

HISTORY OF THE CERATOPSIAN DINOSAUR *TRICERATOPS*
In The Science Museum of Minnesota 1960 – Present
by Bruce R. Erickson



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Frontispiece: First season at *Triceratops* quarry 1960.

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INTRODUCTION

Early in **1960** a plan with budget and field crew was put together with the ultimate purpose of finding and collecting a skeleton of the dinosaur *Triceratops* for study and exhibit at the Science Museum of Minnesota. Badlands areas of exposures of the Hell Creek and Judith River formations in Montana had already been prospected by Eugene Hall and I in **1959** where encouraging evidence of dinosaurs was recorded. During our first visit to the Trumbo Ranch on Hell Creek we were privileged to stay in the ranch bunkhouse and breakfast at the main house each day.

Hell Creek is a major drainage in this area and the namesake of the Hell Creek Formation which occurs widely in the American West. Dinosaur remains are not scarce in the 70 million year old beds of the Late Cretaceous Hell Creek Formation. Among the best known are the hadrosaur *Edmontosaurus*, the ceratopsian *Triceratops*, and the theropod *Tyrannosaurus*. Most specimens are represented by fragmentary bones or separate teeth. A “Good skeleton” is a dinosaur that is reasonably intact with many of its bones not seriously damaged. In light of the previous field seasons findings my report to the museum’s director stated that a dinosaur could be found and collected for study and exhibit.

COLLECTING TRICERATOPS

Once the plan was approved by the museum preparations for the field began. According to my field notes of June **1960** the search began in Garfield County, Montana on the Trumbo Ranch where our field party camped for the duration. The Trumbo “spread” was not a huge ranch yet it covered 36 sections (36 square miles). One of my recollections was John Trumbo remarking that “with badlands interspersed with grassy tables for grazing they could run only about 400 head”. On occasion “wild horses” are also seen on open tables and in the widest coulees. Those are feral animals that have reverted to the undomesticated wild state.

When starting out to locate *Triceratops* a likely horizon to search is the deposits of the late Cretaceous Hell Creek Formation. The dinosaur fauna of the Hell Creek is large and diverse. The fossil taxa which indicate the paleoenvironment of *Triceratops* or of the quarry itself are discussed in the following pages as some aspects from the Hell Creek expedition **1960 – 1964**.

In extensive badlands as those without roads, aerial reconnaissance is needed to locate the extent of special rock layers. Many ranchers have a small plane for dusting crops or finding strays that have wandered into the breaks. Some ranchers are willing to assist in the search for fossil bones for the cost of gasoline and what they may learn about dinosaurs. Such was the case with our search. Fossil bones are not often visible from the air; however, the shale and sandstones that they occur in are. Bone deposits found by air often require finding or making a trail to the site to transport any specimens back to the camp area.

An early indication that this area would be productive of our search were a number of horn core and frill fragments of *Triceratops*, bones of hadrosaurs as well as those of

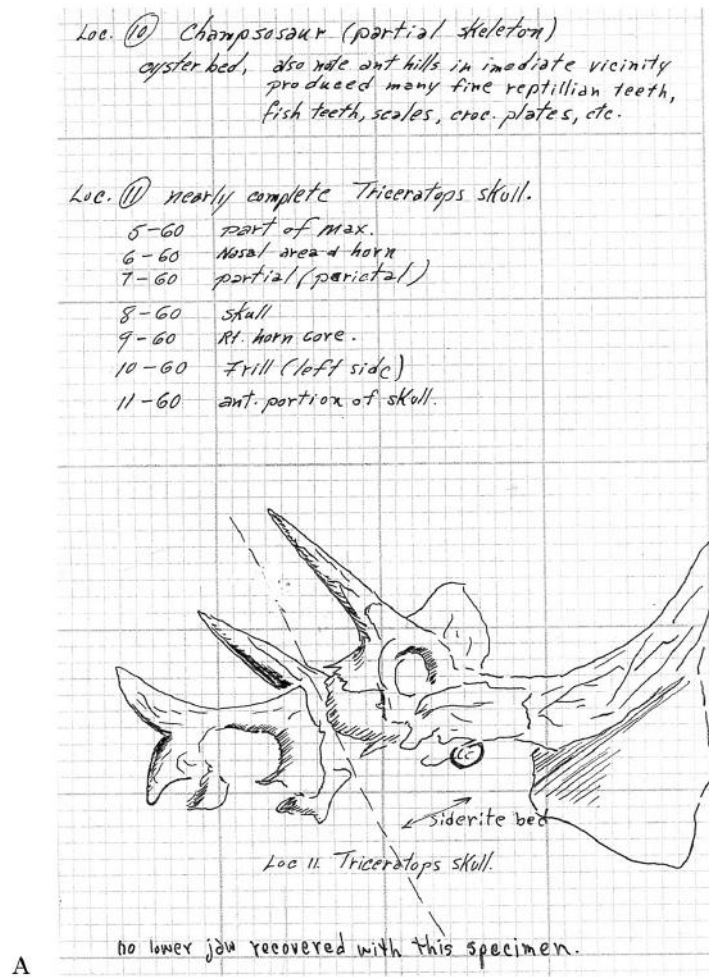


Fig. 1. Field notes of solitary skull at locality 11; A, skull *in situ*; B, (Left to right) Gordon Hadden, Anthropology dept.; Robert Van Cleave, Research Associate, Paleontology dept.; Bruce Erickson Paleontology Department of SMM, jacking skull.

Tyrannosaurus. A few days under the summer sun and we hit “pay-dirt” – a fairly complete skull of *Triceratops* (Fig. 1) which was collected for study, not necessarily for exhibit. This skull lacked its mandible and a section of its frill. The skull’s removal is shown in figure 2.

As daily search by foot and horse went on in the Hell Creek Beds numerous non-dinosaurian fossils were collected. Among those was a most intriguing small reptile from the overlying Paleocene Tullock Formation– this is where and when I learned about Champsosaurs. Extinct since the early Tertiary (Eocene) and resembling crocodilians, Champsosaurs are a late eosuchian survivor that became a major research focus (Erickson, 1972, 1981, 1982, 1985, 1987).

The discovery of a vertebra belonging to *Triceratops* led to more intense investigation of the site and a preliminary excavation. It is noted here that discovery of this significant vertebra was made by Lois Erickson who joined our crew in the search for the hidden quarry *Triceratops*. The preliminary excavation soon became our principal excavation in **1960** designated quarry 14 (Fig. 3). This site was located in a remote area of badlands 20 miles north of Jordan, Montana where access to the site was limited to horse or jeep. At this time when silver dollars were everyday cash and Hell Creek fossils were abundant, saddle horses were our most practical means of prospecting along Snow Creek and Hell Creek.

Early search for a “collectible” *Triceratops* in the surrounding breaks yielded fragmentary evidence of several dinosaurs. This evidence consisted mostly of incomplete squamosal and parietal bones of the frill and pieces of horn cores. One isolated skull in upright position was located by a sagebrush growing between the bases of its two missing brow horns. Excavation of this specimen was not attempted because of the beginning quarry operations at location 14 five miles west. James Jensen arrived to collect for Brigham Young University. By July in 1963 he was soon engaged with excavating the above horn-less skull. This skull when eventually exposed, was missing its brow horns, posterior edge of the frill and its mandible, never the less a good skull. After a number of field encounters with the remains of *Triceratops* I can state that most specimens are represented by a skull only. One explanation for this is, as others have mentioned, that its large cavernous skull, once separated from the rest of the carcass, may have had buoyancy enough to allow its relocation by water currents.

Among those skull remains observed in the Hell Creek none revealed evidence of fontanellization of the frill which may have indicated the presence of *Torosaurus*, another large ceratopsid.

Excavation of our main quarry between **1960 and 1963** utilized the means and materials available. A horse drawn scraper (skid, slip, scoop), jeep, and our old military $\frac{3}{4}$ ton vehicle shown in figure 4 drawing the scraper by motor rather than by horse which was the best method of excavating fossil bones that were buried in a tough “joint clay” matrix which was heavy work for a saddle horse. On the handles of the scoop are crew members Robert Sloan (right) and Delwin Olsen (left). Continued digging exposed much of a skeleton with its partly articulated skull and numerous closely associated postcranial bones. The evidence indicated that the carcass, before fossilization, was lying on its side when its remains were disturbed by some weathering and possible scavengers before it was covered by sediments. Rapid covering



A



B



C



D

Fig. 2.: Removal of skull, loc. 11; A, Site of specimen (arrow); B, largest of two jackets showing crate for support; C, A-frame and tackle to lift jackets from coulee; D, jeep provided horsepower to raise jackets.

accounts for the fine preservation of most of its bones. Some elements located beyond the limits of the quarry which could not be assigned to a specific skeleton were reasonably incorporated into the collection. Those included mostly limb, foot, and rib fragments. This specimen was collected in the traditional way whereby every bone or group of bones was encased (jacketed) in burlap and plaster (rather than flour paste as once used) numbered, and crated for shipment to the museum. Our field party was augmented during **1960 and 1961** for a few weeks by paleobotanist John Hall and two of his students who also surveyed and collected fossils from the Hell Creek Formation for our Cretaceous fossil floral records.

In **1962** as work progressed, a second location designated Location 24 was opened near the well known landmark "Brownie Butte". A number of elements which complemented those of the material of the first quarry were found. Some of those were eventually pressed into service in the final mounting of our *Triceratops*. Of the skull found here with its

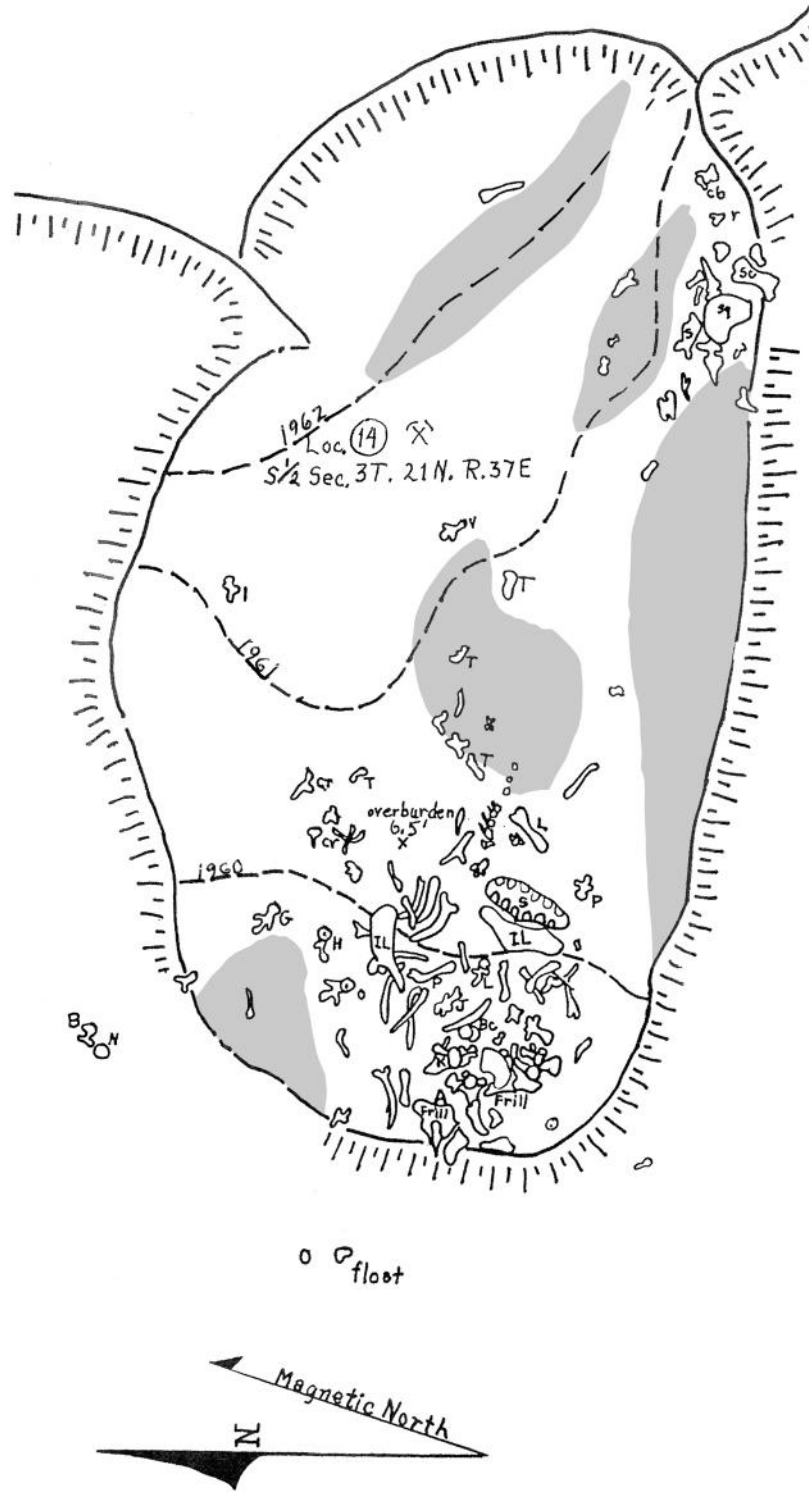


Fig. 3: Early field map of quarry 14; shaded areas represent partly excavated areas for each season.

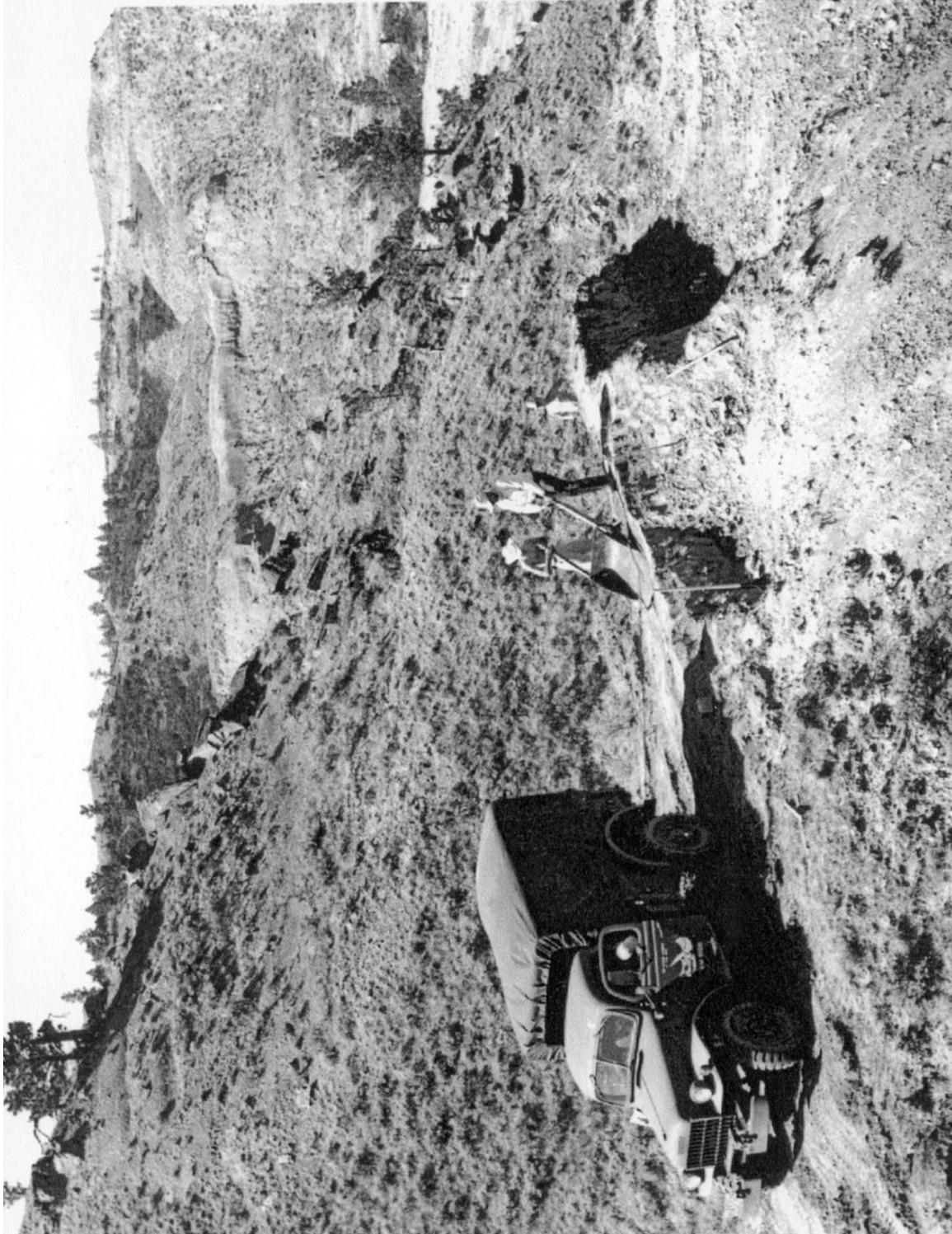


Fig. 4: Quarry excavation where bones were found at different levels indicate irregular rates of deposition during the preservation process.

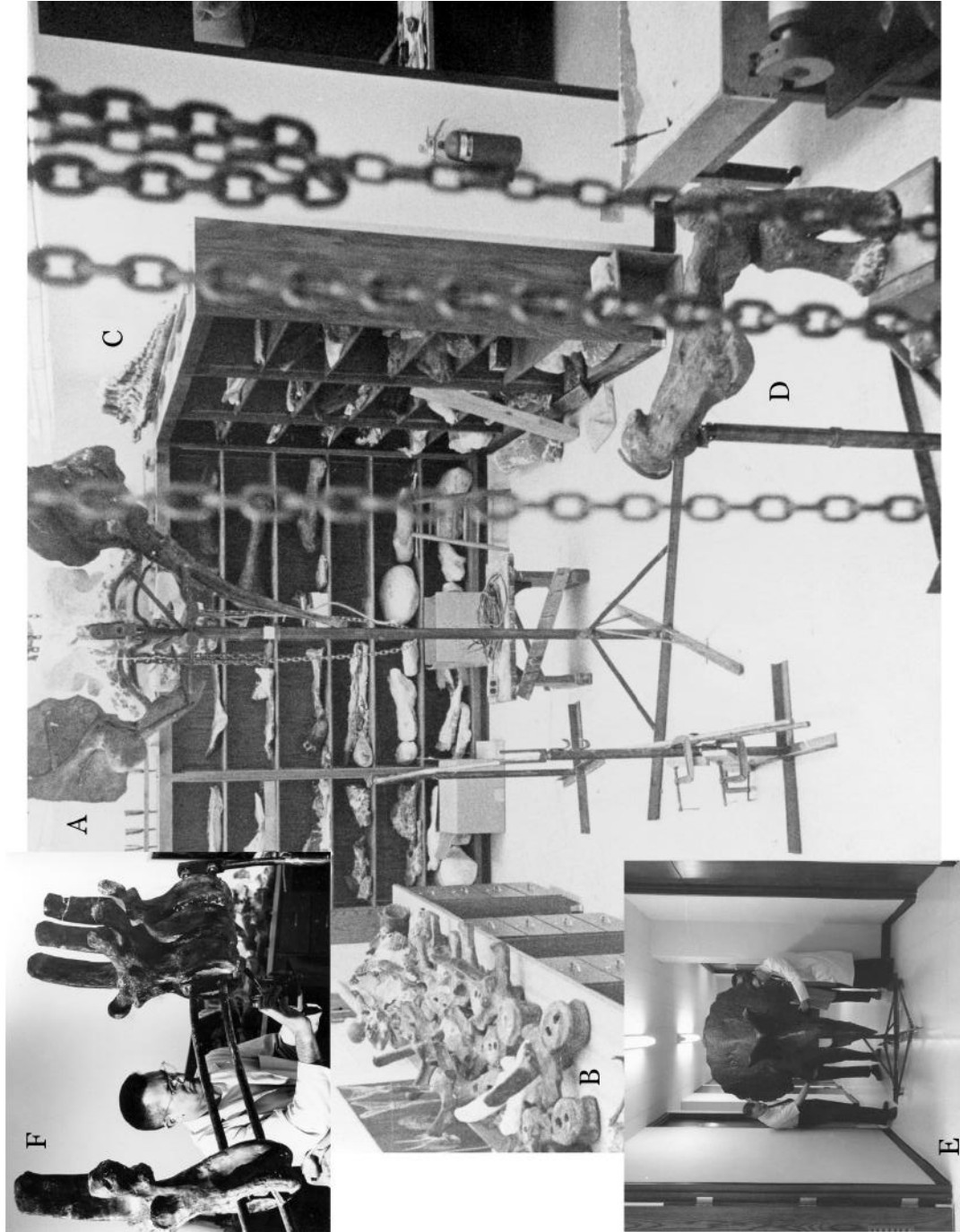


Fig. 5: Laboratory during initial mounting of the skeleton in 1965. A, assembled pelvis; B, vertebrae with drilled centra; C, caudal section, D, left foreleg in flexed position; E, fully prepared skull of *Triceratops* moves from the laboratory to the exhibit floor 1975; F, preparator Ken Sander mounting dorsal vertebrae.

protruding horns, frill, and facial elements, some fragmentation was expected. The massive mandible was also separated from the skull (Fig. 13).

Specimens were collected at 31 localities in Garfield County with evidence of *Triceratops* at most of those. This leads to the conclusion that this dinosaur evidently lived in large herds and is the best known Ceratopsid.

One nearly inaccessible area, locality 19 near Flagg Butte known to John Trumbo was visited by Trumbo, Charles J. Johnston and I in 1962. Here all of our water had to be carried in to the site and we were limited to collecting without making field jackets because of the lack of water for mixing plaster. We collected sandflats for fish material, dinosaur and crocodile teeth as well as other fossil material but no *Triceratops* material yet we made note of its occurrence here. Flagg Butte is one of the 31 localities collected.

Quarry Location 24 was revisited in **1964**. At this time a Champsosaur skeleton was recovered from the overlying Paleocene Tullock Formation. Several former Hell Creek locations were also surveyed for additional fragmentary specimens. From here our small crew of 3 traveled to the Stovall Museum in Norman, Oklahoma to examine Stovall's *Triceratops* material that he collected in Garfield County, Montana in 1950s (ref. aerial photo – Fig. 28).

With crates of dinosaur bones arriving at the museum in St. Paul the lengthy process of preparation began at first in the laboratory at 51 University Avenue, St. Paul, Minnesota. By **1965** the museum relocated to a new facility at 30 East 10th Street, St. Paul where development of the Hell Creek specimens continued. The time to examine other existing collections containing *Triceratops* material was at hand. With only a relatively few skeletons of *Triceratops* residing in the largest paleontological collections, the specimens in the U.S. National Museum, Washington and the American Museum of Natural History, New York needed to be examined. Consequently they were visited. Late in **1965** the American Museum in New York was visited to examine *Triceratops* materials as well as the "Type" specimens of two champsosaurs that Barnum Brown collected from the place of my early acquaintance with champsosaurs in Montana. Below is a letter from Barnum Brown AMNH, who pioneered dinosaur collecting in the American West. This letter to local rancher P. Wischmann briefly details his field work in Garfield County, Montana between 1902 and 1909. The AMNH mounted *Triceratops* (at that time referred to *T. elatus*) provided helpful and needed information. Especially important to our work were details and field notes of Barnum Brown as well as bone associations of this skeleton in spite of its composite character. Numerous other specimens were examined as well. Barnum Brown wrote:

Your letter of March 2nd was forwarded and I will do everything possible to secure the data you wish although I believe that practically all of the specimens I found for the American Museum came from Garfield County and few if any from the present McCone Country the boundary of which were established after I worked that region.

I started work in the badlands of the Missouri River in the Spring of 1902 with Jordan on Big Dry Creek as headquarters and I continued working the region each summer until 1909 when I proceeded to excavate skeletons along the Red Deer River Canyon of Alberta.

My first discovery of dinosaur was the type skeleton of TYRANNOSAURUS REX at the old Max Sieber buffalo Cabin on Hell Creek 16 miles Northwest of Jordan. This skeleton we sold to the Carnegie Museum of Pittsburgh when it was feared Germany might bomb New York City and destroy Museum specimens.

The second Tyrannosaurus Rex skeleton now mounted in the American Museum I found on the John Willis ranch on the Big Dry which I think was also Garfield County. Claude Willis if still living in the country or Bessie Willis nee? Bessie would be the best source of information for she brought our mail out to camp whenever it came. John and Mrs. Willis the last I heard were living in California somewhere near Los Angeles. You might also enquire of Art Ail, sheep man if still living for all nearby ranch people were interested in my work and most helpful.

The third important specimen was a skeleton of the duck-billed dinosaur TRACHODON MIRABILIS which as I remember came from a small tributary of the Big Dry west of Jordan.

I also found a skull of TRICERATOPS in the vicinity of Jordan. I can't be exact as to location for I do not have my bibliography of publications at hand. However, I think you may find exact data in my article "The Hell Creek Beds", Bull. American Museum of Natural History 1907?

It is difficult to trust ones memory in a very active career.

Minor specimens were found on Bear Creek, Prairie Elk and Red Water while working out from the C. K. ranch.

If you wish clarification on any points do not hesitate to write to me again at the above address.

Very sincerely,


Barnum Brown

Bull.
23:33
1907

A second trip early in November was made to the British Museum (NH) in South Kensington to examine an early cast of *Triceratops*. This was a time when few museums had casts of dinosaurs and some early ideas about anatomy and posturing needed review, especially their mounted cast skeleton identified as *T. prorsus* from the Hell Creek Formation of North America. Its somewhat vertical forelimbs have a typically reptilian arrangement; however, the amount of flexing in *Triceratops* between the humerus and the epipodials (radius and ulna) is a debatable subject. Our research which is expressed in SMM's mount has a more akimbo attitude of its forelimbs (figures 7, 8, and the cover image). During this time a further brief interruption in our schedule to conduct a long -- planned survey of some fossil locations for the Saskatchewan Natural History Museum, Regina, Canada also resulted in a sizable Oligocene vertebrate collection for SMM. While working at the Saskatchewan Museum a rather complete specimen

of a fossil marine lizard Mosasaur was acquired for SMM as an exchange specimen. The 6 meter long skeleton now enhances the paleontological halls at SMM.

Returning to the development of our Hell Creek dinosaur, preparation of the massive skull and postcranial skeleton was accomplished by preparator Kenneth Sander and student preparator Jeffery Birch with an assist by student C. Bruce Hanson at SMM, 51 University Avenue. Final preparation and mounting was completed by the same crew at our new building at 30 East 10th Street a short distance away.

During the course of examining the vertebral column which is complete from the skull to the sacrum with possible exception of the last vertebra, all of the vertebrae were found to be closely graduated in size and easily identified and aligned with one another. Figure 5 shows the method of mounting the vertebral sequence. A number of other isolated vertebrae were found at scattered locations during the prospecting stage of collecting in the Hell Creek strata. According to Lull (1933) 13 species of *Triceratops* had been described – most are invalid because the evidence is inadequate being based mostly on size of the vertebrae. Size distinction may simply indicate the animal's age and appears to be the greatest variable. Of the number of species assigned to the genus *Triceratops*, only one or possibly two are regarded as valid. Most species are regarded as belonging to *T. horridus* which is “widely distributed in space and time” (Lull, 1933). *Triceratops prorsus* is possibly a second species however conjectural. The SMM specimen is regarded as *T. horridus*.

An often overlooked aspect of the fauna associated with dinosaur remains are the microfossils which can offer clues as to the paleoenvironment. Small Cretaceous mammals which foreshadowed the explosion of mammals during the early Tertiary and the disappearance of the dinosaurs are not easily collected and often require special techniques to collect. Ant mounds are conspicuous features in these badlands. In the Hell Creek deposits they average about 1 meter in height. They can be a source of microfossils (Fig. 6). The ants themselves routinely gather microfossils along with other 5–10 millimeter size particles (often sand grains) in the construction of their mounds that are 1 – 2 meters across. The method of collecting a mound for its microfossil content usually requires the use of a sieve to remove the upper 50 mm or “roof” of the mound for sorting. If the roof is to be examined for microfossils in the lab it can be removed intact by use of ½ second lacquer treatment to stabilize it before lifting and backing it up with plaster (Fig. 6). With caution and some speed this can be accomplished without disturbing the ant colony inside of the mound. If this process is conducted too slowly a second person should be available to keep the ants off the boots and legs of the person applying the lacquer and plaster backing. Once removed the roof may be transported to the museum lab for close examination.

The distance beyond the mound from which the ants collect particles for constructing the mound roof can be determined by a simple test. With the mound as center, a series of 3 concentric rings, each with an increasing diameter and having beads of one distinct color (eg. red, yellow, blue) the distance between the mound and the specific color of beads found in the roof will give the distance traveled by the ants to collect material for the mound. For example, if yellow beads show up in the mound the ants evidently traveled at least to the ring of yellow beads to collect particles (beads) for the mound roof.



A



B



C



D

Fig. 6: Ant mound collecting; A, mound as found; B, half second lacquer applied by Charles J. Johnston CJJ); C, lifting mound roof after stabilized by lacquer treatment; D, plaster backing applied for transport.

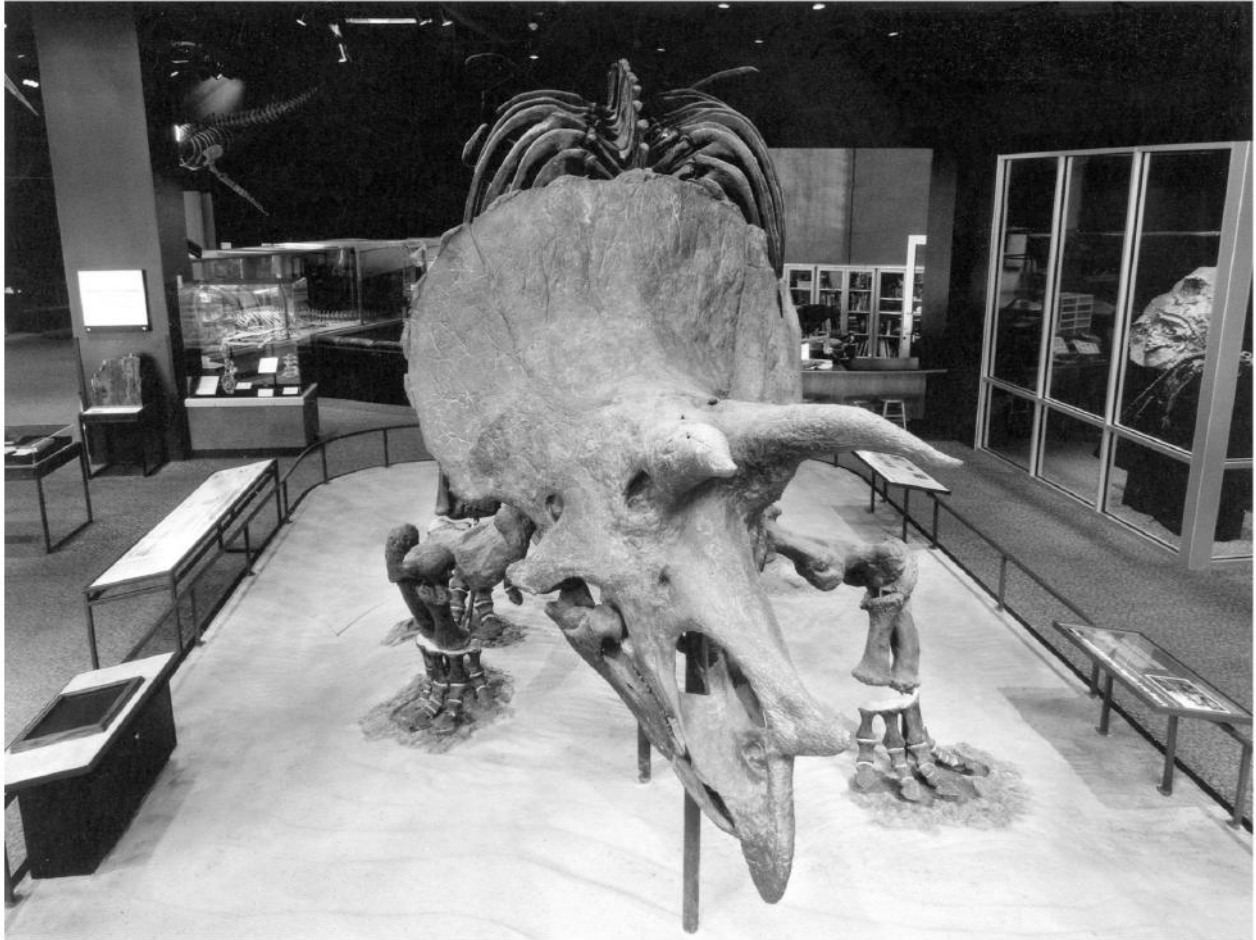


Fig. 7: Skeleton of *Triceratops* in Paleontology Hall with its new base showing foot tracks and its skull canted to its left as discussed in text.

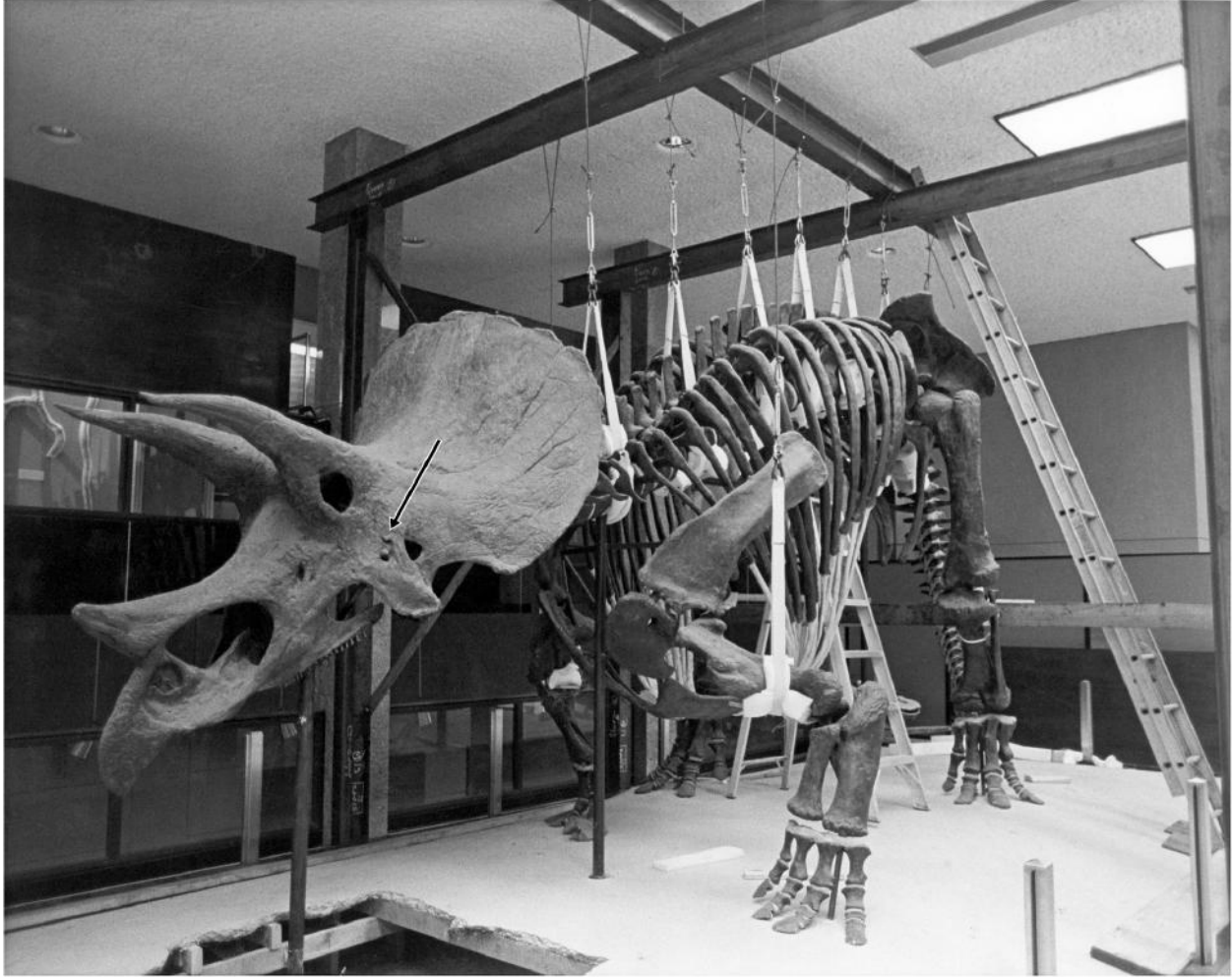


Fig. 8: *Triceratops* skeleton in suspension for repairs after suffering minor damage during museum remodeling in 1975 at 30 East 10th Street location. Arrow indicates healed wound caused in life.

ABOUT THE MOUNTED SKELETON

Of importance in the assembly of a skeleton is the question of posture – it must be anatomically accurate.

Mounting of *Triceratops*, as with other quadrupeds, begins with assembly of the hind limbs and pelvis. The 10 ossified vertebrae of the sacrum of *Triceratops* form a natural arch (shown in Figure 27) for continued alignment of the trunk vertebrae leading to the shoulder girdle region and the articulation of the short forelimbs. Posteriorly from the sacrum the tail of over 40 caudal vertebrae in this specimen extend downward before curving upward and was likely carried aloft much of the time. Before leaving the pelvic region it is noted that when found both ilia were inverted and flattened by the weight of the overburden. Rather than attempting to totally restore the once curved iliac blades they were mounted as preserved revealing their distortion. The other pelvic elements (pubes and ischia) were well preserved. At the time of mounting this skeleton (1964 – 65) it was a general practice to use hidden internal steel supports for some structures such as the vertebral column as well as visible external supports for flat elements such as girdle bones. Figure 5 shows much of the postcranial skeleton which utilized both methods of support. Skeletons such as *Gorgosaurus* at the Field Museum in Chicago were mounted as “Free Standing” skeletons with mostly hidden internal steel supports (Gilpin, 1959). Today cast specimens are often utilized in some exhibits notwithstanding the lack of the intrinsic values of the original bony skeleton.

The gait and stride of SMM’s ceratopsian cannot be determined precisely by scarce putative foot tracks. Its stance and walking behavior as interpreted is restored in the exhibited specimen. When alive, *Triceratops* moved from firm ground to less firm ground at the edge of a pond or stream, as suggested here by its foot imprints and the ripple marks ahead of them. In the simulated ground surface the left front foot was overstepped by the left hind foot leaving double imprints. The next step of the left forefoot was on even softer bottom mud indicated by wider spacing of ripple marks on the ground surface. On the right, the hind foot during its forward progress fell short of the right forefoot which is flexed and set deeply into bottom mud as a possible brace from a frontal impact presumably from another approaching dinosaur. Note the skull is canted to its left directly in line with the flexed right front leg and foot (Fig. 7).

Apart from the foot impressions a healed injury to the left cheek region is visible as a perforating fracture in the left jugal bone anterior to the infra-temporal fossa (Fig. 8) – an injury that was likely due to contact with a horn of another *Triceratops*. The wound became infected as shown by the irregular bony surface of its margin. A possible cause of this injury as explained by Farke (2004)—when two *Triceratops* obliquely locked horns, the nasal horn of one could easily reach the jugal (cheek) of the other skull – an injury may result (Fig. 8, arrow).

In 1975 during blasting associated with construction work for SMM’s expansion at 30 East 10th Street, minor damage to *Triceratops* occurred and caused fracturing of some of its bones. These fractures were located by soundings made of each bone. The skull was not affected as it was already supported separately. Immobilization was needed to prevent further damage to some postcranial bones and allow time to repair any damage already present. A temporary structure of steel arms and web slings to suspend the entire skeleton was constructed

on the exhibit floor to facilitate repairs which were mostly minor (Fig. 8). Research Chemist R. Steinkie of the Fuller Company of Minnesota who was assigned the task of making repairs injected the fractures with a low viscosity epoxy which corrected the damage. This treatment stabilized the skeleton as well as it was with its original preparation (Erickson, 1977, 2002; Steinkie, 1977).

With the later relocation of the museum to its new facility on Kellogg Boulevard near the river the skeleton of *Triceratops* (fig. 8) was dismantled to a point where it could be moved into its new quarters. In 2016 it was again moved to a closer association with the museum's other mounted dinosaurs. At this location it was outfitted with a new ground surface and simulated foot tracks as described above.

ABOUT THE BRAIN OF TRICERATOPS

As with all non-avian dinosaurs its brain was small yet complex with all 12 cranial nerves present, most with numerous branches. Figure 9 represents a new endocranial cast SMM P2014.3.1c produced from a *Triceratops* cranium P93.16.1 from SMM's collections.. The cast shows the location of the origin of each major nerve and some of the smaller nerves. The nerve stalks were formed from their passages within the walls of the cranium or from the tracks impressed into the bone surface of the cranium such as the impressions of the carotid arteries just posterior to the pituitary opening (Fig. 10 A. arrow).

At the anterior end of the cerebrum the nasal stalk (nerve I) emerges from the braincase as it divides into two branches forward. Directly above the base of the nasal stalk is a deep depression of a frontal sinus with an opening arrow into the cranium (brain case) as indicated in figure 10 C. The large pituitary body is situated ventrally beneath the large optic nerve II, the ophthalmic nerve III and trochlear nerve IV. The other main cranial nerves V –XII arise from the cerebellum and medulla. They are labeled in figure 9. Additional branches on nerve V have not all been identified. For various interpretations of cranial nerves see Marsh, 1890; Burkhardt, 1892; Hatcher et al., 1907; Edinger, 1929; Hopson, 1979; and Forester, 1996.

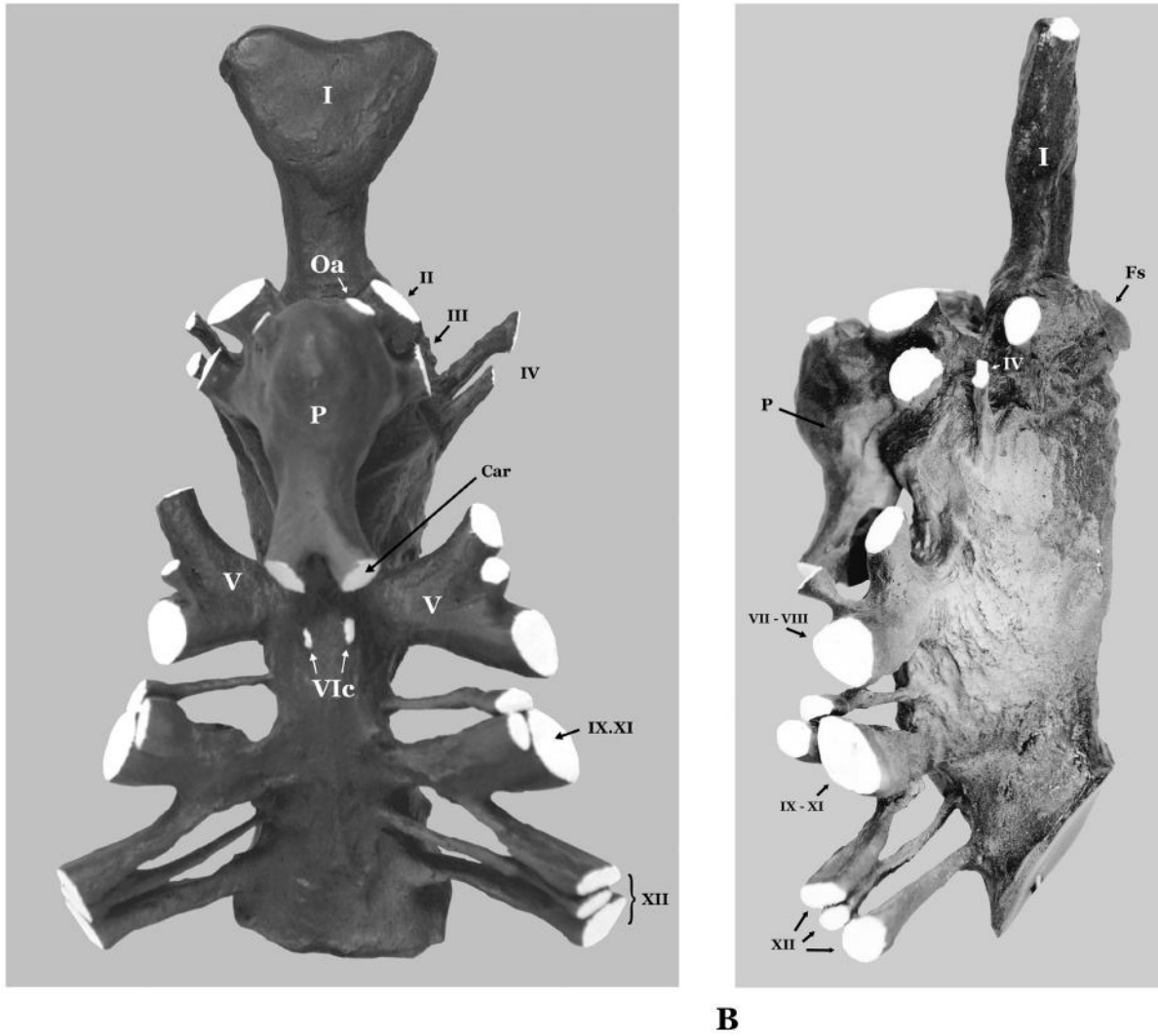


Fig. 9: Endocranial cast of *Triceratops* SMM P 2014.3.1C showing cranial nerves and other structures; A, ventral view; B, left lateral view, cranial nerves I – XII; Fs, frontal sinus aperture; Oa – ophthalmic artery; P, pituitary.

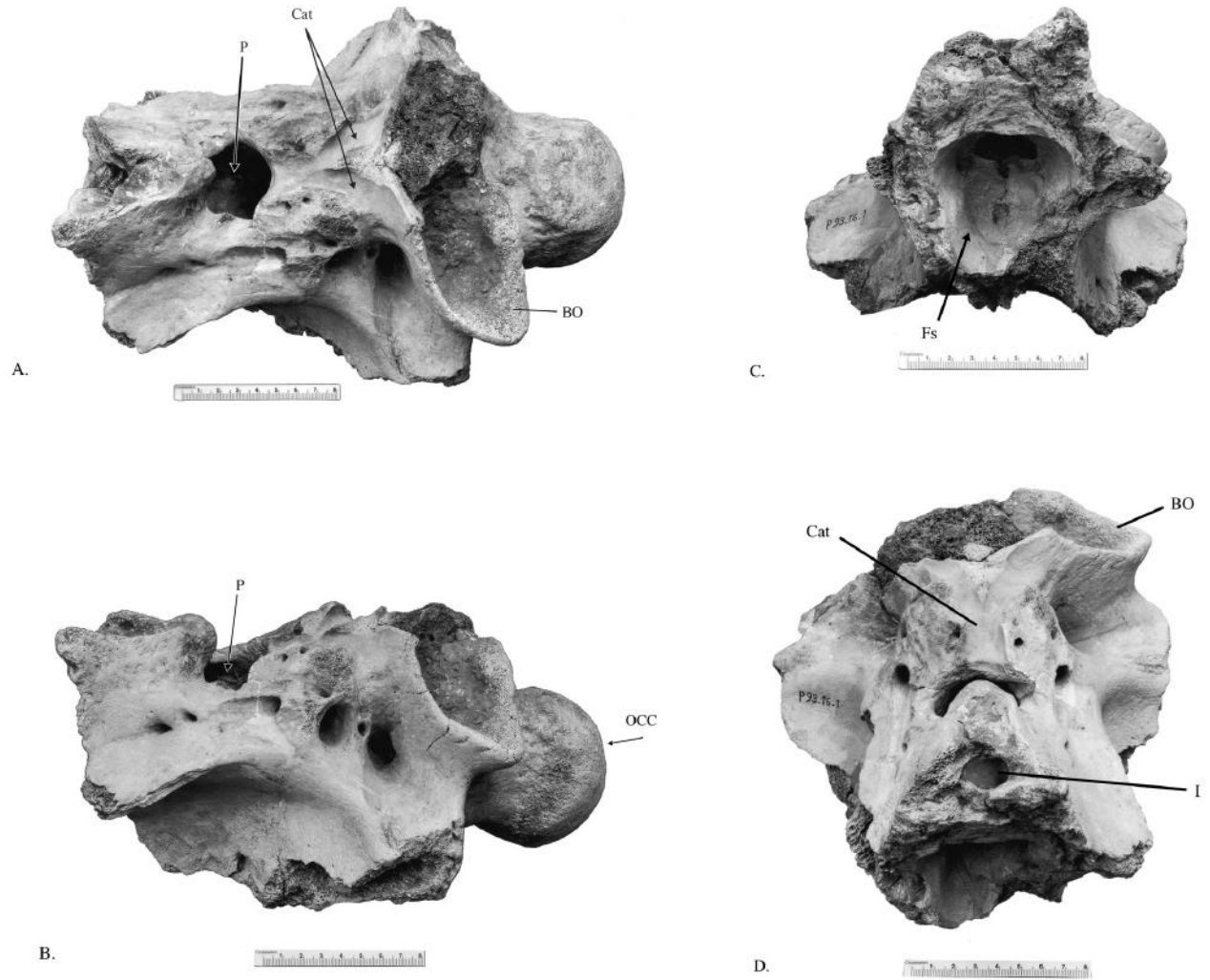


Fig. 10: Brain case SMM P93.16.1; A, ventral view; B, right lateral view, specimen inverted; C, inverted anterior view; D, oblique anteroventral view; BO, basioccipital; Cat, carotid artery track; Occ, occipital condyle; I, olfactory nerve aperture; Fs, frontal sinus; P, pituitary fossa.

EPILOGUE

The 1200 person days devoted to the “Hell Creek – *Triceratops* Expedition” are a significant contribution by SMM. The investment yielded the museum’s first dinosaur skeleton which is the subject of this publication. Numerous other Hell Creek specimens of crocodiles, champsosaurs, turtles, and dinosaurs as well as a few mammals were also added to the museum’s collections by this expedition. Three *Triceratops* skulls were collected during this time. A skull at locality 11 in **1960** (Fig. 1 and 2) was mostly articulated when discovered. This specimen was collected, but without an associated postcranial skeleton its value is primarily for study. Two skeletons each with a fine skull at localities 14 in **1960** and 24 in **1962** were excavated and collected over several field seasons. On the basis of those two “good” skeletons, it was decided that a composite mount would provide the most accurate restoration; therefore, elements from each of the localities were combined in the final mount. The mounted *Triceratops horridus* at SMM as a result of the field work in Montana **1959 – 1963** attempts to show, with all of the unanswered questions about this dinosaur’s movements and behavior, a feasible interpretation of it as a living reptile.

A new endocranial cast, SMM P93.16.1c produced from a complete endocranium SMM P93.16.1 also from the Hell Creek Formation, offers additional information about the brain of this dinosaur. As shown in several figures all 12 cranial nerves are present, some with unreported small branches.

Badlands are often choice locations for collecting vertebrate fossils that are best preserved in stratified sedimentary rock layers. Badlands may also pose disadvantages for the collector. Mishaps of ranchers, cowboys, as well as those who collect fossils in such places include the following dangers: your foot being stepped on by a cow; being kicked or thrown by your horse; hit by a prairie rattler while on foot. Other potential dangers, not to be ignored, are undermined clay sinks; quicksand in a seemingly dry coulee, and storms. One more threat is falling rock and rock slides which can be taken in point. In early July **1963** while collecting a large soft-shell turtle at one of our sites, field veteran of SMM, Chuck Johnston (CJJ), Fig. 6) was injured by a large sandstone rockfall and slide that carried him out onto an open sand flat. Johnston had to be packed out on a litter and transported over 20 miles to the small local hospital. After being x-rayed his radiographs reminded one of the condition of some of the fossil bones we were collecting. The story of our recovery of the *Triceratops* for SMM would not be complete without mention of this as part of its history. CJJ is back.

During February of **1966** SMM hosted Friedelind Wagner granddaughter of German composer Richard Wagner. At a ceremony at the museum Miss Wagner dedicated our newly mounted *Triceratops* and named it “Fafner” after the dragon in her grandfather’s famous opera “Der Ring Des Nebilungen” (Fig. 11). A student of Friedeland Wagner, Bruce Hungerford, Pianist in Residence, Bayreuth Festival Master Classes, performed 2 Beethoven Sonatas during the evening when *Triceratops* was honored.

During the following month John and Sylvia Trumbo from Hell Creek Ranch came to see the dinosaur that we collected on their ranch in the early **1960**’s. During their visit they renewed a few acquaintances from the Hell Creek *Triceratops* Expeditions. One was Bob Spading



Fig. 11: 1966 Ceremony at SMM, *Triceratops* dedication by Miss Wagner (long gown); Museum director Philip Taylor at her left.

whom they worked with during the filming of “Discovery at Hell Creek” a short 16 mm film documenting our work with the search and discovery of *Triceratops*. The film was later shown at a theater in Jordan with a talk about our search for and excavation of *Triceratops*. A comment by a local cowboy noted that our “horses were handled well” in the film.

A more recent visitor to see *Triceratops* in August 2007 was His Royal Highness King Abumbi of Bafut, Cameroon, Africa. With this visit he satisfied his interest in his favorite dinosaur. The King and his entourage visited the paleontology laboratory to see some work in progress and was presented with a separate section of *Triceratops* mandible for his own museum in Cameroon.

Other Finds, Notes, and Views from the

Triceratops Expeditions 1959 – 1964

During the six field seasons in Montana a number of events and views which were gathered are provided below as part of the documentation. Only a few were directly involved in the actual excavation of *Triceratops*. Others are presented here as part of the field environment in figures 12 – 28.



Fig. 12: Adjacent areas beyond the quarry limits are opened to locate bones that may belong to the specimen within the quarry itself. B Erickson (left) and R. Sloan (rt.) retrieve skull elements missing from the quarry excavation.

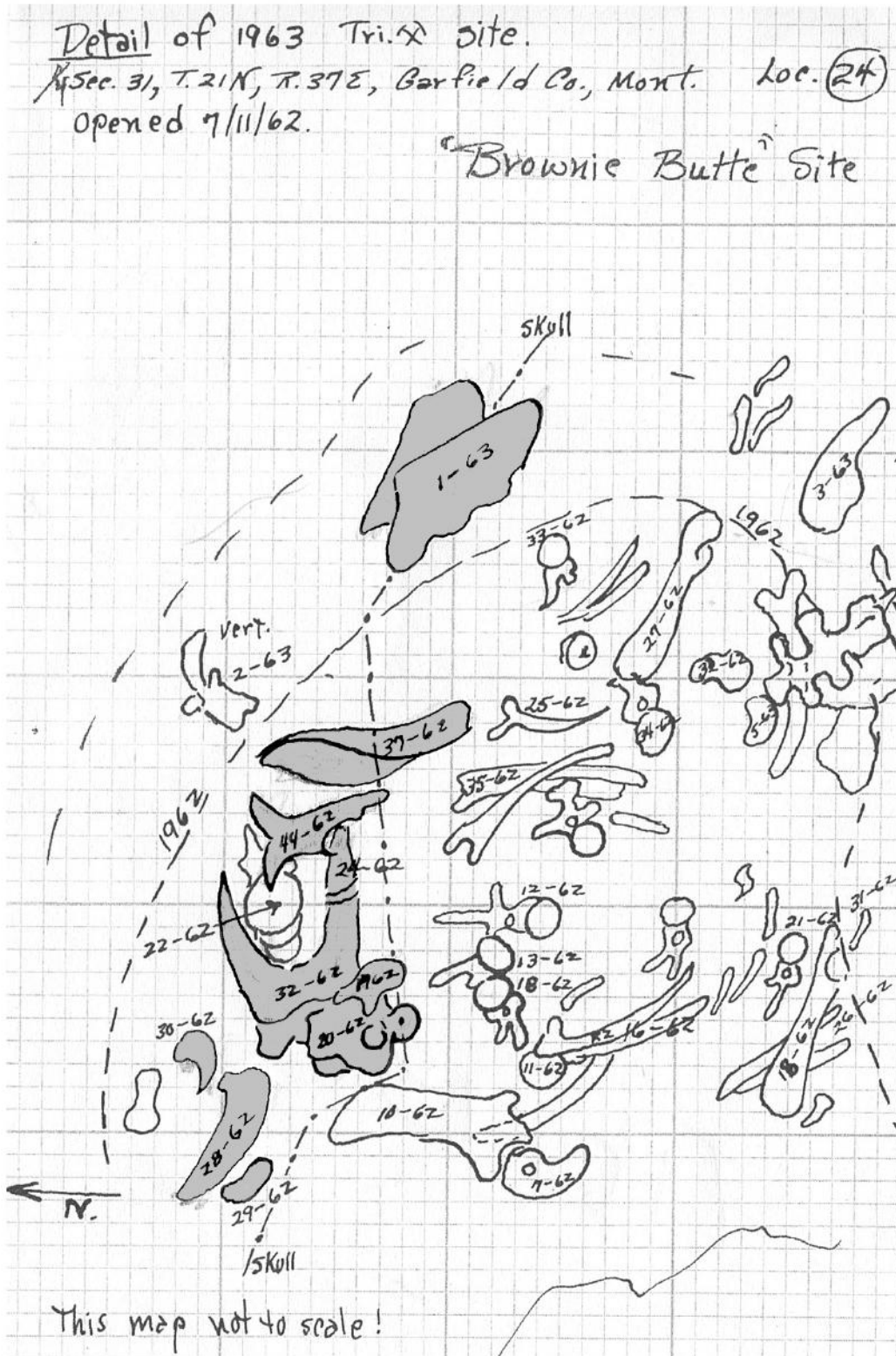


Fig. 13: Field map of a section of the *Triceratops* quarry (Loc. 24) showing the fragmentation of the skull (shaded elements). Disarticulated bones such as those are often carried beyond the quarry limits by water movement or scavengers. Quarry limits for 1962 – 1963 indicated by dashed lines. Field numbers show sequence and year collected.

Fig. 14: The crated skull at locality 11 is ready for transport to the museum. Note the skids on the crate's bottom to assist it in being moved from one side of the coulee where it was discovered, to the other side of the coulee.



Fig. 15: Hell Creek Ranch house 1960, home of Elmer Trumbo when he hunted wolves for the Government in the early twenties. The original roof of the house was sod covered and the house had Kerosene lamps for light inside.



Fig. 16: Dinosaur bone fragments trailing downslope may often lead to a skeleton *in situ* upslope. This is an important awareness when searching for vertebrate fossils especially in badlands.





A



B

Fig. 17: A, Early June storm over the Badlands – (2 min. exposure); B, storms leave Hell Creek overbank and account for much “downtime”. Crossing by horseback is less difficult than crossing by jeep. At high water here, Hell Creek is about 10 feet deep after storm.



Fig. 18: Aerial photograph of Base Camp at Brownie Butte (arrow) looking Northwest 1960 – 1963. Map symbol marks *Triceratops* quarry site (loc. 24).



Fig. 19: “A Cake for the Crew” Lois Erickson cuts the cake that she baked in a reflector oven at Brownie Butte Camp Site.



Fig. 20: Rarely seen wild horses on wide grassy table within the Hell Creek Badlands. Here two are alerted and watching while the others (at left) are moving off.

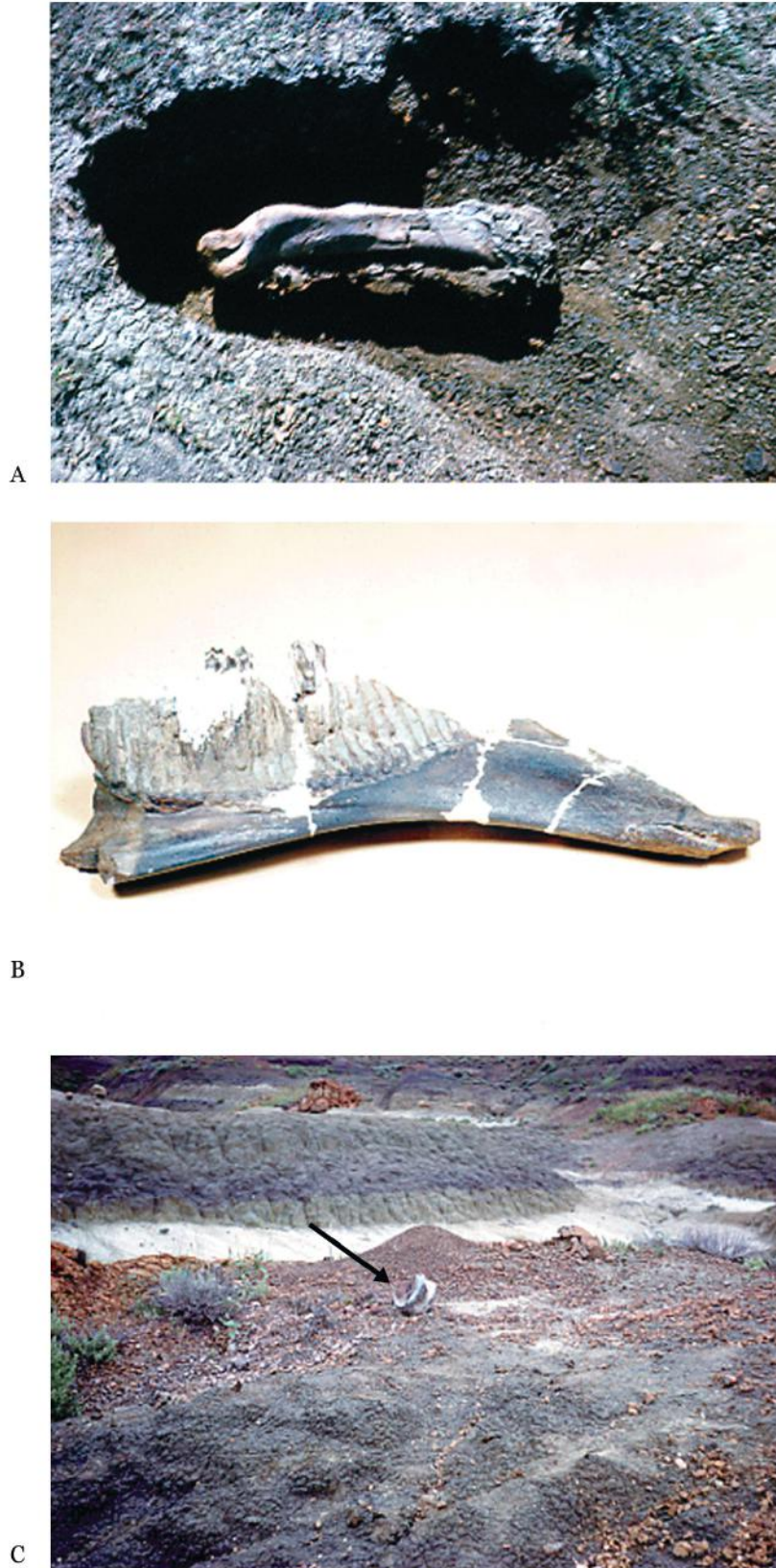


Fig. 21: “Index” fossils: A, metatarsal of *Tyrannosaurus*; B, mandible half of hadrosaur *Edmontosaurus*; C, dorsal centrum of *Triceratops* suggests where to do further prospecting.



Fig. 22: Beginning of a field jacket by plastering a frill bone (squamosal) of *Triceratops* at quarry site.



Fig. 23: Overlooking the Missouri River from the Snow Creek area which yielded numerous fossils as well as the best-eating catfish in Montana.



Fig. 24: “A Fossil-in-the-Making”: A present-day sheep skeleton, its shed woolpack, and its skull drawn back by contracting muscles demonstrates how a skeleton may appear before and during its early stages of fossilization if covered by sediments and left undisturbed.



Fig. 25: Field crew members during the 1963 season (Appendix I).



Fig. 26: "Drifter" ready for another day of prospecting. A cowpony such as Drifter is most useful in roadless badlands because of its surefootedness and ability to cover long distances with its rider.



Fig. 27: Biology students are filled with questions about this dinosaur that often cannot be answered without field reference.

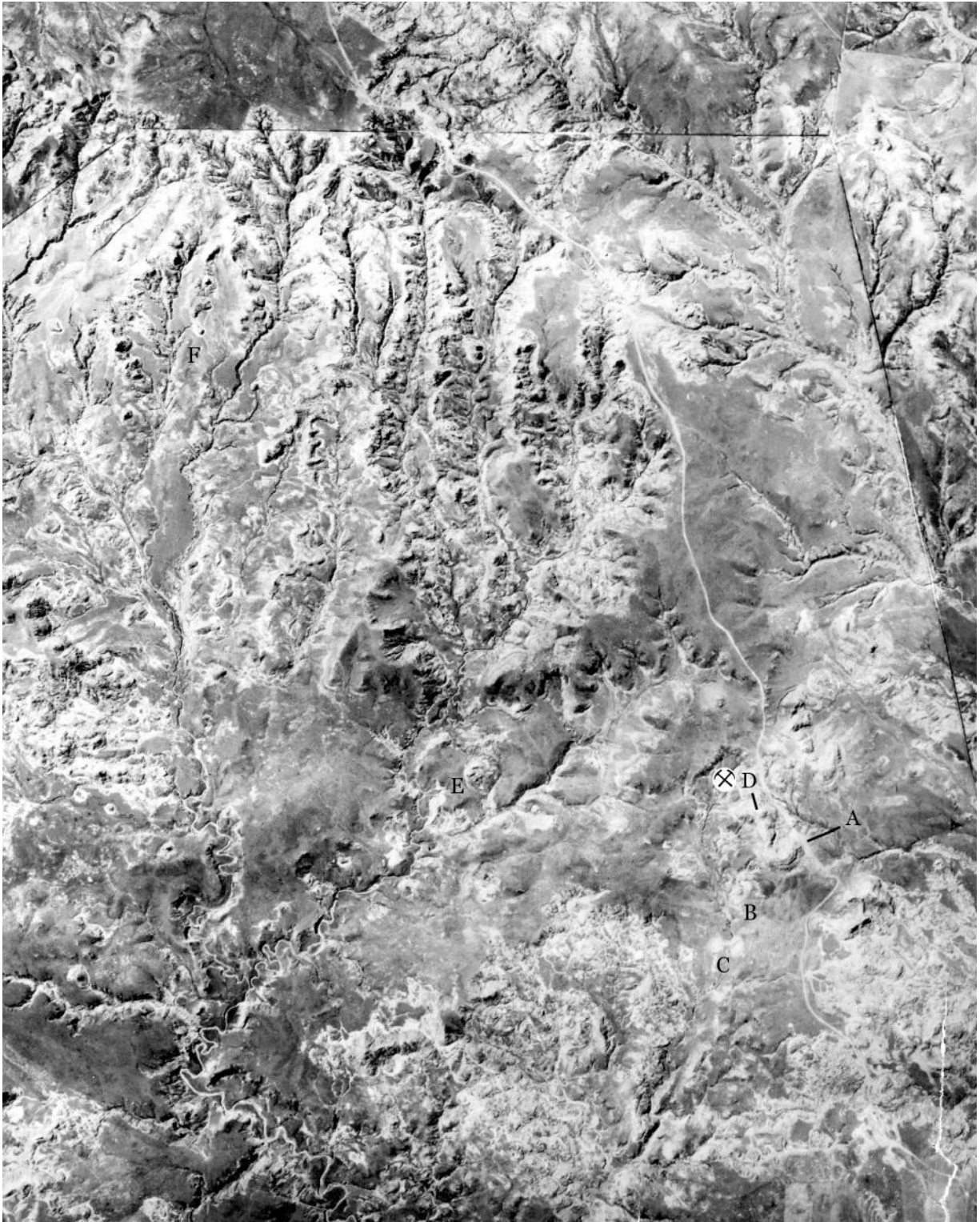


Fig. 28: Aerial photograph of the region most prospected during 1960 – 1963 showing the badlands breaks and tables in Township 21 H, Ranges 36 and 37 E., Garfield County, Montana. This map is a composite of several aerial photographs joined together. Showing locations: A, Brownie Butte; B, camp site; C, first skull site (loc. 11); D, *Triceratops* quarry (loc. 24); E, Stovalls' quarry area ; F, Snow Creek area.

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APPENDIX I

Hell Creek *Triceratops* Expedition Crew Members 1959 – 1964

- 1959: B.R. Erickson, E.W. Hall
- 1960: B.R. Erickson, E.W. Hall, W.H. Hoganson, G. Hadden, R. VanCleave.
- 1961: B.R. Erickson, R. Spading, W.H. Hoganson, L.O. Erickson, J. Hall, D.R. Olsen, C.J. Johnston, P. Fitzpatrick, R.E. Sloan, J. Nelson, J. Webers, R. VanCleave, M. Theison, C.R. Melchior, N. Norton, D. Reily.
- 1962: B.R. Erickson, C.J. Johnston, R. Merrick.
- 1963: B.R. Erickson, P. Fitzpatrick, C. Boggs, J. Birch, R. Spading, F. Logman, S. Garrett.
- 1964: B.R. Erickson, J. Birch, D. Higgins

APPENDIX II

Hell Creek *Triceratops* Expedition Field Numbers F 1-59 – F 5-63

- 1959: F 1-59 – F 4-59; limb and girdle elements.
- 1960: F 1-60 – F 4 – 60; limb and girdle elements.
F 5-60 – F13-60; Skull Locality 11, Brownie Butte.
L 12 -60; F14-60; D14-60; H 15-60; C16-60; M 17-60; N 18-60; postcranials and skull:
Locality, quarry 11.
- 1961: F1-61 – F 18-61; postcranials and skull: locality, quarry 14.
- 1962: F7-62 – F 35-62; F38-62 – F44-62; postcranials and skull: Locality, quarry 24.
- 1963: F1-63 – F5-63; postcranials and skull: Locality, quarry 24.
- Missing field numbers refer to non *Triceratops* material from these localities.
- 1964: Final survey of Locality, Quarry 24.

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