to the Rocky Mountains with lists of plants and animals collected and notes on the fossils.* Brit. North Amer. Boundary Comm. Montreal, Dawson Brothers; 379 pp., 19 pls., 2 maps.

——— 1883

*Preliminary report on the geology of the Bow and Belly River regions, North-West Territory, with special reference to the coal deposits.* Geol. and Nat. Hist. Surv. Canada, Rept. of Progress for 1880-81-82, part B, pp. 1-23, 3 pls., 1 map.

- FRITZ, M. A., 1939  
*Outline of the history and development of the Royal Ontario Museum of Palaeontology.* Contrib. Roy. Ontario Mus. Palaeont., No. 1, 19 pp., 3 pls.
- HANSON, GEORGE, 1942  
*Richard George McConnell (1857–1942).* Roy. Soc. Canada, Trans., ser. 3, vol. 36, pp. 97, 98, 1 pl.
- HARRINGTON, B. J., AND H. M. AMI, 1902  
*George Mercer Dawson.* Roy. Soc. Canada, Trans., ser. 3, vol. 8, sec. 4, pp. 183–201.
- LEWIS, G. E., 1964  
*Memorial to Barnum Brown.* Bull. Geol. Soc. Amer., vol. 75, pp. P19–P27, 1 pl.
- LOUDON, W. J., 1930  
*A Canadian geologist.* Toronto, Macmillan Co. of Canada Ltd.; 257 pp., frontisp.
- MCCONNELL, R. G., 1885  
*Report on the Cypress Hills, Wood Mountain and adjacent country, embracing that portion of the District of Assiniboia, lying between the International Boundary and the 51st Parallel and extending from Lon. 106° to Lon. 110° 50'.* Geol. and Nat. Hist. Surv. Canada, Ann. Rept. (new series), vol. 1, part C, pp. 1–85, pls. 4–6, maps 3, 4.
- MCINNES, WILLIAM, 1920  
*Lawrence Morris Lambe.* Proc. Roy. Soc. Canada, ser. 3, vol. 13 (1919), pp. viii, ix, 1 pl.
- MOORE, E. S., 1937  
*Memorial of William Arthur Parks.* Geol. Soc. Amer., Proc., 1936, pp. 229–236, 1 pl.
- OSBORN, H. F., AND L. M. LAMBE, 1902  
*On Vertebrata of the Mid-Cretaceous of the North West Territory.* Geol. Surv. Canada, Contrib. Canadian Palaeont., vol. 3, part 2, 81 pp., 24 text-figs., 20 pls.
- PARSONS, J. E., 1963  
*West on the 49th Parallel: Red River to the Rockies 1872–1876.* New York, William Morrow & Co.; 208 pp., illus.
- SELWYN, A. R. C., 1883  
*Summary reports of the operations of the geological corps to 31st December, 1881, and to 31st December, 1882.* Geol. and Nat. Hist. Surv. Canada, Rept. of Progress for 1880–81–82, pp. 1–45.
- STERNBERG, C. H., 1909  
*The life of a fossil hunter.* New York, Henry Holt & Co.; 286 pp., 43 pls.
- 1917  
*Hunting dinosaurs in the bad lands of the Red Deer River, Alberta, Canada. A sequel to The life of a fossil hunter.* Lawrence, Kansas, C. H. Sternberg; 232 pp., 53 pls.



STERNBERG, C. M., 1946

*Canadian dinosaurs*. Natl. Mus. Canada, Bull. no. 103, 20 pp.,  
4 figs., 17 pls.

SWINTON, W. E., 1929

*A Canadian armoured dinosaur*. Nat. Hist. Mag., Brit. Mus. (Nat.  
Hist.), vol. 2, no. 10, pp. 67-74, figs. 1-3.

WESTON, T. C., 1899

*Reminiscences among the rocks in connection with the Geological  
Survey of Canada*. Toronto, Warwick Bro's & Rutter; 328 pp.,  
15 pls.

#### GENERAL WORKS ON DINOSAURS

COLBERT, E. H., 1945

*The dinosaur book; the ruling reptiles and their relatives*. New  
York, Amer. Mus. Nat. Hist., Handbook no. 14; 156 pp., 90 figs.

SWINTON, W. E., 1934

*The dinosaurs; a short history of a great group of extinct reptiles*.  
London, Thomas Murby & Co.; 288 pp., 25 pls.





© 1994

LIBRARY  
**ROYAL ONTARIO MUSEUM**







