Excavating British Columbia's first dinosaurs and other palaeontological projects in the Tumbler Ridge area

Richard T. McCrea
University of Alberta

Lisa G. Buckley
South Dakota School of Mines and Technology

INTRODUCTION

In June of 2002, a prospecting trip in the Quality Creek canyon was organized by the Tumbler Ridge Museum Foundation (TRMF). This trip, which was led by the first author and Charles Helm, turned up a substantial deposit of fossil bones of dinosaurs and other vertebrates (McCrea, 2003) as well as a number of fossil footprints and trackways. The bones represent the first significant find of dinosaur skeletal remains in the province of British Columbia (Helm, 2002; McCrea, 2003). The first bones were found in a large sandstone block (Quality Block A or "Main Block") next to Quality Creek at the bottom of a steep-sided canyon. Several bones and bone fragments were exposed along the sides of Block A. Most were not identifiable, but a vertebra, a fibula and ribs were identified (McCrea, 2003). It was evident that the sandstone block was not *in situ* and had slid down from its former position in the wall of the nearby cliff face. Several other large sandstone blocks littered that side of Quality Creek and were found to possess fossil material as well, for a total of twenty exposed bones. Prior to this find only two dinosaur bones had been reported from British Columbia. One possible hadrosaur foot element was found in southeastern British Columbia (Sampson and Currie, 1996) and one (yet to be prepared) *in situ* bone was discovered in the Tumbler Ridge area near an ankylosaur trackway along Flatbed Creek (Helm, 2002; McCrea, 2003).

In the days following the dinosaur bone discovery, efforts were made to determine the original stratigraphic position of the bone-bearing slabs in the cliff face. Several bones were quickly found *in situ*, high above the fallen bone-bearing blocks. They were entombed within a similar matrix as the bones within the fallen slabs. Additional finds of fossil bone were made a hundred or so metres downstream from the original discovery, as well as in a couple localities in the opposite banks. These finds demonstrate that the bone-bearing horizon is laterally continuous, but not on the same scale or density as is found in many localities in Alberta. However, these bones are much older than any others found in western Canada and are quite significant.

The bones in the fallen blocks are encased within coarse-grained sandstone held together by a calcium carbonate ($CaCO_3$) cement, making the rock impervious to the ordinary hand picks and chisels which would normally be used at Dinosaur Provincial Park and Dry Island, Alberta. It was decided that no excavation would take place in 2002. Instead, all of the exposed bones were stabilized and the most vulnerable bones were capped so that they would be protected until a proper excavation could be mounted in the summer of 2003. It was agreed that the excavated bones would remain in Tumbler Ridge if possible, however, there were several obstacles to hurdle. The TRMF did not possess any

equipment (or funding for the purchase of equipment) needed for the excavation. Due to the nature of the locality and the matrix enclosing the bones there would be need for some fairly extreme equipment (hard picks & chisels, wedges, air scribes and air hammers). At that time there was no place to store the bones in Tumbler Ridge, never mind facilities to prepare and study them once they were excavated and recovered from the canyon.

The TRMF under the newly elected President Carolyn Golightly and Vice-President Charles Helm took responsibility for the excavation and began an impressively successful organization and funding campaign, converting a small volunteer group into a highly effective and focused palaeontology research team. The TRMF not only raised a very substantial amount of funding for the excavation, they also raised money for an immensely successful Dinosaur Camp as well as funding and materials for the display of Tumbler Ridge area fossils. The TRMF also played a large role in getting significant sites in the area some form of protective status through various B.C. government branches (McCrea, 2003) and arranged for the summer 2003 excavation permits through Land and Water BC.

Figure 1. Mr. Larry White learning to prepare bones at the Royal Tyrrell Museum of Palaeontology.

The TRMF appointed the first author as project leader for the excavation and the second author as excavation coordinator. With the advice of several friends and colleagues (most notably the majority of the research and technical staff of the Royal Tyrrell Museum of Palaeontology: Phil Currie, Don Brinkman, Dave Eberth, Darren Tanke, Marilyn Laframboise, Kevin Aulenback, Kevin Kruger, Mark Mitchell and Jim McCabe) a viable excavation approach was formulated and an equipment list was drawn up. Furthermore, on the petition of the TRMF and the first author, the Royal Tyrrell Museum of Palaeontology granted Mr. Larry White (an excavation volunteer and representative of the TRMF) the opportunity to obtain field excavation and laboratory preparation experience over a period of several weeks prior to the Quality Creek excavation (Figure 1).

GEOLOGICAL CONTEXT AND PRELIMINARY PRESERVATIONAL INTERPRETATION

The main block (Quality Block A) is one of at least six bone-bearing blocks on the floor of the canyon. Due to the number of bones found in the Main Block it was decided to remove the bones from that one first. The dimensions of the Main Block were roughly 3.5 metres on all four sides and approximately 1.5 metres high, giving the block an estimated mass of 35,000 kg. The Main Block is composed of coarse sandstone with areas of high concentration of iron-rich pebbles and macro-plant remains. There is very little mud or silt. Small vertebrate and invertebrate remains are associated with

Figure 2. Lisa Buckley taking notes on main slab after the delivery of the air compressors, generator and other equipment.

the iron-rich pebble layer. So far the majority of bones found have been disarticulated. Several bones are found in direct association with macro-plant remains, such as logs up to 0.5 metre diameter, but most of which are of smaller diameter and over 2 metres in length. These logs appear to be oriented in one plane, indicating some degree of high-energy sorting which may also give some indication of current direction for this block

A preliminary interpretation of the depositional environment is a high-energy stream, perhaps a sandbar deposit, given the accumulation and sorting of large fossil tree remains and associated skeletal material. The plant material may have been deposited or trapped during low-stand of one or more flooding events. The skeletal material (possibly articulated or partially articulated at the time of deposition) may have been caught up in the log jam, eventually disarticulating with individual elements settling through the logs. Some of the bones may have been afforded some protection from further transport by association with the logs.

The initial assumption by the first author was that the bones and associated footprints of the Quality Creek Canyon were from the Upper Cretaceous (Cenomanian) Dunvegan Formation, even though the geological maps indicate that the Upper Cretaceous (Turonian) Kaskapau Formation was predominant in the area. The Kaskapau Formation is primarily marine while the finds of *in situ* dinosaur footprints, terrestrial plants and dinosaur bones were within sediments of terrestrial origin and that were more consistent with a Dunvegan type facies. Dr. A. Guy Plint (University of Western Ontario) and his students visited the area early in August, 2003 on the invitation of the first author and the TRMF. During this time one of Dr. Plint's Ph.D. students, Bogdan Varban, recognized that all of the strata in that part of Quality Creek Canyon were indeed Kaskapau Formation. The bone and footprint-bearing sediments merely repre-

Figure 3. A natural cast of an ornithopod dinosaur print with skin impressions—lateral view.

Figure 4. The Quality Creek excavation site rigged for weather.

sent a terrestrial interlude within the larger marine sequence (Plint, personnel communication, 2003). This was good news as Turonian dinosaurs and other terrestrial vertebrates are quite rare and less well known than those preserved in Cenomanian sediments.

THE EXCAVATION

In late June, 2003 the authors arrived in Tumbler Ridge and on June 23rd supervised the airlift of excavation equipment and supplies into the canyon. The airlift was done in three drops and included a large 990 kg, 25,000 watt diesel generator and two upright electric air compressors. The airdrops placed the excavation materials intact and on target only a couple of metres from the Main Block (Figure 2). On one of the return trips out of the canyon the helicopter brought out the first dinosaur bones of the excavation (a rib and a fibula) that were in one large slab. Once the equipment was organized a short prospecting trip gave the second author the chance to find her first fossil footprint just downstream from the excavation, which was a natural cast of an ornithopod print with skin impressions (Figure 3).

Over the next several days the compressors were prepped, fuel was hauled down for the diesel generator and the multitude of new scribes and air-hammers were readied onsite. The excavation acquired a shelter for the site from the local Wolverine Nordic and Mountain Society (Figure 4), after which we could at least keep the site dry during the rains, especially those in early July. Larry White also constructed wooden covers to protect the electric air compressors from the weather.

The first excavation activity on the main block was to begin removing overburden in order to get at what was estimated to be the main bone layer, approximately 0.5 metres below the top of the block. The work began with sledge hammers, wedges and air-hammers. The overburden

Figure 5a. Several dinosaur bones in the hard sandstone matrix of Quality Block A (scale = 10 cm)

Figure 5b. Crew slowly removing a jacketed specimen (L–R: Daniel Hyslop, Lisa Buckley and Marisa Gilbert)

was removed in 1–2 cm layers where possible. It had been previously observed that the lithology of the main block was not laterally uniform. Some areas of the block were composed of fairly well-sorted sandstone which contained fossil bone and macro-plant remains (logs). On the upstream side of the block there was a composition of iron-rich pebbles mixed with bivalves, macro-plant remains and organic-rich sands, which contained many small vertebrate fossils. Even when we excavated this material as carefully as possible (usually with medium-air-scribes) we saved the resulting talus for possible chemical preparation of microvertebrate remains (though it still remains to be seen if there are any present).

Once we started to encounter fossil bones we switched to medium air-scribes to excavate them. Due to the fragile nature of the bones and the hardness of the matrix no attempt was made to expose or prepare the bones onsite. Instead, the goal was to pedestal (Figure 5a) and remove them, which was a very slow process, taking up to 60 hours in some cases for a decent-sized specimen (Figure 5b). We were lucky enough to encounter a few bones that were exposed enough to identify (*i.e.* several vertebrae, ribs, *etc.*,), but the final identity of the bones we removed will be unknown until they are prepared in a controlled setting.

Most of the small bones (fish scale, turtle bones, small dinosaur bones, crocodilian scute, ankylosaur armour fragment, *etc*.) were found in the "upstream" side of the Main Block in the iron-rich pebble

layer, while the larger dinosaur bones (vertebrae, limb elements, *etc*.) were found in the sandstone layer in close association with fossil logs. The number and size of the bones increased as we approached a layer of silty sand 0.5 metres from the top surface of the block. This silty-sand layer may represent the main bone horizon for the Main Block. Nevertheless, bone is preserved throughout the entire block and we were compelled to work slowly to avoid unnecessary breakage. By the end of the excavation we had only reached the main bone horizon on the downstream side of the block (Figure 6). The rest of the block still had a thin, but very tough layer of coarse $CaCO_3$ cemented sandstone on top of it.

Figure 6. The Main Block (upstream side) near the end of the excavation on July 23, 2003, (metre stick for scale)

Figure 7. Starfish trace fossil (*Asteriacites* ichnosp.) from Quintette Coal Mine on "Sharman Shore".

OTHER PALAEONTOLOGICAL ACTIVITIES

During the course of the excavation there were opportunities to visit other sites of palaeontological interest. For example, local geologist Kevin Sharman was very active in prospecting for and finding new and interesting fossil sites. Kevin took the excavation crew on a tour of the Quintette Coal Mine on the evening of July 10th. One of the most impressive sites we saw was a large exposure of a rippled bed with numerous starfish traces identified as *Asteriacites* ichnosp. (Figure 7). Later in the month on July 30th, Kevin took the two authors to a sour gas well site that had *in situ* dinosaur tracks and trackways on a near vertical wall. A partial trackway of a large theropod and several partial trackways and individual tracks of ankylosaurs were identified. However only a small percentage of the track-bearing horizon was exposed, the rest was covered with overburden. CNRL, the company who owns the gas well, has offered to help with the excavation of the rest of the track layer when the well ceases operation in a few years. Both of Kevin's sites were in the Lower Cretaceous (Albian) Gates Formation. The excavation crew also visited Roman Mountain to the south of Tumbler Ridge to

Figure 8. Lisa Buckley deluged by fossil enthusiasts at the "First Annual Tumbler Ridge Fossil Road Show."

view Gates Formation bird footprints on an isolated block discovered previously by Charles Helm (Helm, 2000; 2001).

The excavation crew was also given the opportunity to interact with the community via a bi-weekly lecture series put on by the TRMF and the Tumbler Ridge Public Library, but also the well-attended First Annual Fossil Road Show held on July 23rd (Figure 8). There were also a limited number of tours granted to media, dignitaries (including Blair Lekstrom, MLA for Dawson Creek) and TRMF members to the excavation site. The Quality Creek excavation and several area tracksites were visited by the excavation crew of the Beaverlodge dinosaur site (led by Phil Currie of the Royal Tyrrell Museum of Palaeontology), located a short distance away, just inside the Alberta border.

SUMMARY OF SKELETAL EXCAVATION AND SIGNIFICANCE

Over 75 bones were encountered during the six weeks excavation of Quality Block A, 50 of which were excavated. The identifications of these bones are tentative, as preparation of the material has not yet begun. Material from dinosaurs, turtles, crocodilians (one scute) and fish (scales) were recovered. Dinosaur material includes five vertebrae, four ribs, an unidentified phalanx, one ankylosaur scute, a fibula, one theropod tooth and a possible pelvic bone. Possible ossified tendons were also recovered. Across the creek in a sandstone block (Quality Block B), the partial carapace of a turtle was excavated (Figure 9).

Enough macro-vertebrate material was uncovered to suggest the dinosaur in question is a medium-sized ornithopod. There is no indication of how many individuals or how many other taxa of dinosaurs are preserved in the blocks as this time. Several hundred kilograms of rock removed from Quality Block A during the course of the excavation were reserved for the chemical preparation of microvertebrate remains. From preliminary tests, the material disaggregates easily in hydrogen peroxide and the recovery of fossil material is underway. Given the variety of specimens recovered to date and pending the success of recovering microvertebrate remains, the Quality Creek fauna will add information about the dinosaurs and other terrestrial vertebrates of the Turonian.

An ornithopod trackway was discovered on the underside of a Quality Creek cutbank in 2001 (McCrea, 2003). In order to study the trackway, a latex peel measuring 4 metres in length was made. Other isolated ornithopod footprint casts were also recovered from a number of locations along Quality Creek. A natural cast of a pathological theropod footprint was also recovered. As there have been no previous reports of dinosaur tracks from Turonian deposits worldwide (Lockley, 1992), the trackway and the footprint casts represent the first dinosaur tracks reported from this age.

The TRMF's important excavation-related problem of specimen storage was solved by the beginning of August, 2003 with the establishment of the Tumbler Ridge Palaeontological Field Station. The field station occupies two bays of a warehouse building in the industrial area of town. These facilities are well-partitioned, suitable for a large preparation area with associated equipment storage rooms and office space. There is a respectable area for the collections room separate from the other areas.

Figure 9. Richard McCrea at Quality Block B after the turtle carapace was jacketed and removed.

The future prospects of continued vertebrate palaeontology research projects in the Tumbler Ridge area look promising. Based on information gained from the 2003 excavation there is certainly enough fossil material to warrant several more years of excavation. Plans for a 2004 excavation are underway. Additional exposures were found in Quality Creek Canyon, which yielded *in situ* skeletal remains that may become viable excavation projects in the future. Larry White found some fossil bone material in Quality Creek downstream and below the main excavation site. The bones were found in a different lithology (grey sandstone) than the matrix encasing the other Quality Creek bones. The stratigraphic level that is the source of the bone-bearing grey sandstone has yet to be discovered.

It is very important to note that all of these wonderful discoveries and projects were made possible due to the initial discovery of an ankylosaur trackway on the bank of a creek by two boys (Daniel Helm and Mark Turner) who, by chance, thought it would be fun to go "tubing" in that particular location (Shilts, 2001; Helm, 2002; Kelsey, 2003; McCrea, 2003).

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Very many people have participated in the Quality Creek excavation, something that has had a positive impact on this region and will continue to do so in the future. Carolyn Golightly (President of the TRMF) deserves a special acknowledgement for her enthusiasm and tireless fund-raising efforts in the midst of her other numerous and demanding projects—this excavation would not have been possible without her. Charles Helm's (Vice-President of the TRMF) exhaustive promotion of the importance of this project, both locally and provincially is admirable and much appreciated. Thanks to the TRMF for arranging accommodations for the excavation team for the duration of the summer.

Thanks to our crew of volunteers, (Larry White, Anna Eichelberger, Daniel Hyslop, Clint Boyd & Adam Behlke) for their hard work and dedication and to Mark Turner, Daniel Helm and Lindsay Tattersall for constructing the most picturesque "facilities" and for helping to clear the site. We are grateful to the Wolverine Nordic and Mountain Society for making a trail (the "Hill of Pain") to the site. Our grateful thanks to Al Tattersal, Bruce Zimmer, Vince Curley and Fred Walkley for help in many ways. Kevin Sharman with his many trackway and other interesting palaeontological finds has helped to expand the possibilities for research in the area.

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