Mesozoic Vertebrate Life in Alberta and British Columbia

Philip J. Currie
Curator of Paleontology
Provincial Museum of Alberta
Alberta, Canada

ALBERTA HAS LONG BEEN KNOWN as one of the world's important sites for dinosaurs. More than 500 major specimens have been excavated here, enriching the collections of more than thirty institutions around the world. The "great dinosaur rush" of Alberta ended fifty years ago. However, paleontology programs were set up in the mid-1960s at the University of Alberta and the Provincial Museum of Alberta, and the amount and significance of material recovered in Alberta has been increasing steadily since that time.

The Provincial Museum of Alberta has been successful in the past few years in collecting dinosaurs. In 1976, a partial skeleton of *Hadrosaurus* was excavated from the Oldman Formation exposures along the Milk River. A partial skeleton of *Edmontosaurus* was collected in 1977 from the banks of the Red Deer River. The back half of the skeleton was articulated, but towards the front of the specimen the bones were disarticulated and broken. Only a few pieces of the skull were found. Six broken carnosaur teeth were found among the broken bones. Carnosaur teeth are common in the area, but their concentration, together with the condition of the anterior portions of the skeleton, suggests that carnosaurs may be responsible for the large number of "headless wonder" hadrosaur skeletons discovered.

The University of Alberta collected several specimens of hadrosaurs and the ceratopsian dinosaur *Centrosaurus* at Sandy Point, about 70 miles north of Medicine Hat, in 1973, 1974, and 1975. Two hadrosaurs that they decided not to collect were brought to the attention of the Provincial Museum. One of them, a well preserved skeleton with a partial skull, was collected in 1978, while the second was picked up in 1979. In addition to these, the Provincial Museum collected a partial *Centrosaurus* skeleton and two partial skulls of *Centrosaurus* in 1978 and 1979. The prize specimen was found by Michael Benton (University of Newcastle-Upon-Tyne): a beautiful skull and partial skeleton of *Prosaurolophus*, excavated in 1978 and 1979. The exposures at Sandy Point are not very extensive, but are as rich as those in Dinosaur Park.

In 1978, a partial skeleton of a small ornithopod was collected in the Lost River badlands near the United States border. It is significant because of its small size, and because it has well preserved skin impressions of the sacral, caudal, and leg regions.

Dinosaur Provincial Park will be the major center for our field work for at least the next five years. In 1979, a lambeosaurine skeleton was collected near the entrance to the Park. A new skull cap of *Stenonychosaurus*, a small theropod, was found, and a visit to an old quarry resulted in the discovery of a few more phalanges of *Stenonychosaurus* specimen NMC 12340 (Russell, 1969). A more remarkable find was made by Gilles Danis. He discovered and collected for the Provincial Museum the partial skeleton of a dromaeosaurid, probably *Dromaeosaurus* itself. Until now the postcranial skeleton of *Dromaeosaurus* was poorly known, though apparently similar to that of *Deinonychus* (Colbert and Russell, 1969). The partial skeleton includes a coracoid, eight bones from the manus, an ilium, an ischium, a femur, a tibia and six bones from the pes. The sacrum was also recovered, and is made up of *six* fused vertebrae. The manus is similar to that of *Chirostenotes*, but sufficiently different to suggest that *Chirostenotes* and *Dromaeosaurus* should not be synonymized.

In addition to the richness of articulated dinosaur skeletons, Dinosaur Provincial Park is rich in bone beds. None of these beds was systematically worked in the past. One of the major projects initiated in the Park in 1979 was the beginning of a systematic excavation of a two-acre bone bed. At the end of the first summer's work, only about 5% of the area had been worked. More than 95% of the material examined in the worked section can be attributed to *Centrosaurus*. To date, a minimum of 18 individuals have been identified by counting orbital horn cores. Fourteen braincases have been collected. Although it is premature to make any definite statements, the sorting of the material suggests that ceratopsians traveled in large herds. This is reinforced by what is known of other bone beds in Alberta. About one mile from this bone bed is another that has so far yielded some seven individuals of the ceratopsian *Styracosaurus*. Sternberg in 1970 reported the occurrence of another *Styracosaurus* bone bed on the other side of the Red

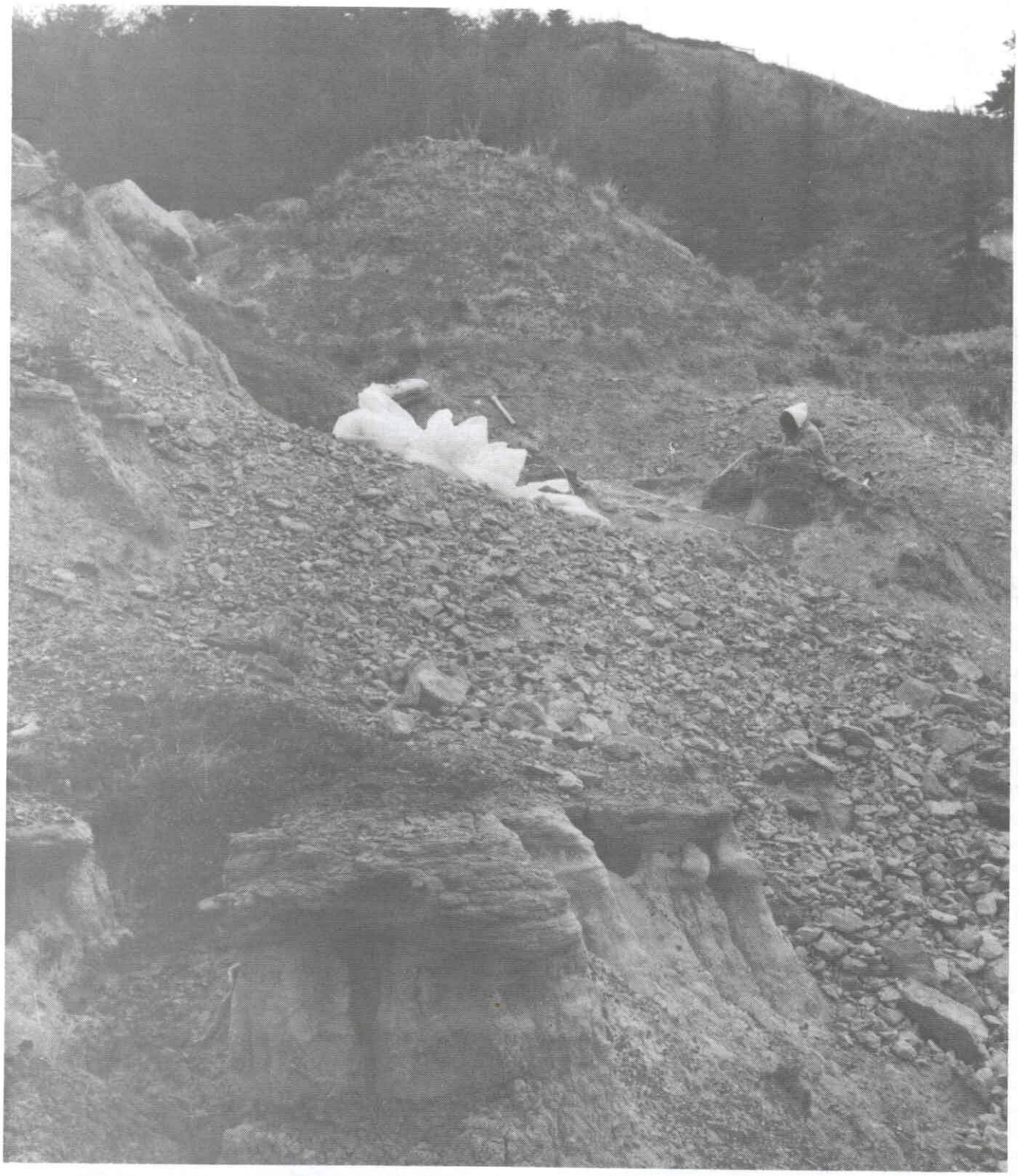


Figure 1. Excavating a hadrosaur skeleton (Edmontosaurus) from the Edmonton Formation near Big Valley, Alberta, June 10, 1977. Linda Strong in picture, taken by Philip J. Currie, Provincial Museum of Alberta. (PMA PN 77.47.41)

Figure 2. Trackways of large, carnivorous dinosaurs in the Peace River Canyon, British Columbia. Picture taken May 14, 1978 by Susanne Swibold, Provincial Museum of Alberta. (PMA PN 78.2.93)

Deer River, and noted that there were several *Centrosaurus* bone beds in the same vicinity. Finally, he referred to an *Anchiceratops* bone bed near Drumheller, and a *Pachyrhinosaurus* bone bed at Scabby Butte. In future years we will be investigating some or all of these other ceratopsian bone beds in an attempt to see if ceratopsians were susceptible to mass deaths. Preliminary examination of the bone beds makes one suspect that there was no difference between the environment where the *Centrosaurus* bones were deposited from that where the *Styracosaurus* bones were buried. In addition to giving us further insights into the herding of horned dinosaurs, the *Centrosaurus* bone bed provides the Provincial Museum with an excellent collection of bones for research, display, and comparative studies. As there are juvenile specimens one sixth the size of adults, we hope we may also end up with an unbiased sample for studies of population structure.

The 1979 field season saw the initiation of a survey program in Dinosaur Park. Many promising specimens were found, and more than 1,000 isolated finds were catalogued. These include a second record of a pterosaur, *Stegoceras* skull caps, and microvertebrates. The Provincial Museum has also acquired the collections that have accumulated in the Park over the years, and is in the process of cataloguing the best material.

Over the past few years, a number of interesting specimens have been donated to us by amateur collectors. Wall and Galton in 1979 established a new genus and species of pachycephalosaurid dinosaur,

Gravitholus albertae, on the basis of a specimen given to us by Ted Malach. Hope Johnson gave the Provincial Museum a pachycephalosaurid frontal from the Oldman Formation that was from a flat-headed form similar to *Homalocephale* of Mongolia. The type specimen of the small theropod *Saurornitholestes* (Sues, 1978) was found by Irene Vanderloh. Finally, Shirley Lawson donated the ungual of a small theropod which is unlike any other ungual that I have seen. The articulation with the penultimate phalanx is not on the proximal surface of the ungual, as it usually is, because the tubercle for the flexor ligaments has grown underneath it.

In 1975, construction started on a dam in the Peace River Canyon near Hudson's Hope, British Columbia. On October 6, 1979, the canyon, and a rich dinosaur footprint locality, were inundated. The site was worked first by C. M. Sternberg in 1930, who in 1932 described six new genera of dinosaur footprints. A. G. Edmund led a party into the canyon in 1965, and made moulds of two trackways for the Royal Ontario Museum. We learned in 1976 that the canyon was going to be flooded, and made our first collecting trip. The expedition was very successful, giving us good display and research material. We mapped one bedding plane of about 30 square meters that had more than 150 footprints on it. At the end of that expedition, it became obvious that we had tapped very little of the available resources. Major expeditions followed in 1977, 1978, and 1979, each succeeding one being more intensive. By the end of the last expedition, almost 70 footprints had been collected,

Figure 3. Cutting out a pair of dinosaur footprints. Peace River Canyon, British Columbia. Carl Kortmeyer, Ron Solkoski, Dan Garsonnin in picture, taken May 14, 1978 by Susanne Swibold, Provincial Museum of Alberta. (PMA PN 78.2.79)

Figure 4. Making a mould of a dinosaur trackway. Details of the tracks are preserved in a rubber mould made by painting liquid latex on the rocks. The mould will not hold its shape, however, unless it has a stiff backing. This is provided by making a fiber glass jacket. Jim Perras, Philip Currie, Dale McInnes in picture, taken May 21, 1978 by Susanne Swibold, Provincial Museum of Alberta. (PMA PN 78.2.124)

moulds had been made of more than 100 of them, and over a thousand footprints in trackways had been mapped and measured. At the time of flooding there were at least several hundred more footprints that we did not have time to document, and stretches of the canyon that had never been searched.

The footprints are significant for many reasons. The most common type, *Amblydactylus*, was made by hadrosaurs. They are identical to prints found in Alberta and Utah. The *handprints* are the key identifying feature, however. It is known from "mummified" specimens of hadrosaurs found in Alberta and Wyoming that the manus was encased in an integumentary sheath, and it would have left the kind of handprint that is found in the Peace River Canyon. A very rare footprint type, *Tetrapodites*, was identified by Sternberg as possibly having been made by a ceratopsian dinosaur. The same type of print has been found in the Edmonton Formation of Alberta. A third type of footprint, as yet unnamed, was recovered in the last week of the last expedition. More than a hundred small (length less than 4 cm.) footprints were recovered on a single slab of rock. These footprints exhibit all the characteristics of bird tracks, and are very similar to those left by modern shorebirds. The smallest dinosaur footprints that we have are about 10 cm. in length, and are quite different in basic structure and in the way that they are associated in trackways. It therefore seems to be most logical to interpret the smallest prints as being those of birds, although we cannot yet eliminate the supposition that they may have been made by an

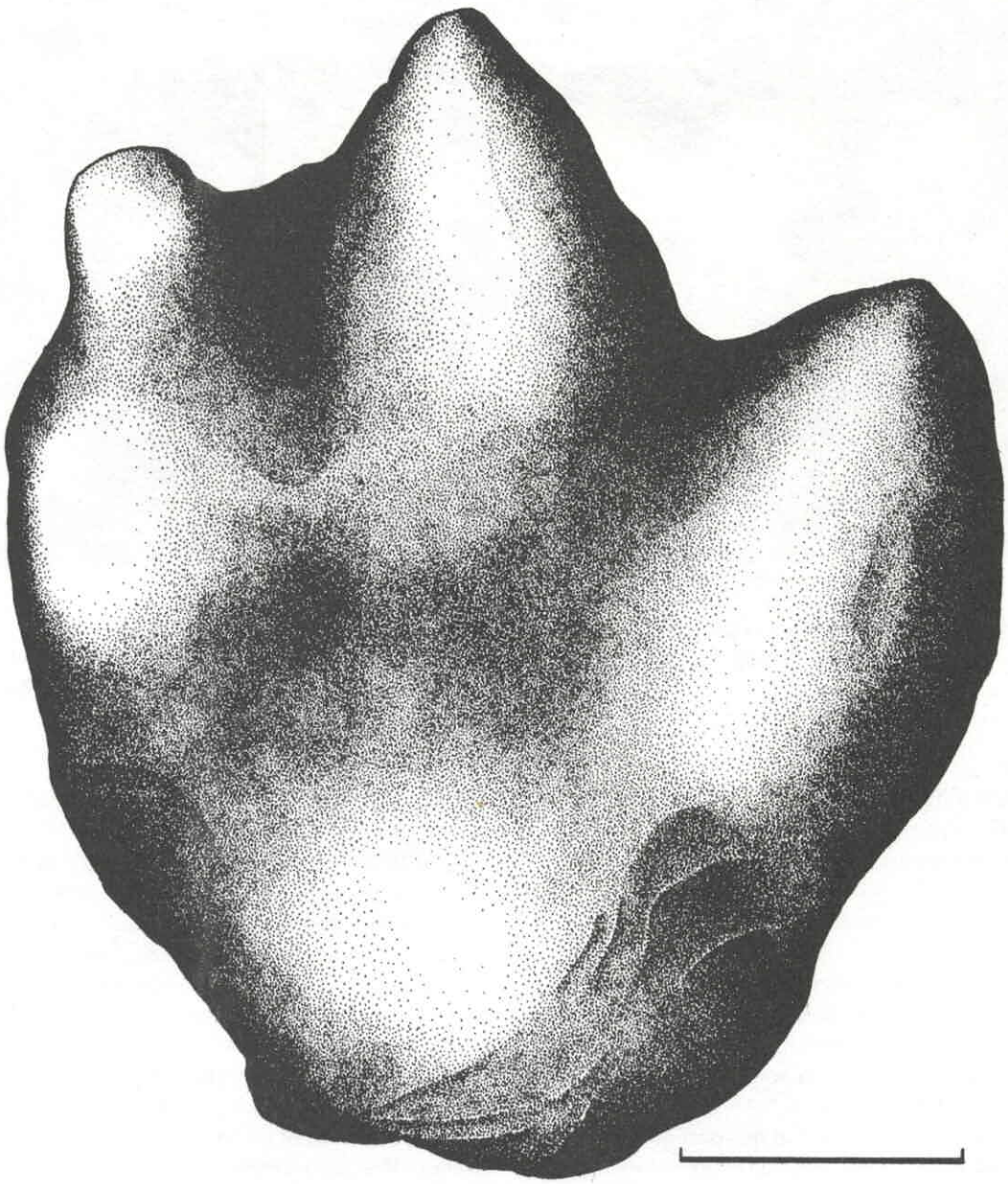
Figure 5. Excavating a dinosaur trackway, Peace River Canyon, British Columbia. The plastic tent in the background is protecting a latex mould from precipitation while it dries. Dan Garsonnin, Philip Currie, Jim Perras, Dale McInnes, Carl Kortmeyer in picture, taken May 21, 1978 by Susanne Swibold, Provincial Museum of Alberta. (PMA PN 78.2.152)

unknown form of dinosaur. The occurrence of hadrosaur prints, possible ceratopsian prints, and possible bird prints is of interest because of the age of the beds. Strata of the Peace River Canyon have been dated by macroflora, microflora, and foraminifera, and by marine fossils in overlying beds, as being no younger than early Albian (Lower Cretaceous) in age. The footprints are the earliest known records of hadrosaurs, and possibly of ceratopsians. The bird-like prints could well be the earliest record of bird footprints and one of the earliest records of birds

Another interesting aspect of the Peace River footprints is the occurrence of growth series. Four trackways have been identified as made by baby hadrosaurs, and a baby footprint of *Irenesauripus mclearni* has also been recovered. With the large numbers of specimens in the canyon, we may be able to say something about the population structure of dinosaurs that is quantitatively significant.

The main significance of the Peace River Canyon footprints is the fact that they occur in *trackways*. The trackways give us insights into the behavior and activity levels of dinosaurs. They show that hadrosaurs traveled in herds, and suggest that the animals walked side by side rather than in clumps. Baby hadrosaurs appear to have walked in groups of animals of the same size. Many of the footprints were made by swimming animals just touching bottom. The large carnivorous dinosaurs seem to have hunted in small packs, and appear to have been equally at home in shallow water and on the shoreline. Small

Figure 6 (above). Diagram of the dinosaur trackway displayed in Figure 2, by Linda Strong. Scale is 3 meters. Figure 7 (below). Drawing of a "negative footprint"—a natural mould of a footprint, or a natural cast of a dinosaur foot—of Amblydactylus **(probably a hadrosaur), found in the Peace River Canyon, British Columbia. Drawing by Elizabeth Garsonnin; scale is 15 cm.**



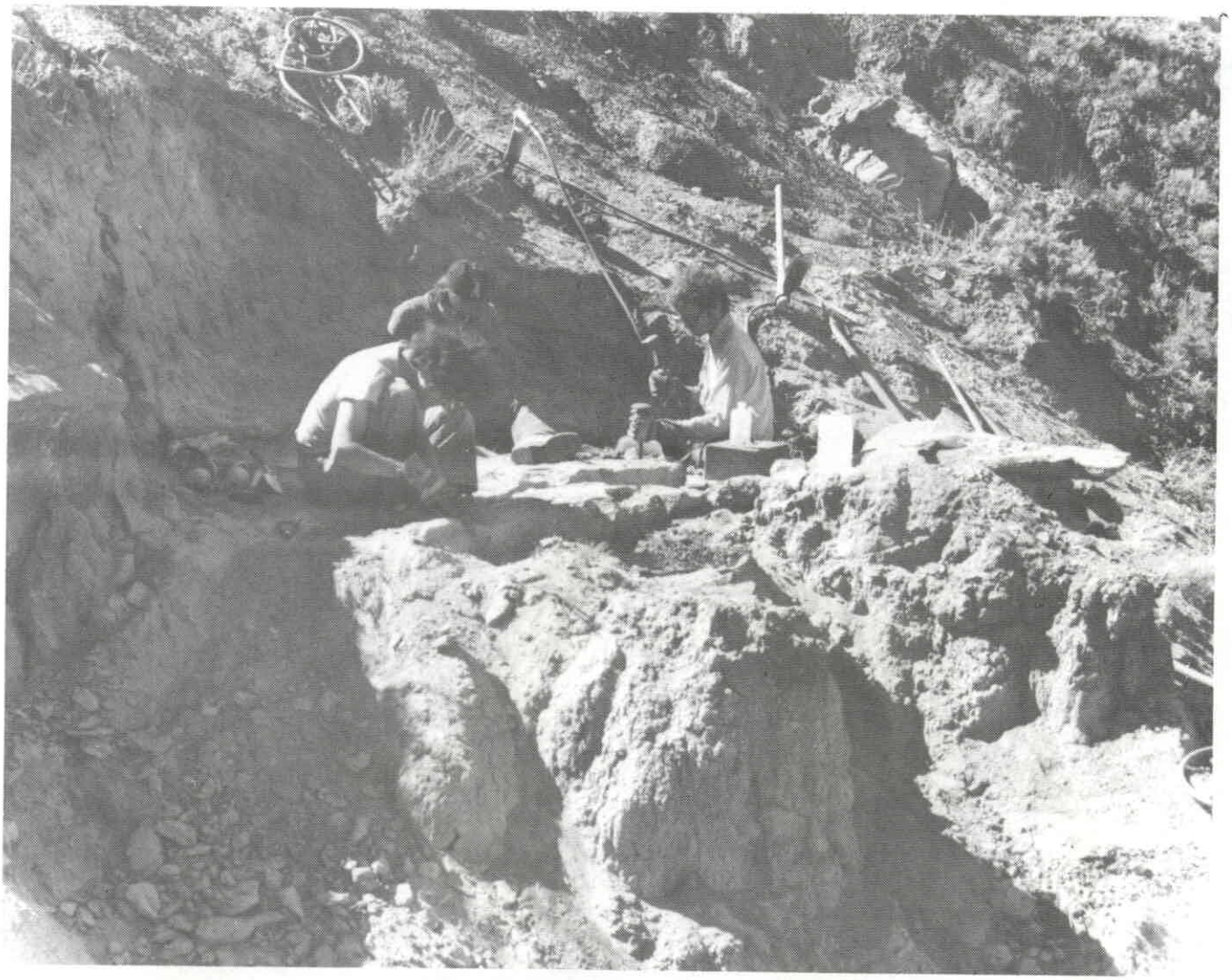


Figure 8. Excavating a hadrosaur skeleton at Sandy Point, north of Medicine Hat, Alberta, July 11, 1978. Michael Benton, Tom Dunk, Dale McInnes in picture, taken by Linda Strong, Provincial Museum of Alberta. (PMA PN 78.8.7)

carnivores appear to have traveled in groups as well. None of the trackways indicates high activity levels, although the carnivores are obviously more agile and quick than the herbivores. The data are currently being analyzed to determine the maximum and minimum speeds of the animals.

We are now aware of ten sites in Alberta and British Columbia where dinosaur footprints have been found. These span the time period between the Upper Jurassic and Upper Cretaceous. One rather spectacular site located on the Alberta-British Columbia border may show that hadrosaurs were present in this part of the world as early as the end of the Jurassic. This is the only site where the footprints are preserved in long trackways, and the only site where we anticipate doing any extensive work in the next few years.

The future looks good for Cretaceous research in Alberta. The next five years will see an intensive study and collection program in Dinosaur Provincial Park. The Park was recently listed by UNESCO as a World Heritage Park, and this is giving the impetus to develop a major interpretive and research center there. For at least the next five years, the Provincial Museum will coordinate a massive multidisciplinary study and collection program in Dinosaur Provincial Park, in collaboration with the National Museum of Canada and the University of Calgary. We have excellent prospects for excavation at Dinosaur Park, Sandy Point, and near Drumheller.

There are promising sites near the United States border and in the northern part of the province that will be systematically explored over the next few years. And Alberta's oil sands are being developed! The oil sands are extensive subsurface deposits that were laid down during the Lower Cretaceous. Logs, leaves, and twigs are frequently recovered from the oil sands, preserved because they were "pickled" in the oil. The only vertebrate material recovered so far has been fish teeth, but I am confident that eventually dinosaurs of exceptional preservation will be recovered. ★

More pictures on the following five pages.►

Figure 9. Caudal vertebrae of a hadrosaur excavated at Sandy Point, July 11, 1978. Picture taken by Tom Dunk, Provincial Museum of Alberta. (PMA PN 78.8.12)

Figure 10. Badlands of Dinosaur Provincial Park near the Centrosaurus bone bed, July 25, 1978. Picture taken by Philip J. Currie, Provincial Museum of Alberta. (PMA PN 78.22.8)

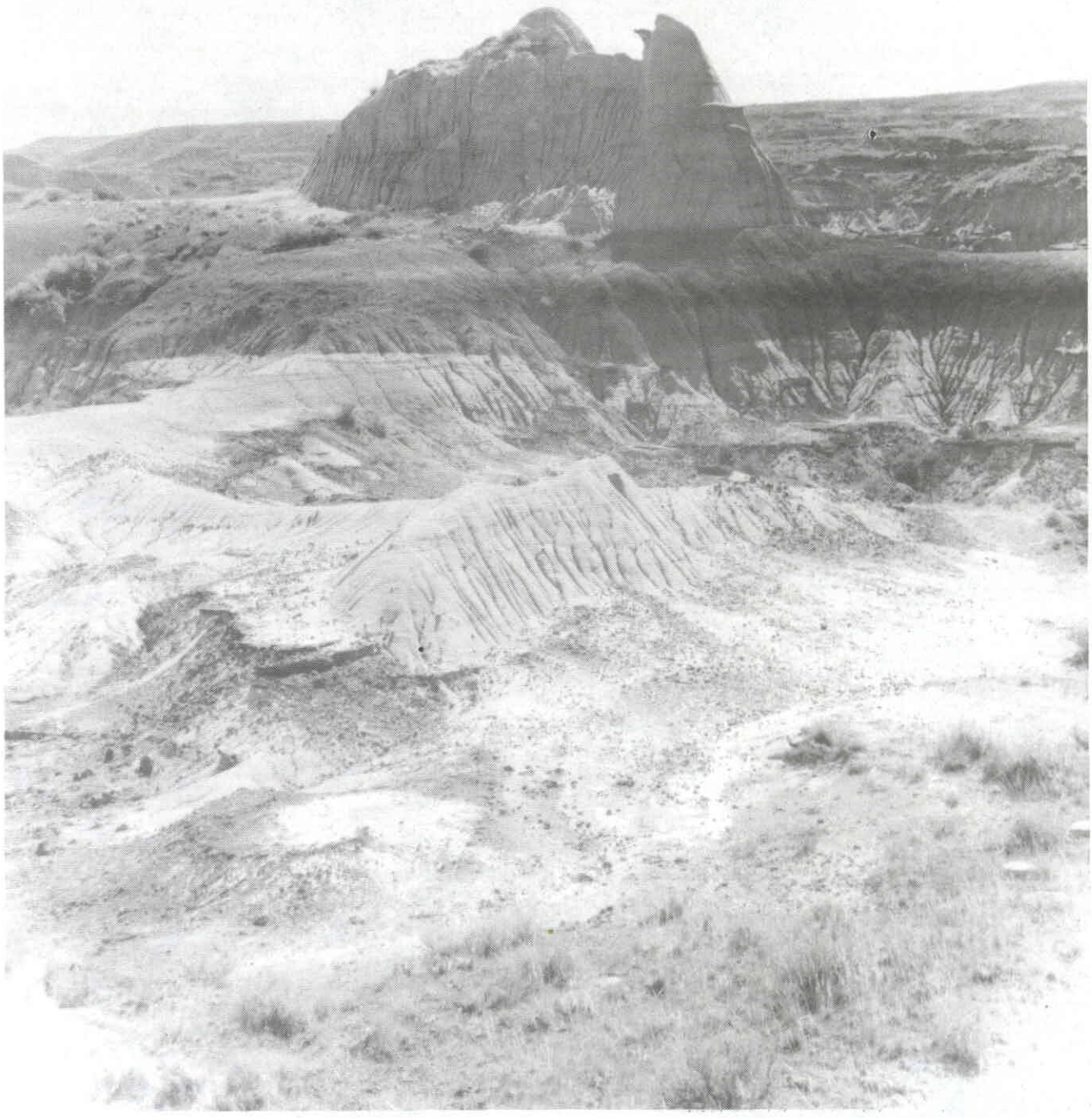


Figure 11. Centrosaurus **bone bed, Dinosaur Provincial Park, July 25, 1978. Picture taken by Philip J. Currie, Provincial Museum of Alberta. (PMA PN 78.22.7)**

◄Figure 12. Because of the short field season, dinosaur skeletons are not excavated bone by bone, but are taken out in large blocks that include a great deal of rock matrix. This is one block of twelve that encase a hadrosaur skeleton excavated at Sandy Point. It has been turned over in preparation for completing the plaster and burlap jacket. Michael Benton in picture, taken August 10, 1978 by Philip J. Currie, Provincial Museum of Alberta. (PMA PN 78.24.10)

Figure 13. When a block is overturned, some rock can be removed from underneath the fossil bones to lighten the jacket. Once the block has been lightened as much as it is practical, the plaster and burlap jacket is completed. Dale McInnes in picture, taken August 10, 1978 by Philip J. Currie, Provincial Museum of Alberta. (PMA PN 78.24.12)

Figure 14. Excavating a bone bed at Sandy Point, August 10, 1978. Dale McInnes and Yvon Brown in photograph, taken by Philip J. Currie, Provincial Museum of Alberta. (PMA PN 78.24.3)

Figure 15. Gilles Danis and jackhammer at the site of the small theropod dinosaur, taken August 21, 1979 by George Olshevsky. (GO 9806-2)

Figure 16. Hind limb elements of the small theropod dinosaur in situ, taken August 23, 1979 by George Olshevsky. (GO 9796-9)