

## UNCOMPAGHGRE DINOSAUR FAUNA: A PRELIMINARY REPORT

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**ABSTRACT.**—A diverse late Jurassic dinosaur fauna, discovered in western Colorado in 1963, contains many undescribed taxa that may represent evolutionary trends at the generic level not previously reported from the Morrison Formation. A preliminary faunal list is given. Bones of the largest known dinosaur, *Ultrasaurus*, are present as are a variety of small animals, including Pterosaurs, in which one sacrum displays avianlike fused sacral neural spines. A new family, the *Torvosauridae*, erected, based on the genus *Torvosaurus* that is redescribed.

One of the most diverse Jurassic dinosaur faunas in North America was found on the Uncompahgre Upwarp in western Colorado in 1963. This fauna contains more undescribed taxa than has been encountered in any other North American Jurassic assemblage in this century. The first vertebrate fossil collecting on the upwarp was by the author in 1964 and continued for the next 20 years. More than 50 tons of dinosaur bone and matrix were collected from an area stretching 35 miles along the upwarp's eastern monocline.

Very little systematic work was done during those two decades of collecting for several reasons: (1) all available funds were used for collecting; (2) the most productive quarries being worked contained masses of disarticulated bones that could not be separated with confidence into specific sets; (3) the author thinks that any attempt to sort and describe extensive deposits of disarticulated material before the largest possible sample is taken will not produce the most comprehensive results; and (4) the collecting program was so productive that it acquired more material each season than could be prepared for study in five or more years. However, many representative specimens were prepared for study, and one unique carnosaur was described and named *Torvosaurus tanneri* (Galton and Jensen 1979).

The author believes the fauna will demonstrate substantial evolution at the generic level when compared to classical Morrison assemblages. Dodson et. al. (1980) state that

their field investigations "failed to find any convincing evidence of evolution at the generic level within the Morrison Formation." There are familiar forms in the Uncompahgre fauna, but there is also consistent evidence of change, or "evolution at the generic level" as demonstrated by: (1) gigantism in more than one sauropod family; (2) at least a 100% increase in carnosaur genera; (3) the presence of the first relatively abundant pterosaur elements, previously known in the North American Jurassic from one phalangeal fragment from Como Bluff; (4) undescribed variations in sauropod skeletal morphology, particularly the axial skeleton; and (5) the presence of ornithischians above the Morrison average, plus various other novel differences.

A problem of identification in this diverse Uncompahgre fauna is focused on the question "How far must an evolving genus move from parent stock, i.e., change morphologically, before it qualifies as a new genus?" Satisfactory criteria to deal with this question do not exist.

Other Morrison quarries today generally produce specimens that can be confidently identified with described material in genera that are comfortably distinct from one another. The Uncompahgre fauna displays so many variations on classical morphology that it probably represents either an advanced or younger fauna. It contains many specimens that look familiar, as if they are closely related, yet vary enough in structure to qualify as new taxa. They may represent evolution at the generic level.

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Detailed studies of the Uncompahgre fauna may at least provide a new window on dinosaur evolution and possibly shed some light on the time-transgressive evolution of Jurassic dinosaurs into Cretaceous forms.

The Uncompahgre fauna will be discussed further and illustrated in a larger paper, "New and Undescribed Dinosaurs of the Southwestern Colorado Plateau," now in preparation.

#### TAXONOMIC REVISION

Romer (1956) listed four carnosaur families: Palaeosauridae, Teratosauridae, Megalosauridae, and Tyrannosauridae. A conservative modern interpretation of the infraorder Carnosauria, as used by Russell (1984), retains the Megalosauridae and Tyrannosauridae but discards the other two families and adds Ceratosauridae, Allosauridae, Aublysodontidae, and Drytosauridae.

Galton and Jensen (1979) placed the genus *Torvosaurus* in the family Megalosauridae, but subsequent laboratory work has doubled the number of elements available for study, revealing a number of diagnostic features in *Torvosaurus* not seen in the Megalosauridae. Although unique morphological characteristics of this genus set it apart from the families listed by Russell, it shares a few common features with the Megalosauridae. In contrast, *Allosaurus* and *Tyrannosaurus*, representing two different families, share common characteristics to a much greater degree than either one resembles *Torvosaurus*.

The genus *Torvosaurus* is best characterized as being a theropod with both primitive and advanced characteristics: the pubis and ischium are of the prosauropod, brachyiliac type; the ilium is of the coelurosaurian, dolichoiliac type. This combination has not been seen in any North American theropod (Galton and Jensen 1979) and may be the only example from any age.

#### Torvosauridae, new family

The new family Torvosauridae is proposed to receive the genus, species, *Torvosaurus tanneri*, Order Saurischia, Suborder Theropoda, Infraorder Carnosauria, New Family Torvosauridae.

**DIAGNOSIS.**—Characterized by robust long bones; skull short, massive, and moderately low; forelimb very short with ratio of maximum length of humerus to radius at more than 2; lachrymal with a 90-degree angle between maxillary and jugal rami; very distinctive pelvic girdle with ilium dolichoiliac; pubis and ischium brachyiliac; pubis with closed obturator foramen. Pubis with an almost continuous median symphysis; very small non-weight-bearing pubic foot.

**TYPE GENUS.**—*Torvosaurus* Galton & Jensen 1979.

**Revised description of *Torvosaurus*:** A large, heavily built theropod with a short skull and a total body length of at least 10 m. Three premaxillary teeth with no rectilinear grooves (Figs. 2D, D<sub>1</sub>); 10 maxillary teeth (Fig. 1, B<sub>1</sub>); open foramina along superior border of fused interdental plates exposing germinal teeth; short dentary with 10 teeth (Figs. 3A-B); unsutured median symphysis; no meckelian groove on medial surface (Fig. 3A<sub>1</sub>). Lachrymal horn absent (Fig. 1A<sub>1</sub>); lachrymal vacuity opening forward (Fig. 1A<sub>1</sub>). Dorsoventrally broad jugal with narrow preorbital ramus. Forelimb with heavy humerus and short forearm with ratios of maximum length of humerus to radius at 2.2; humerus straight with large deltopectoral crest, broad distal and proximal ends (Fig. 4D); proximal end of ulna massive with ratio of maximum length to maximum proximal width at 2.1; metacarpal I with square proximolateral corner; first phalanx of digit I stout, short, and helically twisted along its length; metacarpal II short but extremely massive with ratio of maximum length to maximum proximal width at 1.5; metacarpal III massive, ratio 2.2. Ilium heavy with low dorsal blade, broad brevis shelf and transversely wide acetabular surface. Pubis with closed obturator foramen and a nearly continuous median symphysis on both pubis and ischium. Pubis with no horizontal weight-bearing ventral plane. Astragalus massive, ascending ramus thick and truncated toward calcaneum. (See Galton and Jensen 1979 for previously published figures). Metatarsals massive with no distal lateral or medial pits. Cervical vertebrae with subcircular ball-and-socket joints, the vertical axes being shorter than the horizontal axes; large pleurocoels openly communicating with internal pneu-



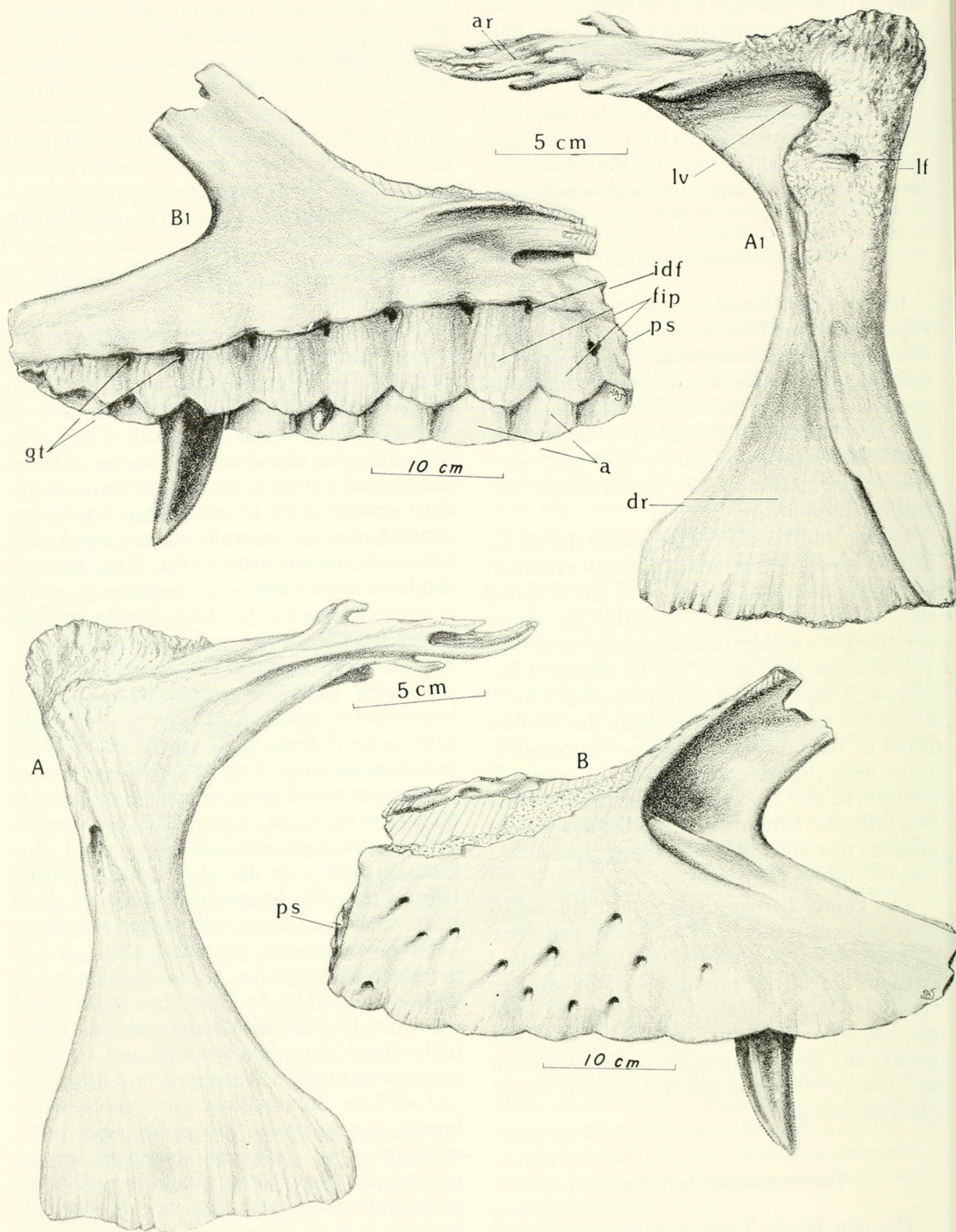


Fig. 1. A-A1, *Torvosaurus tanneri*, left lachrymal: A, medial view. A1, lateral view. B-B1, *Torvosaurus tanneri*, left maxilla. B, lateral view. B1, medial view.

Abbreviations: a, alveoli; ar, anterior ramus; dr, descending ramus; fip, fused interdental plates; idf, interdental foramen; lf, lachrymal foramen; lv, lachrymal vacuity; ps, premaxillary suture.



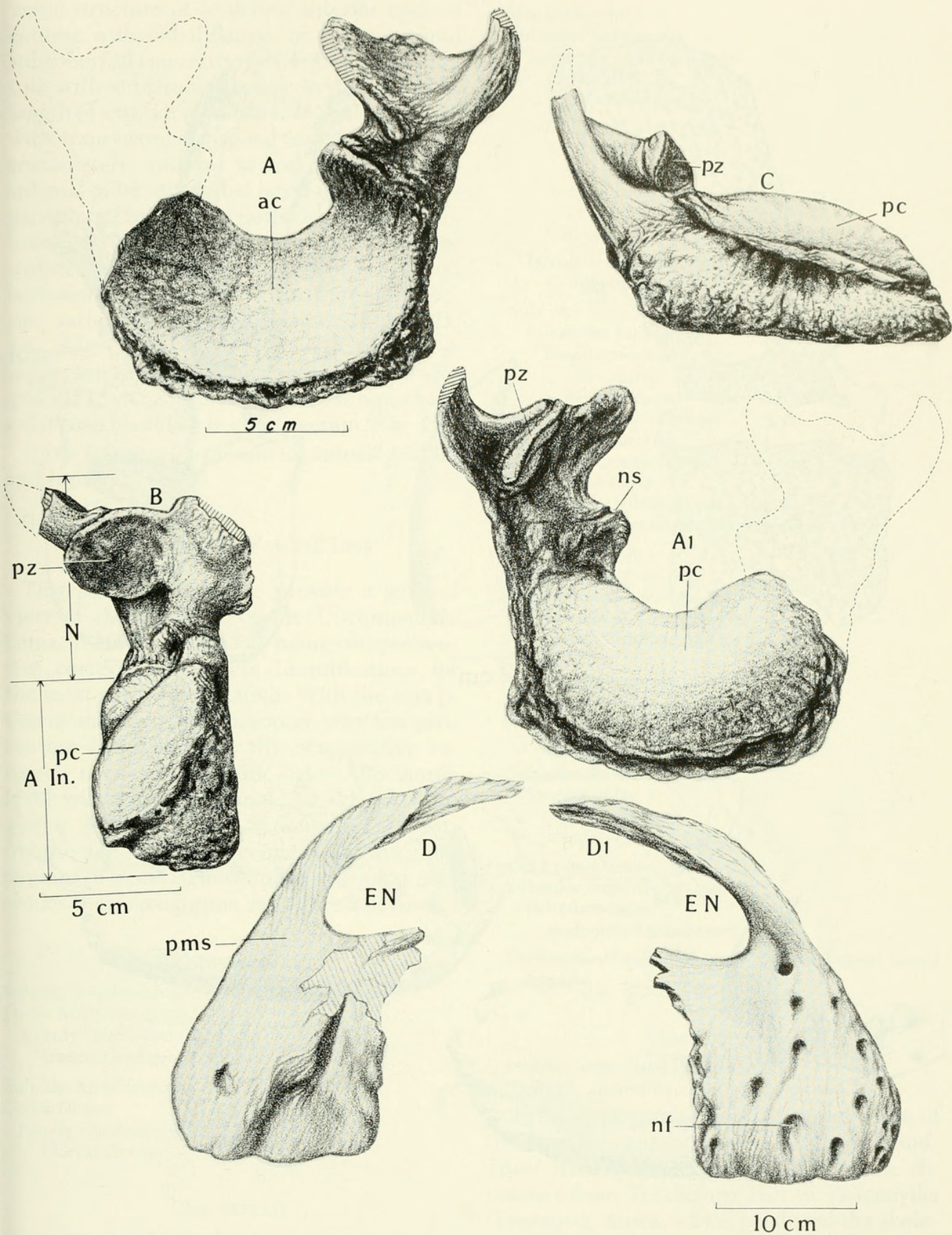


Fig. 2. A-A1, *Torvosaurus tanneri* atlas intercentrum with coossified left neuropophysis. A, anterior view. A1, posterior view. B, right lateral view. C, ventral view. D-D1, *Torvosaurus tanneri* right premaxilla. D, medial view. D1, right, lateral view.

Abbreviations: A In, atlas intercentrum; N, neuropophysis; ac, anterior concavity; en, external naris; nf, nutrient foramen; ns, neurocentral suture; pc, posterior convexity; pms, premaxillary symphysis; pz, postzygapophysis.



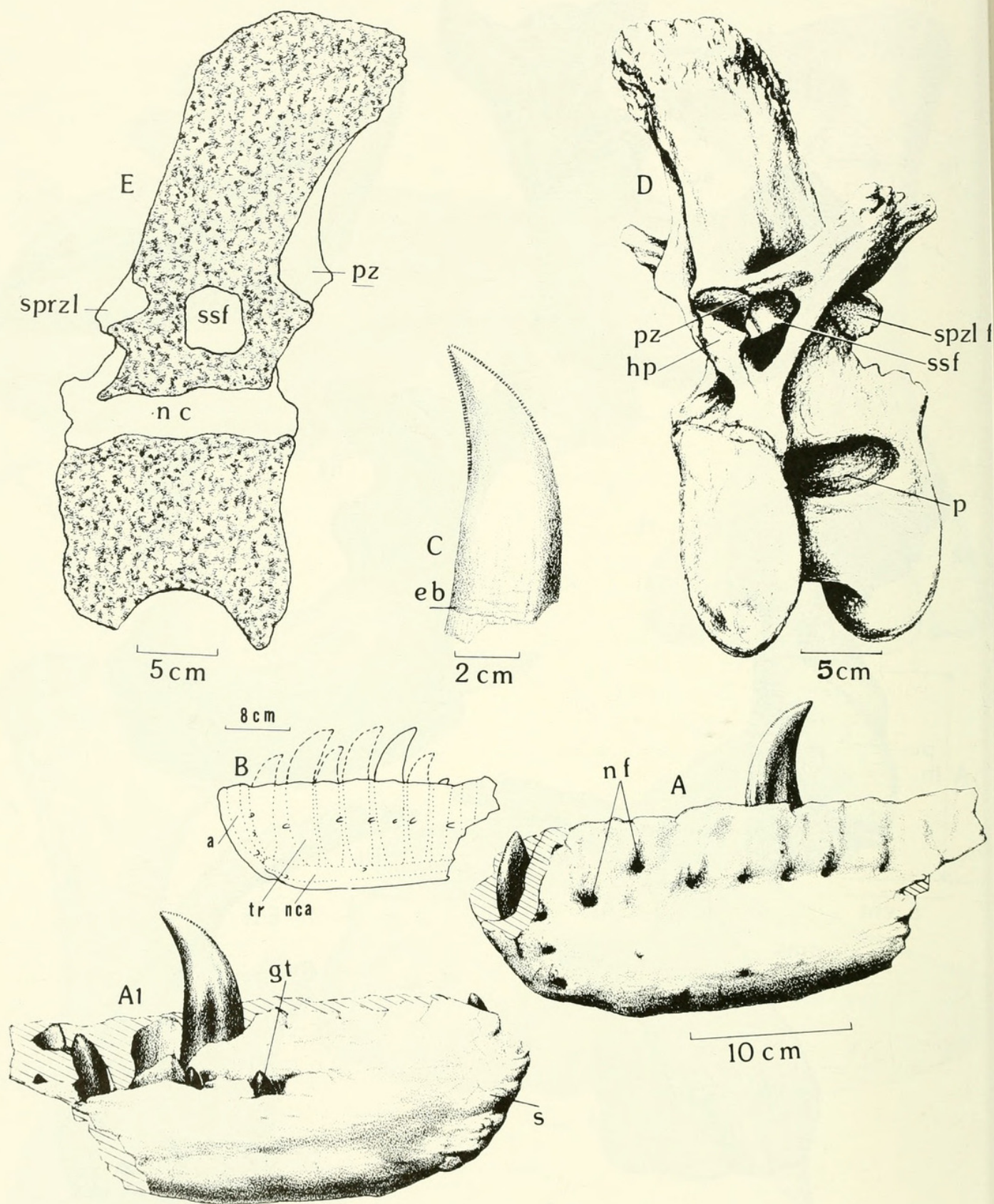


Fig. 3. *Torvosaurus tanneri*: A-A1, left dentary: A, lateral view. A1, medial view. B, simplified tooth diagram, germinal teeth not shown. C, unidentified carnivore tooth. D, *Torvosaurus tanneri* posterior dorsal vertebra. E, median cross section of torvosaur dorsal vertebra.

Abbreviations: a, alveoli; eb, enamel bases; gt, germinal tooth; hp, hypantrum; nc, neural canal; nca, nutrient canal; nf, nutrient formamina; pz, postzygapophyses; s, symphysis; sprzl, supraprezygapophyses; spzl f, supraprezygapophysal flange; ssf, subspinal fenestra; tr, tooth root.



matic structure of centrum; anterior ends of centrae with radial flange, or collar, around subspherical convexity; posterior ends of centrae with subcircular concavity deeper than length of anterior convexity. Dorsal vertebrae with transverse, subspinal fenestrae passing transversely, anterior to and isolating hyposphenal pillar; expanded bases of supraprezygapophysal laminae on posterior dorsal vertebrae intruding onto posterior, superior surfaces of prezygapophyses with no fusion between ventral surface of intrusion and superior surface of prezygapophyses (Figs. 3D, 4B, B<sub>1</sub>). Caudal vertebrae with transverse processes backswept approximately 30 degrees (Fig. 4C<sub>1</sub>). Chevrons more subquadrangular than bladelike in cross-section (Fig. 4F).

TYPE SPECIES: *Torvosaurus tanneri* Galton and Jensen 1979.

UNCOMPAHGRE FAUNAL LIST

This list is intended to provide a general view of the diversity of the Uncompahgre fauna. It is not certified as being comprehensive, correct, or complete. Identifications, for the most part, are tentative. With the exception of one described theropod, very few genera are listed because the comparative research necessary to work below the family level will not, and cannot, be done by the author. Additional taxa are doubtless present, but the nature of the specimens and the great amount of material awaiting preparation precludes their recognition at the present time.

Class OSTEICHTHYES

- Subclass Lepidosauria
- Order RHYNCHOCEPHALIA
  - Family Sphenodontidae
  - Undescribed genus, species
- Subclass Archosauria
- Order DIPNOI
  - Family Ceratodontidae
  - ? *Ceratodus* sp.

Class REPTILIA

- Order CHELONIA (TESTUDINATA)
  - Family Pleurosternidae
  - ? *Glyptops* sp.
  - Undescribed genus and species
- Order CROCODYLIA
  - Family Crocodylidae
  - Crocodylinae

- Order SAURISCHIA
  - Suborder THEROPODA
    - Infraorder COELUROSAURIA
      - Coeluridae
      - Undescribed family
    - Infraorder CARNOSAURIA
      - Allosauridae
        - new genus, species
      - Torvosauridae
        - Torvosaurus tanneri*
        - One or more undescribed families
    - Infraorder Ornithomimosauria
      - Ornithomimidae
  - Suborder SAUROPODMORPHA
    - Infraorder Sauropoda
      - Brachiosauridae
        - Ultrasaurus*
        - Brachiosaurus* ? *altus*
        - undescribed genera
      - Camarasauridae
        - undescribed genera
      - Diplodocidae
        - undescribed genera
      - One or more undescribed families

- Order ORNITHISCHIA
  - Suborder ORNITHOPODA
    - Hypsilophodontidae
      - Laosaurus*
        - indeterminate species
      - Othnelia*
        - indeterminate species
    - Iguanodontidae
      - Camptosaurus*
        - unidentified species
  - Suborder STEGOSAURIA
    - Stegosauridae
      - Stegosaurus*
        - indeterminate species

- Order PTEROSAURIA
  - Suborder PTERODACTYLOIDEA
    - Pterodactylidae
      - unidentified genera and species

Undescribed? suborder (avianlike fused sacral neural spines)

Class MAMMALIA

*Incertae sedis*: distal half of humerus  
(Probably multituberculate or triconodont)

The Uncompahgre fauna includes some of the most spectacular fossil bones ever found. Their size equals or exceeds that of the dinosaurs from Tendaguru Hill in Tanganyika (Tanzania), Africa, which produced the skeleton of the great *Brachiosaurs brancai*, long displayed as the world's largest dinosaur in the Museum für Naturkunde in Berlin. It stands 11.87 m tall and 22.65 m long. The British Museum of Natural History also collected material from Tanzania, but specula-



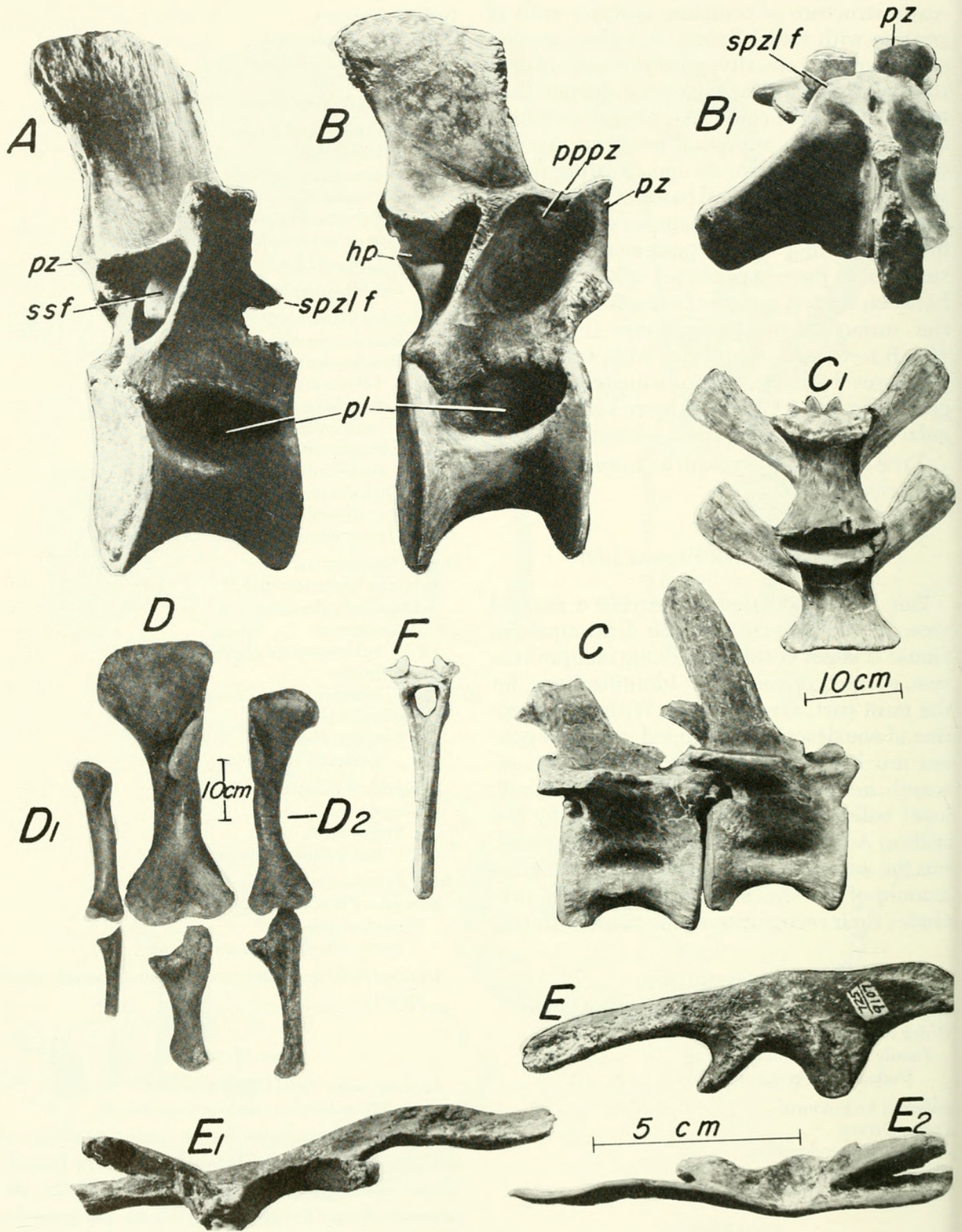


Fig. 4. *Torvosaurus tanneri*, A-F: A, posterior dorsal vertebra, right lateral view. B-B1, posterior dorsal vertebra. B, right lateral view. B1, superior view. C-C1, articulated medial caudal vertebrae. C, right lateral view. C1, ventral view. F, posterior view of chevron, articulates with C, C1. D-D2, three theropod forelegs representing three families: D, Torvosauridae, *Torvosaurus tanneri*. D1, Tyrannosauridae, undescribed genus, species. D2- Allosauridae, *Allosaurus* sp. E-E2, *Othnelia* sp. ilium: E, left lateral view. E1, ventral view. E2, medial view.

Abbreviations: hp, hypantrum; pl, pleurocoel; pppz-posterior process of prezygapophysis; poz, postzygapophysis; pz, prezygapophysis; spzl f, supraprezygapophysal laminar flange; ssf, subspinal fenestra.



tion as to which locality produced the largest dinosaur is put to rest by the presence of a cervical and a dorsal vertebra, both nearly 4'6" (1.36 m) long and two scapulocoracoids 8'10" (2.70 m) long from Dry Mesa.

Because of perpetual universal interest in dinosaurs, the discovery of these materials was given wide exposure by the international news media. The first such discovery was that of a sauropod scapulocoracoid eight feet (2.44 m) long in 1972. It was given the popular name "Supersaurus" by an article in the domestic and all international editions of the *Reader's Digest* (George August 1973).

A larger scapulocoracoid, 8'10" (2.70 m) long, was collected from Dry Mesa the same year but was not prepared until several years later, thus remaining unknown to the news media. It displays diplodocid affinities.

In 1979, during the filming of a Japanese Television Workshop documentary at the Dry Mesa quarry, a second scapulocoracoid 8'10" (2.7 m) long was discovered and received extensive international publicity as the "world's largest dinosaur" under the popular name "Ultrasaurus." At the time of the discovery, and in response to persistent questions from the news media asking what the huge creature would be called, the author replied that, since it was probably the ultimate in size for a land animal, unofficially he would name it *Ultrasaurus*.

Subsequent universal usage of this name, applied to the huge dinosaur bones from Dry Mesa, has established it as the "world's largest dinosaur" in many publications such as various textbooks; documentary films; science pamphlets for school children; popular books written by scientists, e.g., *Dinosaurs, an Illustrated History* by Dr. Edwin H. Colbert; books by popular writers, such as *Dinosaurs of North America* by H. R. Sattler, *The New Dinosaur Dictionary* by Donald Glut, and *Dinosaurs Discovered* by John Gilbert; and various other hardcover publications, all of which cite *Ultrasaurus* as being the world's largest dinosaur.

The *Ultrasaurus* scapulocoracoid represents a family unlike that of the other two large specimens. It is characterized by a constricted central shaft 9" wide (23 cm) and a prominent tabular process on the lower anterodorsal border, and it is not greatly expanded dorsoventrally at the distal end as is the case in *Brachiosaurus*.

This huge bone was protected only by a shallow layer of loose dirt and rocks when discovered, having been subjected to deterioration from plant-root raiding, frost action, and water leaching for a long time. Its extremely fragile condition suggested a plaster mold be made of the first side exposed to preserve all dimensions in case of mishaps during collection and transportation. A model was subsequently developed from the mold, and a cast of it has been circulated internationally as part of "Ultrasaurus, the world's largest dinosaur."

Additional large bones were collected that obviously belong to one of the three large scapulocoracoids, but they cannot be correctly matched up; e.g., a cervical vertebra nearly 4'6" (1.36 m) long was collected, but there is no way to relate it to a particular scapula.

Other unusually large sauropod elements collected include: a posterior dorsal vertebra 4'6" (1.36 m) tall; a very robust median dorsal vertebra 1 m tall; several cervical vertebrae more than 1 m long; an unusually large anterior caudal vertebra; an articulated posterior caudal series 12 feet (3 m) long; an ischium; various rib materials, including a rib head 18" (45 cm) across the capitulum/tuberculum dimension; and a pedal phalange. No large sauropod cranial elements or appropriately large limb bones were found.

### Theropods

At least four genera and more than one unidentified family are represented by theropod humeri. An equal number of novel forms can be identified in caudal vertebrae, but since humeri and caudal vertebrae do not articulate there is no way to properly match them up.

One humerus displays an anomaly involving the distal half of the shaft. A massive abnormal growth of bone penetrated by random vascular burrows indicates a serious pathological condition in life. The elbow joint was destroyed and the forearm was completely useless, if not severely atrophied. The proximal half of the bone is moderately robust, with a straight shaft, a moderate expansion of the proximal articular surfaces, and a short deltoid crest. It belongs to an undescribed genus in an



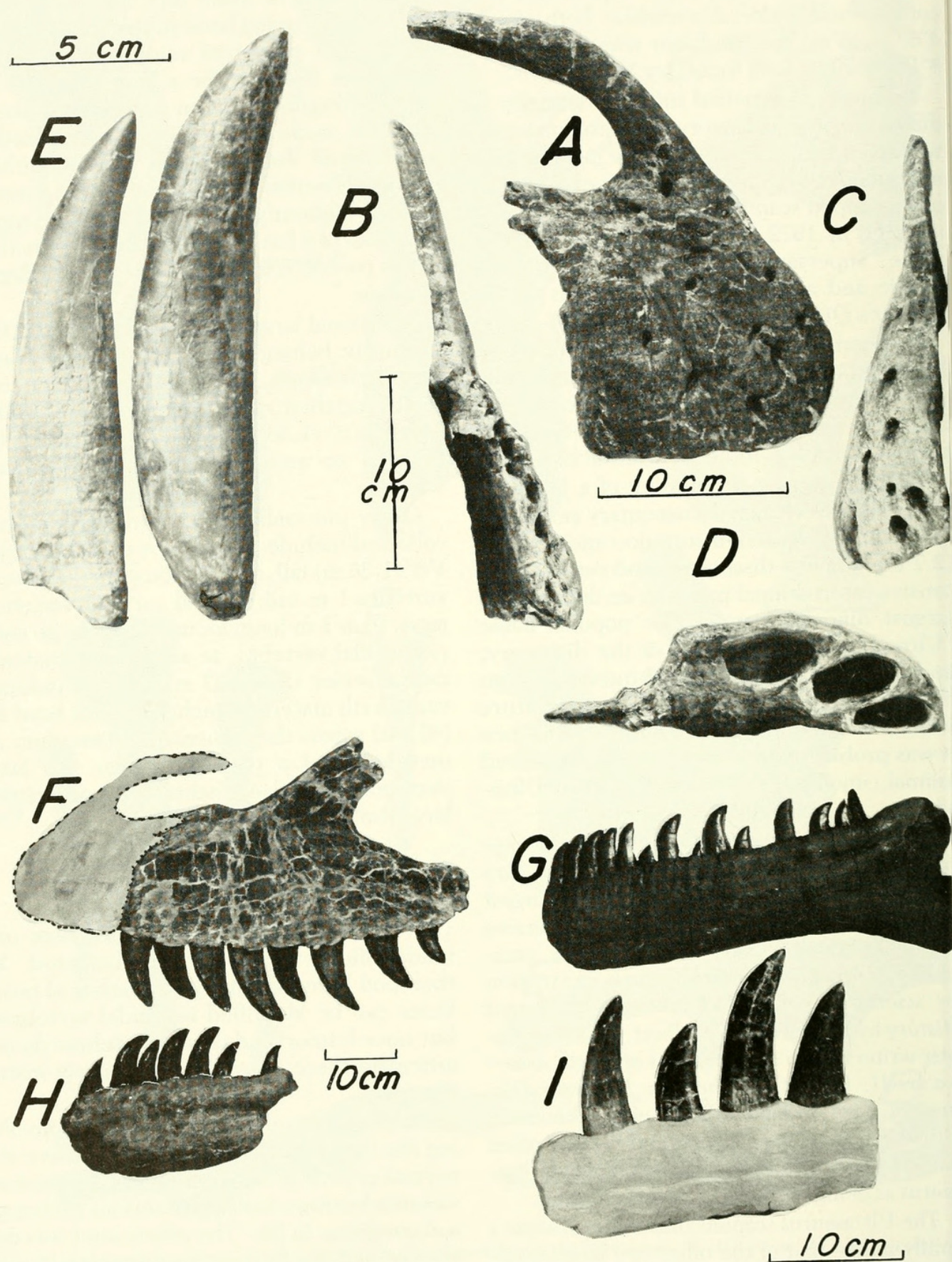


Fig. 5. A–D, *Torvosaurus tanneri* right premaxilla: A, lateral view. B, maxillary contact, or posterior edge. C, anterior edge. E, two shed teeth, ? *Torvosaurus tanneri*. F, H, I, *Torvosaurus tanneri*: F, left maxilla with outline premaxilla. H, left dentary. I, four shed teeth in clay model for contrast with G, left dentary of *Allosaurus* sp.



unidentified family. Other abnormal conditions occurring on elements in the fauna include various excellent examples of gnawed bones.

### A Remarkable Carnosaur

The genus and species *Torvosaurus tanneri* was erected on the holotype elements consisting of the left humerus, radius, and ulna. A matching right forelimb was found nearby but not in close association. The holotype and all referred materials were used in the familial and generic diagnoses.

The referred material was selected because it matched the very robust nature of the genus and because there was no evidence of a second robust carnosaur genus present in the deposit.

Based on a comparison of a dozen metatarsals and an apparent enigma in the distribution of diagnostic characteristics in the vertebral column, the author feels there may be two *torvosaur* species present in the fauna. That possibility may be considered by future workers.

### Small Dinosaurs

There is an interesting variety of single elements from small dinosaurs in the fauna. Small, proximally compressed metatarsals are characteristic of both coelurosaurid and ornithomimid genera making the identification of incomplete pedal elements guesswork. No small cranial elements have been recovered to date, but one very important diagnostic pelvic element was recently uncovered in a plastered block in the laboratory.

An *Othnelia* sp. *ilium* (Fig. 4E) was found marking another occurrence of this characteristically European genus in North America. Galton and Jensen (1975) incorrectly identified the locality producing the first known North American *Othnelia* skeleton as being in the Lower Cretaceous. Instead, the skeleton was collected by the author from the base of the Brushy Basin Member, Upper Jurassic Morrison Formation, near an important fossil plant locality (Chandler 1966) in central Utah.

This small ornithopod belongs to a suborder widely distributed in the Upper Jurassic of North America but poorly known, partly because of a paucity of good study specimens. Its

infraorder, Hypsilophodontia, has undergone various revisions in recent years and at present is in a state of mild confusion. Because of this and the incomplete nature of ornithopod materials from Dry Mesa, miscellaneous small specimens such as centrae and random fragments of small bones can only be listed as unknown ornithopod or theropod.

### Pterosaurs

Pterosaurs were previously known from the Jurassic of North America by one short phalangeal fragment from Como Bluff. Dry Mesa produced the first significant Jurassic pterosaur material, which includes a sacrum with avianlike fused neural spines and a very reduced caudosacral vertebra. The tail was extremely small, with no important function. The neural spines contrast with all described forms that display short, well-separated spines of equal height. One procoelous dorsal vertebra is present, together with three humeri, various more or less complete manual elements, a nearly complete scapulocoracoid, a tiny femur with a spherical head set on a stem nearly parallel to the femoral shaft, and a tiny unidentified cervical vertebra that may be pterosoaurian.

### ACKNOWLEDGMENTS

Interested students and aspiring paleontologists who worked on the Uncompahgre fauna project over two decades include Lee Perry, Dennis Belnap, Kevin Maley, Michael Fracasso, Michael Scheetz, Rodney Scheetz, Brooks Britt, Dee Hall, Richard Erickson, and others. Funding for the project came from a regular Brigham Young University, Earth Science Museum budget plus contributions from private sources such as the National Geographic Society, the Sierra Club, small donations from hundreds of children, and, in particular, the Kenneth Thomson family of Toronto. Logistic and social support were consistently supplied by the late Daniel ("Eddie") Jones and his wife, Vivian, of Delta, Colorado, who directed the author to the best fossil localities worked. The author expresses his sincere thanks to them for knowing where to look and for demonstrating for 20 years an enthusiastic determination to get there. Their contribution to science is invaluable.



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