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Bulletin 20

New Mexico Museum of Natural History and Science

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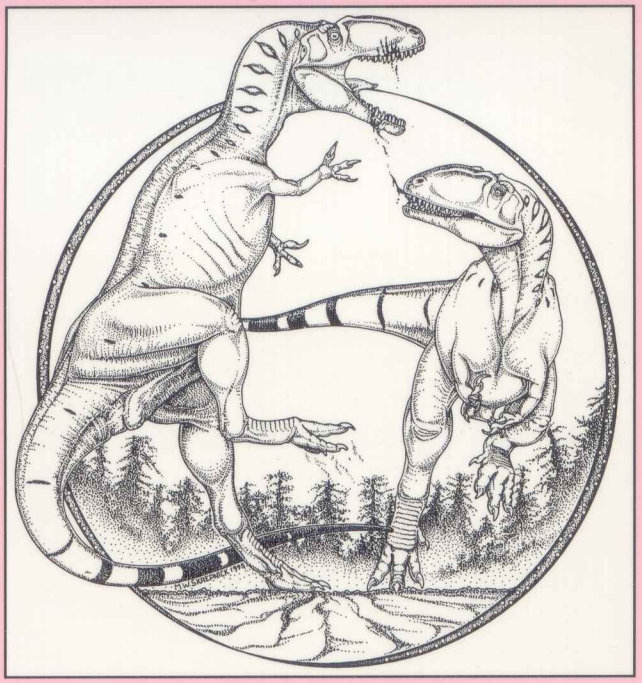
DINOSORES: An Annotated Bibliography of Dinosaur Paleopathology and Related Topics—1838-2001



by

Darren H. Tanke and Bruce M. Rothschild

Albuquerque, 2002

DINOSORES: An Annotated Bibliography of Dinosaur Paleopathology and Related Topics —1838-2001

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This bibliography is dedicated to the memory of Dr. Roy Lee Moodie (1880-1934), America's first vertebrate paleopathologist.

"If I have seen further it is by standing on ye shoulders of Giants"
Isaac Newton

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FOREWORD

"Pathology" has been in the forefront of dinosaur history from its earliest days. Gideon Algernon Mantell, a family physician from Sussex, and his wife, while on patient care "rounds," found the first English dinosaur (Rothschild and Martin, 1993), 19 years prior to Sir Richard Owen's 1841 establishment of the neologism.

APPROACH TO THE QUESTION OF PATHOLOGY

The early years of dinosaurian paleopathology were characterized by promulgation of intriguing, but untested hypotheses. Although the suggested diagnosis may have appeared reasonable, validation of those hypothetical diagnoses were seldom subjected to rigorous testing. Initial speculations were often quite wild, as exemplified by the suggestion that growth hormone overproduction was responsible for frills in ceratopsians (Anon., 1934). There is a major difference between diagnosis by supposition of how a disease may afflict the skeletons and noting the actual nature of impact of known disease (diagnosed in life) on the skeleton. An alternative approach has developed (Rothschild and Martin, 1993; Rothschild and Tanke, 1992), utilizing clinical cases/populations, wherein the diagnosis is known, to establish a standard for disease recognition. Humble origins in reporting of isolated bone injuries and fusions (Brown and Schlaikjer, 1937; Sternberg, 1940; Tyson, 1977; Moodie, 1923) gave way to rigorous scientific studies of population pathology (e.g., Tanke, 2002), now termed paleo-epidemiology.

What began as a curiosity is now fully recognized as science, with all the credibility and obligation. Recognition of disease in the fossil record assumes that the representative body components are preserved, that ancient diseases/disorders have not undergone significant change in morphologic presentation and that the changes can be distinguished from those of diagenesis/taphonomic change. Initial forays into paleopathology were challenged by limited information on the actual impact of contemporary disease. Fortunately, the most often represented material in paleontologic sites (bone) has a limited variability in its disease response. Thus, perspectives in human diseases appear directly attributable to other animals in a species and time-independent manner.

The field of paleopathology has now made the transition from speculation to hypothesis testing. Advancements in technology and understanding of disease processes now allows hypotheses to be critically examined. The underlying assumptions (Rothschild and Martin, 1993, 2001) are that:

1. Disease manifestations are relatively stable through time.

2. Tissue is preserved in a state amenable to analysis.

3. Pathology can be distinguished from diagenesis (pseudopathology).

4. If a testable hypothesis cannot be generated, consider:

   a. Interdisciplinary "brain-storming" sessions.

   b. Relegating the issue to the "future research" file.

5. Analysis of pathology as a skeletal phenomenon provides more insight than examination of isolated bones.

6. Analysis of pathology as a population phenomenon provides more insight than examination of isolated skeletons.

7. Collaborative approaches are essential.

TECHNICAL ASPECTS

Documentation that structural integrity of dinosaur bone is maintained (Broili, 1922; Dollo, 1887) has been supplemented by documentation of preservation of collagen protein in such specimens (Wyckoff, 1980). Rare preservation of skin and muscle structures (Kellner, 1996) affords opportunities beyond that represented in osseous structures. Chinsamy (1994) and de Ricqles (1974) have taken the science of histology beyond simple observation, to tackle the question of dinosaur endothermy.

The importance of distinguishing pathology from artifact has been especially important in the new arena of DNA analysis. A recent report of extraction of ancient DNA from a dinosaur (Woodward et al., 1994) proved to be contamination by humans handling the specimen (Hedges and Schweitzer, 1995). This contrasts with the eloquent work by Mary Schweitzer (Schweitzer, 1993; Schweitzer and Cano, 1994; Schweitzer et al., 1996; Schweitzer and Horner, 1999), in which non-fossilized microscopic structures in tyrannosaur bone appears to have a cellular form, possibly a red blood cell, which is being subjected to cautious analysis. This is truly one of the frontiers of paleopathology.

Computerized tomographic (CT) can now generate three-dimensional images, even "dissecting out" the areas of interest (Conroy and Vannier, 1985; Farrell and Zappulla, 1989; Woolson et al., 1986) and it is now documented that magnetic resonance imaging can be applied to fossils (Sebes et al., 1991).

DENOUEMENT

Collaborative investigations by specialists in structure/function relationships (e.g., paleontologists) and specialists in disease (e.g., health care providers) has allowed significant progress. Paleopathology provides a window on a long extinct world, providing otherwise unattainable perspectives of activity and environment. Collaborative efforts in paleopathology also familiarize paleontologists with techniques that facilitate non-destructive anatomic studies. "Cross-pollination" in an intellectually honest, collegial environment affords unlimited opportunities. The future is limited only by our imagination. [BMR].

ACKNOWLEDGMENTS

This project could not have been completed so fully without the assistance and co-operation of our many colleagues worldwide. The co-editors would like to especially thank Mr. Tracy Ford (Poway, California, USA) for photocopying and taxonomic advice; Mr. Gerhard Maier (Calgary, Alberta, Canada) and Mr. Claude Owen (St. Catharines, Ontario, Canada) both for translation of some of the German articles; Patricia E. Ralrick for photocopying, tracking down obscure articles, data-entry and her unflagging support. Mr. Tom Kaye (Prospect Heights, Illinois, USA) kindly donated a zipdrive early on during the project. Dr. Barry Baker of Texas A&M University (Cleburne, Texas, USA) kindly arranged for the acquisition of some hard to find citations as this project neared final completion. Mr. Dennis Lister, formerly of the TMP Co-Operating Society provided financial and other useful advice. We thank Dr. Philip J. Currie, Mr.'s Andy Neuman, Vien Lam and library staff of the Royal Tyrrell Museum of Palaeontology (Corinne Pugh, Deb Lister) for their past and continued assistance and support which has helped make this ongoing compilation possible. Dr. Kenneth Carpenter read an earlier (c. 1999) draft of this manuscript. Finally, we thank Drs. Andrew Heckert and Spencer Lucas (New Mexico Museum of Natural History and Science, Albuquerque) for their assistance in getting this long-awaited bibliography published in its present format.

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DINOSORES: AN ANNOTATED BIBLIOGRAPHY OF DINOSAUR PALEOPATHOLOGY AND RELATED TOPICS —1838-2001

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INTRODUCTION

Paleopathology used to simply be defined as the study of diseases and injuries of ancient man and animals. This definition has changed dramatically over the past fifteen to twenty years, however. With our ever increasing knowledge base and advanced medical technologies, paleopathology has now become a large and complex multidisciplinary field of study encompassing a wide variety of topics. A quick perusal of this bibliography will directly reflect that multidisciplinary theme. In addition to citations on dinosaur osteopathy and dental disorders, you will find other diverse and related dinosaur topics such as mass mortality, soft tissue preservation, eggshell pathology, footprints showing signs of injuries; "limping" dinosaur trackways; dinosaur blood; behavior and possible behaviors derived from the study of paleopathology, insects as vectors of disease, medical technologies or techniques useful for the study of paleopathology (CAT scans, X-Ray, TEM, MRI), intraspecific/interspecific strife, science fiction, biochemistry, DNA, bone histology, biomolecules (amino acids, proteins, lipids, etc.), cannibalism, physiology, cartoons and other categories of interest.

Many citations listed below were culled from scientific journals and technical publications, although popular sources such as books, magazines, newspaper, video and a few Internet sites are also included. While we have included many popular works, no doubt we have missed some. Please alert us to any missing citations. All citations are in English and of a scientific format unless otherwise noted.

The authors' abstracts, summaries or introductions in each paper are typically included in whole or in part as this bibliography's annotations, and are fully credited herein as such; i.e. [Author's abstract]. Abstracts or summaries penned by the bibliography editors will be followed with our initials [DHT= Darren H. Tanke; BMR= Bruce M. Rothschild]. Any additional or supplemental editorial comments within an original abstract will be enclosed in square brackets, i.e.: [ ], again followed by that editors initials. Any opinions expressed are our own. The closing comments in each annotation as "Illustrated/Unillustrated" is meant to indicate whether examples of dinosaur dento-, osteo-, ichno- or oopathy are actually illustrated in that particular paper. Tables, maps, charts and graphs are not considered as illustrations here.

The following citations have been culled from the massive (14,500+ entries as of July, 2002) and ongoing annotated bibliography of vertebrate dento- and osteopathy (fossil and Recent). Some entries have been re-edited as necessary for this particular bibliography. However, the writing style and format of data presentation herein still parallels that of the main annotated bibliography project. In the future, the main bibliography will be divided up by topic and released as smaller bibliographies dealing with hard tissue path-ology and related topics in extant and fossil fish, amphibians, reptiles, mammals and birds; similar to this bibliography dealing with dinosaurs. Visit: <http://dns.magtech.ab.ca/dtanke> for details on this project.

Some citations will show blank areas regarding the title, volume number, series number, pagination, etc. This indicates that we do not have this information at present and would appreciate any additions or corrections to fill in these deficits. Most, but not all citations were available for our inspection. However, for the sake of completeness, we have included these missing citations anyway, but they are identified in the following annotation as "NOT SEEN." For the most part, citations unavailable for our inspection are NOT included in the taxonomic or subject indexes appearing at the end of this document and are also identified in the annotation as "NOT INDEXED." For some unseen or unindexed papers, we try to provide (where possible) some basic information as to the papers contents. The complete absence of any citations in this compilation means we are either unaware of that publication or have overlooked it. If you have any of these missing citations, know of new works not cited here, want to contribute a "personal communication," or are a researcher and have new articles to submit, the editors would be grateful if you could send them reprints or photocopies of submitted drafts so as to help make future versions of this bibliography up to date.

Our initial intentions was to wait to have this bibliography "completely finished" before publication, but we were/are continually thwarted by new citations. Just when we thought we "had it all" something new turned up. Hydra simply regenerated two new heads for each one Herakles chopped off. His task was relatively simple. Therefore, we present you with a nearly completed version. Some foreign-language articles have been translated (in whole or in part) into English. These are available to researchers either in trade for similar translated articles or a donation towards this or the main annotated bibliography project.

What osteological and/or soft tissue characteristics make a dinosaur a dinosaur has come into increasingly serious question and vigorous debate in recent years. Some authors consider birds as living dinosaurs (or within the group Dinosauria), while others think pterosaurs are dinosaurs. While admittedly both groups are closely related to dinosaurs, the matter remains largely unresolved (to everyone's satisfaction at least). Including birds and pterosaurs in this bibliography would have made it a much larger document. Therefore, until this taxonomic conundrum is resolved, dinosaurs in the bibliography presented herein are considered as dinosaurs in the classic sense---terrestrial, non-crocodilian archosaurs (Triassic to Late Cretaceous in age).

If you find this information resource useful in your published research, we would be grateful if you would cite this com-

pilation in the bibliography of your future technical paper(s). Also, please alert your colleagues to this ongoing project.

To the best of our knowledge, this is the first attempt at a solely specific dinosaur paleopathology and related topics bibliography published on paper. A preliminary version of this bibliography was completed on October 15, 1999 and made available on disk at the SVP meetings in Denver. We hope it can be of some use to you in your research activities. Any corrections, comments and additions or financial support are actively solicited.

This entire compilation is protected by copyright. Copyright of annotations identified as "Authors' abstract" is held by that particular publication the abstract is cited from. At present, this entire bibliography consists of 997 individual entries, gathered from the literature and public domain up to mid-February, 2002.

ABBREVIATIONS

Institutional: AMNH= American Museum of Natural History, New York, New York, USA; BMNH= British Museum of Natural History, London, England; CM= Carnegie Museum, Pittsburgh, Pennsylvania, USA; CMN= Canadian Museum of Nature, Ottawa, Ontario, Canada; FCM= Facultad de Ciencias Marinas, Ensenada, Mexico; FMNH= Field Museum of Natural History, Chicago, Illinois, USA; LACM= Los Angeles County Museum, Los Angeles, California, USA; MOR= Museum of the Rockies, Bozeman, Montana, USA; MPM= Milwaukee Public Museum, Milwaukee, Wisconsin, USA; NMMNH= New Mexico Museum of Natural History, Albuquerque, New Mexico, USA; OMNH= Oklahoma Museum of Natural History, Norman, Oklahoma, USA; ROM= Royal Ontario Museum, Toronto, Ontario, Canada; SMM= Science Museum of Minnesota, St. Paul, Minnesota, USA; SMNS= Staatliches Museum fur Naturkunde, Stuttgart, Germany; SMU= Southern Methodist University, Dallas, Texas, USA; TMP= Royal Tyrrell Museum of Palaeontology, Drumheller, Alberta, Canada; UCMP= University of California Museum of Paleontology, Berkeley, California, USA; USNM= United States National Museum, Washington, D.C., USA; UUVP= University of Utah, Vertebrate Paleontology, Utah Museum of Natural History, University of Utah, Salt Lake City, Utah, USA; YPM= Peabody Museum of Natural History, Yale University, New Haven, Connecticut, USA; ZPAL= Paleobiology Institute, Academy of Sciences, Warsaw, Poland.

Other: C= Celsius; CT= Computed Tomography; DISH= Diffuse Idiopathic Skeletal Hyperostosis; Fm.= Formation; MYA or mya= millions of years ago; N= Newtons; ybp= years before present.

A

Abbey, V.M. 1977. Petrified Dinosaur Blood. Lapid. Jour., 31(8):1858.

("16 million year old dinosaur blood," recovered as red water created during a lapidary process involving the slicing of fossilized dinosaur bone (collected from Colorado, USA) for the creation of fossil jewelry. At least one popular newspaper article resulted from this finding; we have not been able to trace it. Other, older reports of petrified dinosaur blood are probably not dinosaur blood, but pyrite framboids of diagenetic origin. See Martill and Unwin, 1997 for detailed description and discussion. Other papers by Schweitzer and others are also of interest. Unillustrated. Format: Popular. [DHT]).

Abel, O. 1935. Vorzeitliche Lebensspuren. [Prehistoric Life-Traces]. Gustav Fischer, Jena. 644 pp.

(NOT SEEN. Abel figures a Jurassic dinosaur (*Eubrontes*) footprint and a biped trackway from New England, USA showing an injured pes; missing the inner toe (digit II) of the right foot. See Lockley, 1991; Lockley et al., 1994. Language: German. [DHT]).

Abelson, P.H. 1954a. Paleobiochemistry-Organic Constituents of Fossils. Ann. Rpt. Dir. Geophys. Lab., 1953-1954. Carnegie Inst. Wash. Yearbk., 53:97-101.

(The presence of ancient amino acids in Devonian (360 mya) agnathid fish *Dinichthys terralli*; Late Pliocene horse *Plessipus*; Oligocene horse *Mesohippus*; Late Cretaceous mosasaur *Mosasaurus*; Late Cretaceous hadrosaur *Anatosaurus* and Upper Jurassic *Stegosaurus* are demonstrated. See also Abelson, 1955. Illustrated. [DHT]).

____ 1954b. Amino Acids in Fossils. (Abstract). Science, 119:576.

(Amino acids have been discovered in association with a variety of invertebrate and vertebrate fossils. An Ordovician trilobite *Calymene* (approximately 360 million yr old) contained amino acids, three of which have been isolated and identified as alanine, glumatic acid, and valine. These three compounds were also found in a fossil vertebra of the Jurassic dinosaur *Stegosaurus*. Eight other invertebrate and four vertebrate fossils also contained identifiable amino acids.

Particular attention was devoted to $CaCO_3$ fossils. Recent shells of clams, oysters, and tropical snails had 0.1 to 0.2% protein, made up of the most common amino acids. Older shells had an amino acid content of 0.1% or less. The stable amino acids, such as tyrosine, were notably diminished or absent in the more ancient remains.

The fossil observations have been correlated with laboratory studies of the temperature stability of amino acids. Experiments conducted at 200-260 degrees C on aqueous solutions and on amino acids contained in the proteins of clam shells have led to additional knowledge of the thermal stability of amino acids. Half of the alanine present in a dilute solution disappeared in 4 hr at 250 degrees C in a process involving a first-order reaction. From this type of observation, it was estimated that, in storage at room temperature, half of any original alanine could remain after 2 billion yr.

These findings have significance for paleontology and geology. [Author's abstract]).

Abler, W.L. 1992. The Serrated Teeth of Tyrannosaurid Dinosaurs, and Biting Structures in Other Animals. Paleobiology, 18(2):161-183.

(This novel paper includes mention and one figure of an example of a toothmark occasionally found on teeth of Late Cretaceous tyrannosaurids from Alberta, Canada and as having possibly been caused during aggressive intraspecific interactions. A variety of bacterial agents could have lodged in the inter-serration spaces and be transmitted to victims through active biting. See also: Abler, 1997; Tanke and Currie, 1995, 1998 (2000). [DHT]).

____ 1997. Tooth Serrations in Carnivorous Dinosaurs. pp. 740-743. In: Encyclopedia of Dinosaurs. Edited by P.J. Currie and K. Padian. Academic Press, San Diego. xx + 869 pp.

(Figures an unusual pathologic unspecified tyrannosaur tooth (TMP83.98.90) collected from the Campanian Dinosaur Park Formation of Alberta, Canada. While the overall shape of the tooth is normal, multiple rows of supernumerary serrations of normal morphology are present on the sides of the crown and run parallel to the long axis. Etiology of this extremely rare condition [DHT, pers. field obs.] was undetermined. Mentions that broken tyrannosaur teeth are found from time to time and that meat particles trapped in the slots (diaphyses) between the serrations "....would have guaranteed an infectious bite." [DHT]).

____ 1999. The Teeth of the Tyrannosaurs. Sci. Amer., 281(3):50-51.

(Includes comments on septic bites in tyrannosaurids. Reprinted in Paul, 2000).

____ 2000. The Teeth of the Tyrannosaurs. pp. 276-278. In: Paul, G.S. (Editor) 2000. The Scientific American Book of Dinosaurs. St. Martin's Press, New York. vii + 424 pp.

(Includes comments on septic bites in tyrannosaurids. Originally published as Abler, 1999. [DHT]).

____ 2001. A Kerf-and-Drill Model of Tyrannosaur Tooth Serrations. pp. 84-89. In: Mesozoic Vertebrate Life: New Research Inspired by the Paleontology of Philip J. Currie. Edited by Darren Tanke and Kenneth Carpenter. Indiana University Press, Bloomington. xviii + 577 pp.

(Neighboring serrations on the teeth of the theropod dinosaur *Albertosaurus* meet at an angle so small that their junction amounts to a crack in the tooth. A round void (ampulla) at the base of the junction distributes force over an increased area, preventing the crack from propagating through the tooth and breaking it. Serrations on teeth of other ancient

reptiles (phytosaur, *Dimetrodon)* exhibit the junction "crack," but lack the protective ampulla. [Author's abstract]. Illustrated).

Abrams, N.R. 1953. Etiology and Pathogenesis of Degenerative Joint Disease. In: Arthritis and Allied Conditions. pp. ___-___. Edited by J. Hollander, 5th Edition, Lea and Febiger, Philadelphia. 1014 pp.

(NOT SEEN. On p. 691, Abrams incorrectly refers to osteoarthritis as a common disorder of prehistoric animals and specifically in dinosaurs; see Rothschild, 1990c. [DHT]).

Ackerknecht, E. 1953. Paleopathology. pp. 120-126. In: Kroeber et al., editors. 1953. Anthropology Today: An Encyclopedic Inventory. University of Chicago Press, Chicago. xv + 966 pp.

(Spondylosis is known in the Upper Jurassic sauropod *Diplodocus*; see Rothschild and Berman, 1991 for corrected diagnosis of DISH. Also reprinted in Sol, T. (Editor) 1962. Anthropology Today, Univ. Chicago Press, Chicago, pp. 39-45. [DHT]).

Acorn, J. 1993. (Edited by Linda Strong-Watson). Dinosaur - World Tour - Official Souvenir Catalogue. The Ex Terra Foundation, Edmonton. 97 pp.

(Souvenir guidebook for the "Ex Terra Canada China Project," a worldwide traveling exhibit of Chinese and Canadian dinosaur and other fossil vertebrate skeletons. Includes a few items of interest. Mass mortality of Chinese juvenile ankylosaurs of the genus *Pinacosaurus*, possibly overwhelmed by a sandstorm, pp. 32-37. 12 animals were found huddled together, each standing in an upright pose. Pages 38-41, nests and eggs of the Late Cretaceous hadrosaur *Hypacrosaurus* found at Devil's Coulee in southern Alberta, Canada. Certain aspects of this site can be considered as mass mortality event(s). Pages 42-47, Late Cretaceous ceratopsian *Pachyrhinosaurus* material recovered from a spectacular monospecific bonebed exposed at Pipestone Creek, near Grande Prairie, Alberta, Canada. Up to 250 bones were recovered per square meter [this includes waterworn bone fragments and small teeth and is true for the richest sections of the bonebed only [DHT] and was representative of a mass mortality event]. Format: Popular. [DHT]).

Albritton, Jr., C.C. 1989. Catastrophic Episodes in Earth History. Chapman and Hall, London, xvii + 221 pp.

(On page 133, a short section entitled "Bad Eggs" notes the pathological occurrence of either unusually thin, or multilayering of eggshell in the Late Cretaceous sauropod *Hypselosaurus*; material collected from southern France and the Spanish Pyrennes Mountains. [DHT]).

Aldhous, P. 1995. "Jurassic DNA" Looks Distinctly Human. New Sci., 145(1964):5.

(Reports of Late Cretaceous dinosaur DNA by Woodward et al., 1994 are highly controversial. S. Paabo believes the findings reflect human contamination only. See Paabo, 1993. Format: Semi-Popular. [DHT]).

Alexander, R. McNeill 1996. *Tyrannosaurus* on the Run. Nature, 379:121.

(Alexander comments on, and generally agrees with Farlow, Smith and Robinson, 1995, who contend that the Late Cretaceous *Tyrannosaurus* probably did not run as fast as suggested by previous authors, nor as fast as shown chasing a vehicle in the hit science fiction movie "Jurassic Park." A large and heavy animal, such as *Tyrannosaurus*, would seriously injure or accidently kill itself if it fell while running at the speeds postulated by other workers. [DHT]).

Allard, M.W., Young, D. and Huyen, Y. 1995. Detecting Dinosaur DNA. Science, 268:1192.

(Critique of Woodward, Weyand and Bunnell, 1995 who claimed to have discovered Late Cretaceous dinosaur DNA. Allard and his colleagues suggest the fossil DNA is actually from extinct mammalians. See other critiques on pages 1191-1193. With response by Woodward on page 1194. [DHT]).

Alonso, J., Arillo, A., Barron, E., Corral, J.C., Grimalt, J., Lopez, J.F., Lopez, R., Martinez-Delclos, X., Ortuno, V., Penalver, E. and Trincao, P.R. 2000. A New Fossil Resin with Biological Inclusions in Lower Cretaceous Deposits from Alava (Northern Spain, Basque-Cantabrian Basin). Jour. Paleo.., 74(1):158-178.

(The author's illustrate (fig. 11-1) a ceratopogonid, a blood-sucking fly. Borkent, 1995 suggested such insects may have been predaceous on dinosaurs. [DHT]).

Amery, H. 1997. Looking at ...*Velociraptor* - A Dinosaur from the Cretaceous Period. Gareth Stevens Publ., Milwaukee. 24 pp.

(Includes short section on the famous *Protoceratops/Velociraptor* death struggle specimen found in Late Cretaceous Mongolia sediments. Format: Popular (Childrens). [DHT]).

An, __ et al., 1995. _____. _____, __:___-___.

(NOT SEEN. NOT INDEXED. Ancient DNA from dinosaur eggs. Refuted by Hong, 1995).

Anderson, B.G., Lucas, S.G., Barrick, R.E., Heckert, A.B. and Basabilvazo, G.T. 1998. Dinosaur Skin Impressions and Associated Skeletal Remains from the Upper Campanian of Southwestern New Mexico: New Data on the Integument Morphology of Hadrosaurs. Jour. Vert. Paleo., 18(4):739-745.

(The authors describe and well illustrate exquisitely preserved skin impressions with tubercles from the tail region of a fragmentary indeterminate hadrosaur collected from the Upper Cretaceous Ringbone Formation of New Mexico, USA. The function of the complex ridge and groove arrangement present on each tubercle is discussed. Not only would this increase the surface area of the skin (for increased heat exchange?), but may have added ".... surface resistance to tearing or puncturing." Also illustrated in Monastersky, 1999. [DHT]).

Anderson, J. 1994. How Dinosaurs Managed to Procreate. Calgary Herald, January 28, 1995:__. Also: Dino Love- Dinosaurs Were Such Heavyweight Lovers That Procreation was a Muddy Affair. The Edmonton Journal, Sunday, Sept. 18, 1994:D8.

(Mating trauma; dinosaurs. How did large dinosaurs achieve copulation? Dr. Stuart Landry Jr., professor emeritus of biology at the University of New York at Binghamton suggests this was accomplished while in the water or mud in order to support the great weight of the mating animals. A copulating male dinosaur rising on his hind legs would be unable to pump blood that much higher to the brain and would have fainted or suffered a heart attack. Once finished, the male, returning his forelegs to the ground would have landed with such force that it would "reduce its front legs to jelly." Unillustrated. Format: Popular. [DHT]).

Anonymous 1934a. Glands May Have Caused Evolution of Freak Dinosaurs. Sci. News Letter, 25:182.

(See Anonymous, 1934b,c. Format: Popular).

____ 1934b. Glands May Have Caused Evolution of Freak Dinosaurs. Science (n.s.), 79 (2046):10.

(Dinosaurs may have evolved some of their most bizarre species as the result of a peculiar glandular disease, known as acromegaly. Acromegalic human beings become "horse-faced" giants, with huge hands and feet. The disease is caused by the overactivity of the pituitary, a small ductless gland within the skull. Acromegaly has been invoked by Dr. Richard S. Lull, paleontologist of Yale University, to account for the terrific skull sizes and the outrageous development of horns by certain species of ceratopsians, or horned dinosaurs, whose remains have been found in the Belly River Valley [sic: Belly River =(Judith River or now called the Dinosaur Park) Fm.- Late Cretaceous (Campanian), Red Deer River Valley], in western Canada. What may have turned a disease into a driving force in evolution is uncertain: Dr. Lull conjectures some abnormality in the food available to the animals. [Author's abstract]. There is no indication Lull continued on with this line of research; nothing appears in the subsequent literature. [DHT]).

____ 1934c. Glands May Have Caused Evolution of Freak Dinosaurs. El Palacio, 36:65-66.

(NOT SEEN. Reprint of the Anonymous 1934a,b article?).

____ 1965. New Species of Dinosaur Claimed by Chinese. Sci. News Letter, 88(7):101.

(Note on the discovery of the Chinese sauropod *Mamenchisaurus hochuanensis* (140 million years ybp). The presence of pathologies on the cervical and caudal vertebrae, femur and tibia are noted but not illustrated or commented on in detail. They supposedly are of a type not found in other dinosaurs. [DHT] Format: Popular).

____ 1969. Dinosaurs Under Stress. Sci. News, 96(21):477.

(The mysteriously sudden extinction of dinosaurs at the end of the Cretaceous Period may have been due to psychological stress, Prof. H.K. Erben of Bonn University told a Paleontologist's Association Congress in Kiel. Electron microscope examinations of dinosaur eggs from the Late Cretaceous Period shows a pathological excess of calcium in the shells. Some eggs had as many as seven layers of shell, Prof. Erben says. Excessively

thick shells are occasionally found in birds and turtles today. Veterinarians attribute the excess to a malfunctioning of the pituitary gland occasioned by stress. In the case of the dinosaurs, the stress probably resulted from changes in the environment that made life increasingly difficult. However, Prof. Erben notes that the calcium excess might have also been due to genetic mutation. [Author's abstract] Format: Popular. Also reprinted in S. Calif. Pal. Soc. Bull., 2(2):7).

____ 1972. What Did in the Dinosaurs: Warm Blood or Soft Eggs? Sci. News, 102(4):53.

(Dinosaur egg pathology- thinning of sauropod eggshell found in various French localities. Format: Popular. [DHT]).

____ 1975. Did the Anaerobes Defeat the Dinosaurs?. Newsletter Commonwealth Geol. Lias. Off., 12(6):6.

(NOT SEEN. NOT INDEXED).

____ 1977a. Did the Dinosaurs Die of Rickets?. New Sci., 74(1050):265.

(Thin eggshell and "twisted skeletons" of dinosaurs suggested to Soviet geologist V. Elisseyev that dinosaur may have become extinct due to rickets. Absence of lime in the diet is implicated. Details of the "twisting" are not provided. We are unaware of any further research done in this area; see Elisseyev, 1977. Format: Popular. Unillustrated. [DHT]).

____ 1977b. Dinosaur Doctor. Explorer, 19(3):14-15.

(NOT SEEN. NOT INDEXED).

____ 1982. K-Tech II. Cretaceous-Tertiary Extinctions and Possible Terrestrial and Extraterrestrial Causes. Edited by D.A. Russell and G. Rice, Syllogeus, 39, Nat. Mus. Nat. Sci., Nat. Mus. Canada, Ottawa. 151 pp.

(Includes brief comments on the thinning of Late Cretaceous eggshells (sauropod *Hypselosaurus*) in France (Erben et al., 1979) by D. McLean and D.A. Russell (pages 91-92); also some comments on the Late Cretaceous extinctions possibly being brought about by widespread poisoning of the environment due to toxic elements released by an extraterrestrial (comet or meteorite) impact. [DHT]).

____ c. 1987. Scientists Find Mass Grave for Dinosaurs. South China Morning Post, Asian News Section. Date and pagination unknown.

(Mass mortality of juvenile *Pinacosaurus*. The small group was possibly overwhelmed by a sandstorm. Illustrated. [DHT]).

____ 1989a. Rocks Record the End of a Life Never Begun. New Sci., 122(1663):32.

(Review of Hirsch, Stadtman, Miller and Madsen, 1989 work on a pathological dinosaur egg showing multilayering of eggshell collected from the Upper Jurassic of Utah, USA. Format: Popular. [DHT]).

____ 1989b. The Dinosaur That Never Was. Omni, November, 1989:36.

(Details as per Anonymous, 1989a).

____ 1989c. Bonebed Yields Hoard of Horns. Calgary Herald, Thursday, Dec. 7, 1989: A8.

(Newspaper report on the excavation of a *Pachyrhinosaurus* bonebed S.W. of Grande Prairie, Alberta, Canada. Evidence for paleopathologies is seen in the lower back, ribs which showed healed injuries. Intraspecific flank-butting is suggested as a cause of these injuries. Osteopathy unillustrated. Format: Popular. [DHT]).

____ 1990a. The Bull Lizard of Hell Creek Comes to Milwaukee. Lore, 40(1):2-8.

(Page 3 mentions a healed puncture wound on the left side of the skull (squamosal bone) in a Hell Creek Formation (Lancian) ceratopsian *Torosaurus* from Montana, USA. Intraspecific behavior (horn thrust) is suggested as the probable cause of the pathology. Format: Popular. [DHT]).

____ 1990b. Museum Digest- An Interview with John Ostrom. Lore, 40(1):10-12.

(Dr. Ostrom comments on the extra fontanelle discovered in a new Late Cretaceous *Torosaurus* skull on display at the Milwaukee Public Museum. This suggests aggressive intraspecific behavior in this ceratopsian. [DHT] Format: Popular).

____? 1990c. _____'90. Official GuideBook for the Hitachi Dinoventure Exhibit on display at Chiba, Japan, Summer, 1990. 128 pp.

(AUTHOR UNKNOWN. NOT INDEXED. On page 112 of this guide, three examples of Late Cretaceous paleopathology in hadrosaurs from Alberta, Canada are illustrated. "A" is a fragment of a ?radius with new bone development completely encircling the original shaft (TMP66.17.9A). "B" is a dorsal rib head (TMP87.48.3) with mild osteophytic growth, and "C" is another caudal neural spine (TMP65.16.24) bearing a prominent swollen callus on the distal extremity. The latter specimen is figured upside-down. [DHT] Language: Japanese (with a few English subtitles). Format: Popular).

____ 1991a. Return of the Seismosaur. Discover, 12(8):8,10.

(Chemist W. Dale Spall and other scientists at Los Alamos National Laboratory believe they have recovered bone protein from the skeletal remains of the 150 million sauropod *Seismosaurus* collected from New Mexico, USA. After a filtering procedure to separate proteins from other contaminants, a chromatograph isolated several possible proteins from the surrounding rock and the fossilized bone. After closer analysis, some of these were proven to be present in both the rock and the bone, thus barring any possibility of them coming from the sauropod. One protein did show up in the bone alone, and further chromatograph studies proved the sauropod protein not to be a match against the protein collagen found in extant animals. Spall believes the protein "is one involved in directing mineral deposits in the bone," although other unnamed paleontologists remain skeptical. Spall believes such information could be used in the future to better determine dinosaur systematics. See: Gurley, Valdez, Spall, Smith and Gillette, 1991. [DHT] Format: Popular).

____ 1991b. The Largest *T. rex* Yet Discovered. Geol. Today, 7(1):11-12.

(Ex Black Hills Institute "Sue;" now in Chicago Field Museum, Chicago, Illinois, USA. Broken and healing left fibula with a massive exostosis along most of the length of the shaft. Two distal caudal vertebrae were fused together by a great mass of bone. The jaw seems to have been injured as a very malformed double-cusped tooth was found. Discovery of additional pathologies is anticipated as preparation of this specimen continues. Format: Popular. [DHT]).

____ 1991c. Dinosaur Footprints from the Morrison Formation, Moab Area, Utah. Brochure designed by the University of Colorado at Denver Dinosaur Trackers Research Group and the Bureau of Land Management, Grand County District, Moab Office, Utah.

(NOT SEEN. NOT INDEXED. Large Upper Jurassic theropod dinosaur trackway revealing a pattern of alternating long and short steps; suggesting an injured and limping animal. See Lockley, Hunt, Moratalla and Matsukawa, 1994 for detailed description. [DHT]).

____? 1992a. _____. Utan Scientific Magazine, 8, 10, August. Gakken Mook:129 pp.

(AUTHOR UNKNOWN. NOT INDEXED. Includes former Black Hills Institute *Tyrannosaurus* or "Sue." Page 16 shows a pathologic humerus (avulsion). Page 19 shows a large callus affecting the mid-fibula, which is growing up against and touching the tibia. BMR and DHT have examined the specimen firsthand and it represents a healing fracture. The same page also shows two fused distal caudal vertebrae. Language: Japanese; Format: Popular).

____ 1992b. Some Dinosaurs Were Warmblooded. Geotimes, 37(10):7.

(The article discusses the work of William J. Showers and colleagues at North Carolina State University and University of Southern California, wherein the body temperature of animals can be determined by analyzing the oxygen isotope composition of bone phosphate. The body temperature of a warm-blooded animal is constant, and thus any differences in the oxygen isotopic composition between bones from the body core versus the extremities is minor. In cold-blooded animals the opposite is true. Testing of isotopes in dinosaur bones from the end of the Cretaceous revealed *Tyrannosaurus*, and unspecified hadrosaur and ceratopsian genera were comparable to extant American genera of warm-blooded cervids, inviting speculations of warm-bloodedness in these dinosaurs. Format: Semi-Popular/Technical. [DHT]).

____ 1992c. Update on the World's Largest Known *T. rex*. Geol. Today, 7(3):79-80.

(Scarring on the humerus indicating torn ligaments (avulsion), a badly broken and healed fibula, crushed and healed caudal vertebrae, a broken and improperly healed cervical rib, a bitten (?) and healed right side of the skull suggest this *T. rex* "led a vigorous, very active, and somewhat nasty life." [DHT] Format: Popular).

____ 1993a. Jurassic Park and All That. Amer. Paleo., 1(4):12.

(Short review of some of the latest papers on fossil insect DNA

found in amber, and attempts to isolate dinosaur DNA. [DHT]).

____ 1993b. Death by What? Lapid. Jour., Nov.:10.

(Short note. An unusual and unique piece of pathological and unspecified dinosaur bone from the Upper Jurassic of Utah, USA is figured, with a request as to what it is and what the dinosaur might have died from. There is a suggestion of bone cancer in the accompanying text. A portion of a thin section taken from this specimen is now housed at the Royal Tyrrell Museum of Palaeontology collections and bears the catalogue number TMP94.191.1. Note illustrated with a color photograph. See Rothschild, Tanke, Hershkovitz and Schultz, 1998 for formal description, also a popular article by Anonymous, 1998d and Talbot, 1998. [DHT]).

____ 1994a. The Official Souvenir Guide to the Dinosaur Empire. Royal Tyrrell Museum Cooperating Society, Royal Tyrrell Museum: 20 pp.

(Guidebook to the popular "Dinosaur Empire" dinosaur robotics and skeletons show exhibited in the Drumheller, Alberta, Canada hockey arena in the summer of 1994. Pages 4 and 5 show one display of a Late Cretaceous tyrannosaurid *Albertosaurus* attacking the ankylosaur *Euoplocephalus*. The latter is whacking the predator in the thigh with it's enlarged tailclub (this exhibit is now on display at the Royal Tyrrell Museum). It is stated that "Broken and healed bones of *Albertosaurus* are frequently found," but this is not true. Such fractures (such as in the fibulae noted on page 6) are one of the more common elements found fractured and healed in tyrannosaurids of all genera, but occurrences of fractures in this group cannot be considered "frequently found." A double-fracture of the mid-dorsal rib of an unspecified hadrosaur (cf. *Edmontosaurus*) from the Late Cretaceous of Edmonton, Alberta is figured on page 6. A pair of unspecified hadrosaur proximal caudal vertebrae from the Late Cretaceous of Dinosaur Provincial Park, Alberta (one with a severely fractured neural spine healed in a twisted condition) and one normal for comparison are given on page 6. In the pair illustrated in right lateral view, the normal vertebrae is wrongly identified as the injured one. All pathologic specimens are housed in the Royal Tyrrell Museum of Palaeontology. Format: Popular. [DHT]).

____ 1994b. Hot-Blooded Dino Debate Stays Hot. Amer. Paleo., 2(3):5.

(Unillustrated note on the debate over isotopic studies of Late Cretaceous *Tyrannosaurus* dinosaur bone by Barrick and Showers, 1994 as evidence for warm-bloodedness. [DHT]).

____ 1994c. Antarctic Peak Yields a Dinosaur Drama. Nat. Geogr., 186(4):vi.

(Early Jurassic allosauroid *Cryolophosaurus* found with two cervical ribs embedded in throat region; leading to speculation the animal died by choking on its' last meal. Format: Popular. [DHT]).

____ 1995a. Dino DNA, Finally? Amer. Paleo., 3(1):7.

(Short note on dinosaur DNA find made by Woodward et al., 1994. The find has come under some serious criticism; see Aldhous, 1995a. [DHT]).

____ 1995b. Dino Expert Skeptical of DNA Find. The Calgary Sun, Thursday, March 16, 1995:4.

(Dr. Philip Currie, head of the dinosaur research program at the Royal Tyrrell Museum of Palaeontology, Drumheller, Alberta, Canada casts doubt on the authenticity of claims of dinosaur DNA being found in a "cotton-like" part of the inner surface of dinosaur eggs recovered from an undisclosed locality in China. Currie also adds that Japanese scientists are close to obtaining DNA from dinosaur eggs found in Alberta. Unillustrated. See Anonymous, 1995c. [DHT]).

____ 1995c. Fossil Called Key to Unlocking the Past. The Calgary Sunday Sun, March 19, 1995:11.

(Chinese molecular biologist Chen Zhangliang comments on his discovery of dinosaur DNA found within a "sticky pulp" from a 65 million year old dinosaur egg. Unillustrated. See also Anonymous, 1995b. [DHT]).

____ 1995d. Dinosaur Heals. Geology Today, __, May-June:84.

(Short note on a Lower Cretaceous *Iguanodon* with broken vertebrae that healed and fused together into a deformed shape. See Hawkes, 1995. Unillustrated. [DHT]).

____ 1996a. *Tyrannosaurus* Wrecks. Discover, 17(4):12.

(Fall-related mortality in the large Late Cretaceous *Tyrannosaurus* is related. This 6.5 ton bipedal form has often been portrayed as a fast runner. But what if it were to slip and fall during a fast run? Surely, that old adage "The bigger they are the harder they fall" comes into play here. Researchers Jim Farlow and J. Robinson calculated that a *Tyrannosaurus* running at 45 miles per hour and then falling, would generate a force of 80,000 pounds (for the body) and 30,000 pounds for the head. Such impact forces would be fatal for a falling animal. It is suggested that *Tyrannosaurus* ran at slower speeds than previously considered. See Farlow and Robinson, 1996. Illustrated. Format: Popular. [DHT]).

____ 1996b. Chomp Champ. Discover, 17(12):24.

(Late Cretaceous *Tyrannosaurus* bite marks found on ceratopsian *Triceratops* sacrum. Bite forces of just over 3,000 pounds at the tips of the teeth of a biting *Tyrannosaurus* are suggested, making it one of the strongest biters known. See Erickson, Van Kirk, Su, Levenston, Caler and Carter, 1996; Tchoe, 1996. Illustrated. Format: Popular. [DHT]).

____ 1996c. *T. Rex* was a Pack Hunter! Dinosaur Discoveries, 1:1, 4.

(Includes mention of pathological conditions affecting the *Tyrannosaurus* nicknamed "Sue." A well healed fractured leg (etiology= a whack from the tailclub of an ankylosaur?) might indicate that a mate took care of her (epimeletic response) and brought food to the injured animal. Fatal and non-fatal intraspecific biting is also mentioned. Osteopathy unillustrated. Format: Popular. [DHT]).

____ 1996d. Two New African Theropods. ibid, p. 3.

(Recently collected skull of the 100 mya (Cenomanian) large theropod *Carcharodontosaurus saharicus* from the Sahara Desert of Morocco bears a pathological lesion on the skull [right maxilla] which is indicative of intraspecific fighting and biting behavior. Osteopathy unillustrated. Format: Popular. [DHT]).

____ 1996e. The King of Bites. ibid, 2:6.

(Popular note on the 1996 publication by Dr. Greg Erickson and others on the bite forces of the Late Cretaceous *Tyrannosaurus*. [DHT]).

____ 1996f. L'Antibiotique du Jurassique. [Jurassic Antibiotic]. Science & Vie, No. 951:57.

(An antibiotic, extracted from micro-organisms found in a piece of 130 ma old amber, has shown to be effective for fighting strong *Staphylococcus* bacteria, now immune to actual commercial antibiotics. The next step now is to find if it is toxic to human organism and if it is easy to obtain and produce in great quantities. Unillustrated. Format: Popular. Language: French; full English translation presented here. We are unable to substantiate this claim. Any citations regarding this research are actively solicited by the editors).

____ 1996g. A *Tyrannosaurus rex* Named Sue. Found on Internet on February 13, 1999 at: http://www.wmnh.com/wmsue.htm

(Late Cretaceous *Tyrannosaurus* popularly known as "Sue," now curated in the Chicago Field Museum, Chicago, USA. Includes mention of pathologies: broken and healed fibula, broken and healed tail vertebrae, poor vision (or blindness) in right eye caused by intraspecific face-biting and a cervical vertebra with embedded *T. rex* tooth [sic?; this bone has been listed as a cervical rib in all other literature]. In addition to field photographs taken during the collection of this specimen, four thumbnail images showing pathologies are also given. The first two were taken too far away from the skull to be of any use. The third shows some holes in the bone which may have been drainage points from infections. A finger appears to be poking into a hole. The last thumbnail image shows "a small bony lump" affecting an undisclosed position on the lower jaw. It is unfortunate all of these pictures were not taken closeup. Format: Popular. [DHT]).

____ 1996h. *Tyrannosaurus rex* - The "Tyrant King Lizard." Found on Internet on February 14, 1999 at: http://www.EnchantedLearning.com/subjects/dinosaurs/dinos/T*rex*.shtml

(Includes comments on intraspecific face-biting, falling injuries (including 14 healed rib injuries observed in an *Allosaurus* that had "belly-flopped") and gout. Osteopathy unillustrated. Format: Popular. [DHT]).

____ 1996i. Marvels of Mass Deaths. Dinonews, 9:5.

(Comments on monospecific mass mortality bonebed deposits and their research potential. The *Einiosaurus* and *Achelosaurus* bonebeds in Montana, USA and *Pachyrhinosaurus* bonebeds in Alberta, Canada are mentioned. Format: Popular. [DHT]).

____ 1997a. *Tyrannosaurus* Leed Aan Jicht. [*Tyrannosaurus* Had Gout]. Algemen Dagblad, May 22, 1997:7.

(Gout in Late Cretaceous *Tyrannosaurus* and another unspecified tyrannosaurid. See Rothschild, Tanke and Carpenter, 1997, 1997a. Format:

Popular. Language: Dutch. [DHT]).

____ 1997b. Gout was Royal Pain for *T. rex*. _____.

(See Rothschild, Tanke and Carpenter, 1997, 1997a. Unillustrated. [DHT]).

____ 1997c. Bonebed. Trackways (TMP Cooperating Society), 12:2.

(Relates the rediscovery of an *Albertosaurus*-dominated bonebed first located north of Drumheller, Alberta, Canada by Barnum Brown of the AMNH during the 1910 field season. Articulated skeletal portions representing nine individuals were collected by Brown and about 25% of the site was excavated then. This appears to represent a unique mass mortality event. Additional excavations are planned. Unillustrated. Format: Popular).

____ 1997d. Fabulous Sum for a Fearsome Fossil. Science, 278:218.

(Short note on the sale of "Sue," a *Tyrannosaurus* skeleton. Mention is made of "dinosaur tooth marks" affecting the skull and a tooth fragment found embedded in a rib showing this animal was "no stranger to combat." Format: Popular. [DHT]).

____ 1997e. *Tyrannosaurus rex* - A Highly Important and Virtually Complete Fossil Skeleton. Sotheby's Auction House, Sale 7045 auction catalogue. Auction: Saturday, October 4, 1997, New York, New York, USA. No pagination.

(Preface authored by Philip Currie (Royal Tyrrell Museum) mentions occurrence of a bonebed of Late Cretaceous tyrannosaurids *Albertosaurus* located near Drumheller, Alberta, Canada [mass mortality event of at least 13 animals]. He also mentions the evidence of pathologies in *Tyrannosaurus* can be utilized to elucidate behavior in this form. Includes color photographs of pathological bones of the *Tyrannosaurus* still in their plaster field jackets- articulated tibia/fibula, the latter with a healing fracture mid-shaft with good alignment; a series of 4 articulated distal caudal vertebrae showing "exostotic evidence of a healed break," though only the two anterior-most are actually involved. Other skeletal pathologies are noted: broken and healed ribs, bite marks to the skull and "muscle reattachment" [avulsion] of the right humerus. Healing of the fibula prompted Peter Larson of the Black Hills Institute to speculate on care-giving (epimeletic) behavior by conspecifics, while broken ribs and facial wounds were incurred during intraspecific fighting. The tail injury was possibly caused during mating. Also mention of the "Ruth Mason Quarry," a bonebed dominated by the Late Cretaceous hadrosaur *Edmontosaurus*- another mass mortality event with "tens of thousands of fossilized bones." Format: Popular. [DHT]).

____ 1997f. The Case of the Hole in the Head. Bones (Big Horn Basin Foundation; The Wyoming Dinosaur Center). February, 1997:5.

Describes injuries in "Stan," a Late Cretaceous *Tyrannosaurus* collected in South Dakota, USA. Facial injuries (unspecified) are present. Several ribs were fractured in life and healed. Two neck vertebrae are fused together and a third ".... immobilized by extra bone growth as it healed." A hole in the back of the head fits a *Tyrannosaurus* tooth perfectly, and bone in this region has been broken away. The *Tyrannosaurus* known as "Sue" (Chicago Field Museum, Chicago, USA) shows a pathologic rib with an imbedded tooth which caused infection. Injuries in this and other *Tyrannosaurus* may be related to intraspecific territorial fighting. The skull of "Stan" is figured on this page and the front cover of this issue. While not specifically pointed out, several openings affecting the surangulars are visible- these may represent healed bite trauma. Format: Popular. [DHT]).

____ 1997g. Dinosaur-Sized Pain. The Atlanta Journal, Sunday, May 25, 1997:D6.

(Another in the numerous newspaper and magazine articles relating to the discovery of gout in the Late Cretaceous *Tyrannosaurus*. See Rothschild, Tanke and Carpenter, 1997. Format: Popular. Unillustrated. [DHT]).

____ 1997h. Dinosaur Doctor Diagnoses the Disease of Dukes. Found on Internet on Dec. 22, 2000 at the New Scientist website: http://www.newscientist.com/hottopics/dinosaurs/doctor.jsp

(Gout affecting manus of *Tyrannosaurus*. The article erroneously states gout is also known from *Tyrannosaurus* specimens at TMP. There is only one specimen and it from a generically indeterminate tyrannosaurid (*Gorgosaurus* or *Daspletosaurus*) from Dinosaur Provincial Park, Alberta, Canada. Osteopathy unillustrated. Format: Popular. [DHT]).

____ 1997i. Gout Found on *T. rex* Hands. Found on Internet on Nov. 20, 2000 at http://www.zoomwhales.com/subjects/dinosaurs/news/Trexgout.shtml

(Childrens article. Format: Popular. Osteopathy unillustrated. [DHT]).

____ 1998a. Natural History. Butterfield & Butterfield Auctioneer and Appraisers. Volume X04, Sale 6782 auction catalogue, sale on May 31, 1998, San Francisco and Los Angeles, California, USA. 84 pp.

(The following auction sale items and figure captions are relevant to this bibliography:

1. Page 25, "Dinosaur Age Biting Midge," a 93 million year old ceratopogonid in amber, collected from Sayreville, New Jersey, USA. The catalogue speculates as to whether it contains remnants of dinosaur blood in its "obviously distended abdomen." Specimen unillustrated. Estimated value: $500-$600 US.

2. 2 multi-egg clutch specimens with 12 and 4 complete eggs respectively. Probably hadrosaur, both were collected from the Xia Xia Formation of Henan Province, China. The former is cited as possibly preserved via a "significant volcanic event;" i.e. mass mortality. Both of these are illustrated, p. 79. Estimated value $18,000-$22,000 and $6,000-$8,000 US respectively.

3. Therizinosaur embryo in egg with soft tissue (cartilage and egg yolk are claimed) preservation, p. 81. It was collected from the Cretaceous Nanchao Formation, Nanyang Valley, Henan, China. Illustrated. Estimated value $100,000-$150,000 US. Illustrated. [DHT]).

____ 1998b. Adventures in Argentina. Trackways (publication of Royal Tyrrell Museum Cooperating Society), 14:1.

(Mass mortality bonebed of an unidentified Early Cretaceous large theropod (related to *Giganotosaurus*) in Argentina, with 5-7 individuals represented. Also includes comments on the Late Cretaceous *Albertosaurus* bonebed to be worked by Tyrrell Museum staff in June, 1998. This appears to represent a mass mortality event also. Format: Popular. [DHT]).

____ 1998c. El Dinosaurio!. Alberta Connections, 4(1):9.

(Details as per Anonymous, 1998b. Illustrated. Format: Popular. [DHT]).

____ 1998d. Saurian Sore. Discover, 19(10):26.

(Hemangioma, Upper Jurassic unspecified dinosaur. See Rothschild, Tanke, Hershkovitz and Schultz, 1998 for full description. The lesion is figured with a color photograph. Format: Popular. [DHT]).

____ 1998e. Oh Baby, What a Find. The Calgary Sun, Wednesday, November, 18, 1998:28.

(Relates the discovery of a Late Cretaceous dinosaur mass mortality event involving "thousands of eggs," discovered in a 2.5 square kilometer area in Patagonia, Argentina. Remains of titanosaur sauropods (representing embryos measuring about 38 cm long) were found in some of the eggs. It is suggested the eggs and embryos perished due to local flooding which caused suffocation. Illustrated. Format: Popular. See also Chang, 1998. [DHT]).

____ 1998f. Dinosaur Injuries. Found on the Internet on November 28, 1998 at: http://www.nmnh.si.edu/injury.htm

Two pathologic specimens are figured. The first is an anomaly of the scapula in an Upper Jurassic *Allosaurus*. Severe exostosis development is attributed to a fracture or "deformed by disease." The second specimen is that of an Upper Jurassic *Camptosaurus* ilium with a large cup-like depression posteriorly. While no attempt is made to identify the lesion, it is suggested the animal would have been lame as a result. This specimen was described by Gilmore in 1909 and 1912. Format: Popular. Illustrated. [DHT]).

____ 1998g. Researchers Excited About Finding Fossilized Dinosaur Skin. Billings Gazette, Wednesday, November 18, 1998:8A.

(Mass mortality of Late Cretaceous sauropod eggs/embryos, skin impressions, Patagonia. See Chiappe, 1998; Chiappe et al., 1998. Format: Popular. Illustrated. [DHT]).

____ 1998-1999. Cattle of the Cretaceous - *Edmontosaurus annectens*. Written In Stone (Black Hills Institute of Geological Research, Inc. Newsletter), 2(2): 2 pp.

(Includes comments on the "Ruth Mason Quarry," a Late Cretaceous monospecific bonebed of the hadrosaur *Edmontosaurus*. The site contains the remains of "literally thousands" of animals. Skeleton disarticulation is nearly complete. Cause of the mortality is not suggested. Format: Popular. [DHT]).

____ 1999a. Dino Parasites? Amer. Paleo., 7(1):13.

(See Martill and Davis, 1998a, b. Format: Popular. Unillustrated. [DHT]).

____ 1999b. Skull Completes Collection. Omaha World-Herald, Friday, October 8, 1999:16.

(Newspaper article. A skull of the Late Cretaceous ceratopsian *Diceratops* is figured. While not mentioned in the text, two extra openings in the frill and of unknown origin are visible in the photograph. Such openings have been identified as pathological in nature by previous authors. Format: Popular. [DHT]).

____ 2000a. A Volunteer to the Bone. Naturescene, 1(3):4.

(Volunteer Alan McDonald works on a hadrosaur tibia at the Canadian Museum of Nature in Ottawa. While not mentioned in the text, this specimen is pathologic. This is the specimen mentioned in Lindblad, 1954; see that reference for additional details. Format: Popular. Illustrated. [DHT]).

____ 2000b. Dinosaurs and Birds - Are They Related? Found on Internet Dec. 22, 2000 at: http://www.wbu.com/chipperwoods/photos/dinos.htm

(Page 5 shows a closeup picture of several fractured and healing ribs in the infamous *Tyrannosaurus* "Sue." It is suggested the condition was painful. Format: Popular. [DHT]).

____ 2000c. *Allosaurus* - "Different Lizard." Found on Internet Dec. 22, 2000 at: http://www.zoomwhales.com/subjects/dinosaurs/dinos/Allosaurus.shtml

(Includes mention of fractured and healed ribs. It is speculated that these injuries were incurred as the result of a fall. Osteopathy unillustrated. Format: Popular. [DHT]).

____ 2000d. Dinosaur Facts. Found on Internet Dec. 22, 2000 at: http://www/whoofnet.com/learn_09.html [no longer current]

(Under the question "What diseases did dinosaurs suffer?," the following comments are made: Most ill dinosaurs would have been killed off by predators. Arthritis is known in *Iguanodon*. Pitting in some ceratopsian frills ".... looks suspiciously ...." like bone cancer. Broken hip bones and spines on the backbone with healing are known, but what illnesses dinosaurs suffered from are poorly known. Format: Popular. Osteopathy unillustrated. [DHT]).

____ 2000e. Saurian Dogfight. New Sci., 167(2249):23. Also found on Internet Nov. 17, 2000 at the New Scientist website: http://www.newscientist.com/news/news_224980.html

(Intraspecific face-biting behavior in large theropod dinosaurs. See Tanke and Currie, 1998 (2000). Format: Popular. Osteopathy unillustrated. [DHT]).

____ 2000f. More Thoughts on *T-rex*. Found on Internet on November 30, 2000 at: http://www.biopark.org/moretrex.html

(Essentially an overview of 1999 Scientific American articles by Bill Abler and Greg Erickson. Mentions of septic bites (Abler); intraspecific fighting in large theropods, mass mortality of *Albertosaurus as* documented from a bonebed in Alberta, Canada and a possible healed *T. rex* bite affecting an *Edmontosaurus* tail (Erickson). Unillustrated. Format: Popular. [DHT]).

____ 2001a. Special Tells Life Story of Prehistoric Predator. Omaha World-Herald, Sunday, April 8, 2001:2.

(Newspaper announcement of the upcoming "Walking With Dinosaurs" television special featuring Rebecca Hanna and "Big Al," an *Allosaurus* which shows numerous postcranial injuries such as 4 broken ribs, infectious growth affecting a toe among other maladies. Unillustrated. Format: Popular. [DHT]).

____ 2001b. Tick Could Have Had Dino Diet. Found on Internet on April 5, 2001 at: http://news.bbc.co.uk/hi/english/sci/tech/newsid_1308000/1308379.stm

(Beautifully preserved 90-94 million year old argasid (soft) tick *Carios jerseyi*, found in amber from New Jersey, USA. The tick measures 0.520 mm X 0.455 mm. While the tick could have fed on dinosaurs, it is more likely that it was parasitic on seabirds. Researched by Professor Hans Klompen at Ohio State University, with the formal paper published in Annals of the Entomological Society of America (not seen). The tick is illustrated. [DHT]).

Aragon, C.J. 1985. Untitled. Omni, 7(6):134.

(Makes a tongue in cheek comment that because dinosaurs were so tall, they must have been targets of lightning strikes during violent thunderstorms. Actually, for the giant long-necked sauropods, this must have been a serious possibility. Death by lightning strikes is a very real occurrence for wild extant animals; in fact, a single lightning bolt can cause mass mortality affecting dozens of herding or grouped individuals. Format: Popular. [DHT]).

Aratani, M. and Yanokura, M. 1994. Heavy-Ion Rutherford Scattering Applied to Dinosaur Egg Shell from Canada and Soil Samples from Kawaruppu, Urahoro, Hokkaido at the End of the Cretaceous Period. Riken Rev., 4:39-40.

(NOT INDEXED. Heavy-ion Rutherford scattering by use of krypton and xenon incident ions has been performed for the soil samples from the sedimentary layers at the end of the Cretaceous Period recently discovered at Kawaruppu, Urahoro, Hokkaido [Japan]. Environmental levels of iridium and barium were detected from the ultrafine soil particles and black soil surfaces, respectively, as the heaviest elements in the spectra. These results may cast a light on the problem related to the origin and the site of the global scale catastrophic phenomena responsible for extinction of dinosaurs at the end of the Cretaceous Period. [Author's abstract].

Avila, J. 1998. What Can *T-Rex* Teach Us? Internet website observed October, 1998 at: http://www.msnbc.com/news/171749.asp

(Includes comment on a badly broken and poorly healed rib fracture in the Chicago Field Museum *Tyrannosaurus* specimen nicknamed "Sue." Intraspecific fighting is considered as a cause of this injury. Osteopathy unillustrated. [DHT]).

Ayer, J. c. 2000. The HOWE RANCH Dinosaurs: 10 Years of Dinosaur Digging in Wyoming. Sauriermuseum Aathal, Aathal, Switzerland. 96 pp. (Also published in 1999 in French as "Un Os, Deux Os, Dinos ... Les Dinosaures, Historie d'un Gisement au Wyoming").

(An Upper Jurassic specimen of *Allosaurus*, nicknamed "Big Al Two" is described and figured. On the left side of the body, there are supposed traces of injuries affecting the scapula and several ribs. The fine figure of this region suggests post-fossilization crushing of otherwise normal (in life) bones. Two cervical vertebrae and three vertebrae from the base of the tail apparently show injuries but are not figured. Format: Popular. [DHT]).

B

Bakker, R.T. 1986. The Dinosaur Heresies- New Theories Unlocking the Mystery of the Dinosaurs and Their Extinction. William Morrow and Co., Inc., New York, 481 pp.

(In parts of this controversial (at least in dinosaurian circles) book, the author seriously considers the role of continental drift, vertebrate biota interchange between continents, and resultant disease transfer as being responsible for dinosaurian and other massive terrestrial vertebrate extinctions documented in the fossil record. Comparisons to the early twentieth century African Rinderpest plague which killed millions of ungulates are made. See Balsai, 1987 for a rebuttal. The *Coelophysis* mass mortality event preserved at Ghost Ranch, New Mexico, USA is compared with the "predator trap" at the La Brea Tarpits; see Schwartz and Gillette, 1994 for a differing opinion. See Balsai, 1987 for critical review of this book. [DHT] Format: Semi-popular).

____ 1992. Inside the Head of a Tiny *T. rex*. Discover, March, 1992:58-59, 61-69.

(The useful applications of CT scanning for paleontological research is demonstrated. Format: Popular. [DHT]).

____ 1995. Raptor Red. Bantam Books, New York. 246 pp.

(NOT INDEXED. A curious book with overly anthropomorphized dinosaurs, but a delight to the paleopathologist as the storyline is replete with injured, sick, fighting and diseased dinosaurs or contains closely related topics. Whether or not the frequency of injuries was as is implied in Bakker's book is open to serious question. The basic plot revolves around the physically rough life of an Upper Jurassic female theropod *Utahraptor* (named "Raptor Red"), her trials and tribulations. Rather than go through the book page by page and give a descriptive narrative, I have broken the relevant topics down into subheadings and give the relevant page numbers here below:

Bites/Biting:

:female *Utahraptor* bites male, drawing blood; courtship behavior: p. 93.

:unspecified pterosaur bites *Deinonychus*: p. 125.

:"jealous?" sister of Raptor Red bites the latters mate for no apparent reason: p. 175.

Bruising:

:*Utahraptor* leg after repeated collisions of flood debris against leg: p. 66.

:*Utahraptor* ribs after trying to bring down ankylosaur *Gastonia* prey: p. 103.

Cripples:

:*Utahraptor* group kill an *Iguanodon* that had been crippled in a fall: p. 62.

:Raptor Red with leg injury is recognized as a cripple by *Deinonychus* group: pp. 208-209.

Crush injuries:

:toes of *Utahraptor*, trying to bring down ankylosaur *Gastonia* prey: p. 103.

Deformities:

:potential of deformities in chicks if animals mate with closely related but different species: p. 28.

Dislocations:

:hip of male *Utahraptor* after being crushed by falling prey: p. 17.

:shoulders in *Utahraptor*, incurred while trying to bring down ankylosaur *Gastonia* prey: p. 103.

:temporary dislocation of *Utahraptor* knee during confused predation attempt on sauropod *Astrodon*: p. 199.

Epimeletic (care-giving) response:

:Raptor red drags her sick adult sister away from marauding predators: p. 203.

:"maternal" care of Raptor Red's injured sister: p. 204.

:mate of Raptor Red provides care by bringing food to injured animal: pp. 223-224.

Fractures (bone):

:*Utahraptor* suffers from 3 cracked ribs after fighting with *Acrocanthosaurus*: p. 141.

:broken rib protrudes from skin; *Utahraptor*: p. 204.

Frostbite:

:danger of, juvenile *Utahraptor*: p. 188.

Fungal problems:

:prolonged skin contact with moisture in *Utahraptor* can lead to fungal infections: p. 150.

Insects:

:Assassin bugs which feed on *Utahraptor* and other species can inject biotoxins leading to itchy sores, infections and plague: pp. 151-152.

Interspecific fighting/predation:

:*Utahraptor* vs. *Acrocanthosaurus*: pp. 139-140.

:unspecified segnosaur causes flesh injury to one of a *Utahraptor* hunting pair: pp. 188-189.

:sauropod *Astrodon* uses whiptail as an effective injury-inducing weapon against predaceous *Utahraptor* group: pp. 196-201.

:*Utahraptor* vs. *Deinonychus*: pp. 206-211, 213, 218.

Intraspecific fighting:

:between female *Utahraptor*, fighting over the attentions of a male conspecific: p. 91-97; females again, but this time the mother of one chick attacks her sister because the sisters mate has a chick in his mouth and is preparing to kill it: p. 177.

:during confusing plot: pp. 177-179.

:ankylosaur *Gastonia* males head-butting: p. 101.

Limping:

:unspecified ornithomimid, limping ever so slightly, singled out as a prey item: p. 128.

:limping *Utahraptor*: pp. 189, 200, 202, 206, 208.

Mass mortality:

:dinosaur (*Iguanodon*) and various non-dinosaurian species due to a massive flood event: pp. 64-65.

Miscellaneous:

:male ankylosaur *Gastonia* gets poked in the eye by the spiky armour of a rival during intraspecific fighting: p. 104-105.

:*Utahraptor* chick dies of respiratory infection: p. 156.

:"mad raptor disease": p. 193.

:".... ancestral dynasty [of sauropod *Astrodon*] ruined by immigrant disease....": p. 197.

:plague reduces local *Acrocanthosaurus* populations: p. 230.

Pain:

:in sauropod *Astrodon* as it is attacked by *Utahraptor* pair: p. 13.

:caused by ticks; *Utahraptor*: p. 39.

:as ticks are plucked off by birds; *Utahraptor*: pp. 43-44.

:*Utahraptor* stiff and painful fingers and toes after clinging to tree during a flood: p. 69.

:large theropod *Acrocanthosaurus* cracks several teeth and breaks one off, leaving nerve exposed and gets whacked on the leg by the tailclub of the ankylosaur *Gastonia*, all this during a failed predation attempt: pp. 71-72.

:inside acrocanthosaur mouth long after being hit in face by ankylosaur tailclub: p. 135.

:*Utahraptor*, after suffering 3 cracked ribs while fighting with an *Acrocanthosaurus*: p. 141.

:*Utahraptor* wound scabs over, but still painful: pp. 189-190.

:*Utahraptor* knee dislocation painful: pp. 199, 204, 205 (knee stiff), 206, 208, 209, 215, 222.

:*Utahraptor* head: p. 211.

:*Deinonychus* pedal claw pierces tail skin of prone and injured *Utahraptor*, registering pain: p. 214.

Parasites:

:ticks or other bug infestations on courting male *Utahraptor* disqualify him as a potential mate: pp. 34, 152.

:ticks of several species attack *Utahraptor* group: pp. 39-40, 42-44.

:ticks removed by birds: pp. 43-44.

Teeth (fractures of):

:*Utahraptor* breaks tooth trying to bite open a turtle: p. 56.

:*Utahraptor* breaks three tooth crowns while digging for small mammals: p. 99.

:large theropod *Acrocanthosaurus* cracks several teeth and has one snapped out after unsuccessfully trying to kill an ankylosaur *Gastonia*: pp. 71-72.

:*Utahraptor* breaks a tooth biting into a belemnite: p. 169.

Wounds:

:presence of wounds disqualify potential mates: p. 31.

Zoopharmacognosy (medical practices):

:*Utahraptor* groups roll in soda mud to remove ticks: pp. 39-40.

In an epilogue, Bakker (p. 239) briefly comments on the possibility of transmission of viruses, bacteria and parasites during continental faunal interchange of dinosaurs. There is mention of paleopathology in theropod dinosaur too (p. 240): ".... broken and healed ribs, cracked limbs, and lower back vertebrae fused together by injury." Dento- and osteopathy unillustrated. Format: Science-Fiction. [DHT]).

Balsai, M.J. 1987. Review of: Bakker, R.T. 1986. The Dinosaur Heresies: Theories Unlocking the Mystery of the Dinosaurs and their Extinction. Delaware Valley Paleo. Soc. Newslet., 9(6):2-7.

(Harsh critique of Bakker's 1986 book. Bakker stated that dinosaur extinctions were brought about by the exchange of diseases carried by animals crossing over newly established land bridges, citing the recent case of Rinderpest in Africa as a contemporary example. Balsai acknowledges the work of Colbert who had previously stated that such an event might affect animals only of the same kind, but could not be spread from one

dinosaur family to another. Balsai concludes, "... that he [Bakker] has no real grasp or understanding of the principles of pathology, microbiology, parasitology, and epidemiology." Also includes reference to work by T. Swain (1976) who has suggested that dinosaurs inability to adapt to newly evolved angiosperm plants (which contain toxic alkaloid feeding deterrents), may have caused dinosaurs a variety of difficulties, including the gradual thinning of ceratopsian eggshell, thus contributing to their extinction. Format: Popular. [DHT]).

Barreto, C. 1994. The Dinosaur Growth Plate: A Study in Paleohistology. pp. 255-260. In: Dino Fest. Edited by G.D. Rosenberg and D.L. Wolberg. The Paleontological Society Special Publ. No. 7.

(Histology of longitudinal sections of juvenile Late Cretaceous hadrosaur *Maiasaura* long bones reveals a structure similar to the hypertrophic zone of the growth plate as seen in extant birds. Illustrated. See also Barreto, 1996, 1997. [DHT]).

____ 1996. A Comparative Study of the Dinosaur Growth Plate. p. 27. In: Dinofest International Symposium. Program and Abstracts. April 18-21, 1996. Arizona State University, Tempe. Edited by D.L. Wolberg and E. Stump. See also: Barreto, C. 1997. Dinosaur Growth Plates and Dinosaur Bone Growth. pp. 95-100. In: Dinofest International. Proceedings of a Symposium Held at Arizona State University. Edited by D.L. Wolberg, E. Stump and G.D. Rosenberg. 587 pp.

(Growth plate structure in unspecified dinosaur(s) and its implications are discussed. The author concludes: "When different animals have truly identical features that are inherited from a common ancestor, we call these homologous characters. When we identify homologous characters in living and extinct animals, we can assume they had the same function. Birds grow to adult stature in a very brief developmental period. The special structure of the bird growth plate enables the bone to elongate very rapidly. We concluded that the growth plate of the dinosaur was the same as that in birds, and therefore that dinosaurs were capable of the rapid growth rates of birds." See Barreto, 1994, 1997. Unillustrated).

Barrick, R.E. 1994. Thermal Physiology of the Dinosauria: Evidence from Oxygen Isotopes in Bone Phosphate. pp. 243-254. In: Dino Fest. Edited by G.D. Rosenberg and D.L. Wolberg. The Paleontological Society Special Publ. No. 7.

(NOT INDEXED).

____ 1996. Were All Dinosaurs Created as Metabolic Equals? p. 28. In: Dinofest International Symposium. Program and Abstracts. April 18-21, 1996. Arizona State University, Tempe. Edited by D.L. Wolberg and E. Stump. (See also: Barrick, P.M. 1998. How Much Did Dinosaurs Eat: Metabolic Evidence From Oxygen Isotopes. (Abstract). Jour. Vert. Paleo., 18(3):26A).

(Apparently dinosaurs were not all metabolic equals. The author states: "Analyses of dinosaurs indicate that they employed a range of metabolisms from a low, heterothermic rate to well maintained homeothermy indicative of relatively high metabolic rates.").

____ and Showers, W.J. 1994. Thermophysiology of *Tyrannosaurus rex*: Evidence from Oxygen Isotopes. Science, 265:222-224.

(The oxygen isotopic composition of vertebrate bone phosphate (δP) is related to ingested water and to the body temperature at which the bone forms. The δP is in equilibrium with the individual's body water, which is at a physiological steady state throughout the boy. Therefore, intrabone temperature variation and the mean interbone temperature differences of well-preserved fossil vertebrates can be determined from the δP variation. Values of δP from well-preserved *Tyrannosaurus rex* suggest that this species maintained homeothermy with less than 4° C of variability in body temperature. Maintenance of homeothermy implies a relatively high metabolic rate that is similar to that of endotherms. [Author's abstract]. See also Folger, 1993; Anonymous, 1994c; Luck-Baker, 1994; Morell, 1994; Millard, 1995).

Barsbold, R. 1974. Poedinok Dinozavrov. [Dinosaur's Duel]. Priroda, 2:81-83.

(Unique predator/prey situation. A spectacular example of the Late Cretaceous *Velociraptor mongoliensis* locked in combat with the protoceratopsian *Protoceratops andrewsi*, found in Toogreeg, Mongolia. This is one of the most spectacular fossil finds of all time; photographs or drawings of the find are to be found in a great many popular and childrens dinosaur books. The *Protoceratops* remains standing on all four feet. The *Velociraptor* rests on its right side near the head of the prey. The *Velociraptor* is holding the head of the *Protoceratops*, with the right forelimb of the former inside the mouth of the latter. The hind legs are doubled up and the right foot, with its enlarged sickle-like claw, is embedded in the *Protoceratops* abdominal region. Thus, the predator would seize its victim by the head and deliver a fatal disemboweling kick or kicks to the soft underbelly of its victim, much as often practiced by various extant cats. While Barsbold suggests both animals were buried together under aquatic conditions (a bog or lake), it is now widely believed that they were overcome by a sudden sandstorm or were buried by the collapse of a sand dune which shifted onto the victims during their final death struggles. See also Kielan-Jaworowska and Barsbold, 1972; Unwin, Perle and Trueman, 1995. [DHT]).

Battaglia, C.A. 1979. In Defence of Dinosaurs. Johns Hopkins Magazine, 30(2):20-27.

(Article on paleontologist R.T. Bakker. Interspecific battle between two *Allosaurus* and a solitary *Ceratosaurus* is illustrated; the latter balancing on its tail and kicking out with both hind legs. Bakker believes dinosaur extinction was due to diseases. Format: Popular. [DHT]).

Baur, G. 1890. A Review of the Charges Against the Paleontological Department of the U.S. Geological Survey, and of the Defence made by Prof. O.C. Marsh. Amer. Nat., 24:298-304.

(A most unusual paper in the annals of "professional" paleontology. The article is mostly a harsh critique of Prof. O.C. Marsh's questionable professional ethics and shortcomings as a scientist. It also includes a discussion on the pathologically fused metatarsals of the American Late Jurassic *Ceratosaurus*. Marsh had suggested the metatarsal fusion was a normal character and thus proved a close bird/dinosaur relationship---at the time a radical new suggestion, but one that is widely accepted today. In hindsight it would seem Marsh was right but for all the wrong reasons, as the specimen is actually pathologic. On this circumstance Baur (p. 301-302) writes: "The specimen on which the conclusion was based is pathological. The animal when alive had a fracture of the lower part of the metatarsus, but it was happy enough to recover from this accident. The bones coössified, as it generally happens in such cases, at the place where they were broken, but not at any other place. From this pathological specimen Prof. Marsh trumpeted forth to the world one of his greatest discoveries. Prof. Marsh knows very well that this specimen is pathological, but he has never taken back his blunder, notwithstanding that I discussed this matter at different times with him." Baur himself ultimately died in a German insane asylum at the age of 44, which might also cast some doubt on his own character and integrity. The sordid details of the infamous "Cope/Marsh War" and the problems encountered between G. Baur and O.C. Marsh are amply described on pages 243-261 of Url Lanham's 1973 book *The Bone Hunters*, Columbia University Press, New York. Both DHT and BMR have made an inspection of the *Ceratosaurus* metatarsals on display at the USNM. While DHT believes them to be pathologically fused together, BMR's x-ray examination reveals no evidence of abnormal bone - so the jury is still out. [DHT]).

Baszio, S. 1997. Systematic Palaeontology of Isolated Dinosaur Teeth from the Latest Cretaceous of South Alberta, Canada. In: Investigations on Canadian Dinosaurs. Cour. Forsch.-Inst. Seckenberg, 196:33-77.

(Excellently illustrated paper with numerous plates showing teeth of many small theropods, large theropods and assorted ornithischian dinosaurs. Included are examples of "growth abnormalities" affecting the problematic small theropod tooth-genus *Paronychodon*. [DHT]).

Beard, J. 1990. Did Nickel Poisoning Finish Off the Dinosaurs? New Sci., 126(1717):31.

(Nickel, from a vaporized asteroid rained, onto the Earth's surface and poisoned plants, leading to the extinction of the dinosaurs. Format: Popular. [DHT]).

Beecher, C.E. 1902. The Reconstruction of a Cretaceous Dinosaur, *Claosaurus annectens* Marsh. Trans. Connecticut Acad. Sci., 11:311-324.

(An unusual smooth-edged oval-shaped perforation of the posteroventral right scapula of this Late Cretaceous hadrosaur is described and figured. [DHT]).

Begley, S. 1993. Here Comes the DNAsaurs. Newsweek, 71(24):56-61.

(Includes discussion of fossil DNA found in insects in amber, potential and attempts of finding dinosaur DNA in fossil bone, extraction techniques and the possibility of "cloning" dinosaurs from genetic material. Format: Popular. [DHT]).

____ 1997. Sore Enough to Eat San Diego. Newsweek, June 2, 1997:63.

(Gout in Late Cretaceous *Tyrannosaurus*; see Rothschild, Tanke and Carpenter, 1997, 1997a. Osteopathy unillustrated. Illustrated with a

cartoon. Format: Popular. [DHT]).

____ and Yoffe, E. 1991. New Theories and Old Bones Reveal the Lifestyles of the Dinosaur. Newsweek, 118(18):52-58.

(This article reviews the current broad spectrum of dinosaurian research, including paleopathology. Although students of the latter are not credited by name, the article includes mention of B. Rothschild's work on stress fractures in ceratopsian phalanges, and D. Tanke's work on trampled hadrosaur distal tail vertebrae. There is also an unusual (sic?) mention of sauropods with backbone injuries probably received during mating. Such injuries occur no more than once in each animal so affected, the authors stating the injured dinosaur got it right the second time or swore off sex for life. The latter statements might be a misquote from Cronkite (1991), where D. Tanke suggests this possible scenario in hadrosaurs, not sauropods. David Gillette from Utah has a large skeleton of the massive sauropod *Seismosaurus*, with 230 plum-sized gastroliths or stomach stones. Another gastrolith, about the size of a grapefruit was also found; Gillette thinks this individual may have choked to death on this stone. [DHT] Format: Semi-Popular).

Benes, J. and Burian, Z. 1979. Prehistoric Animals and Plants. Hamlyn, London, 311 pp.

(Mention of a broken and healed horn in the Late Cretaceous ceratopsian *Triceratops*. [DHT]. Format: Popular).

Benton, M.J. 1985. To Clone a Dinosaur. New Sci., 1439:41-43.

(Fossil DNA. Format: Popular. [DHT]).

____ 1990. Scientific Methodologies in Collision- The History of the Study of the Extinction of the Dinosaurs. pp. 371-400. In: Evolutionary Biology, 24. Edited by M.K. Hecht, B. Wallace, and R.J. MacIntyre, Plenum Press, New York.

(In this review of past hypotheses regarding dinosaur extinction, the author notes several suggestions of a medical nature that have been forwarded to explain the dinosaurs ultimate demise. These include overactivity of the pituitary gland and excessive (acromegalous?) growth of bones and cartilage (Nopcsa, 1917); Moodie (1923), who suggested disease; pathological thinning of eggshells (Erben et al., 1979), and cataract blindness (Croft, 1982). [DHT]).

____ 2000. Walking with Dinosaurs — The Facts. BBC Worldwide Ltd., London. 192 pp.

(Mention of a *Triceratops* with a "deep dent" in the side of the face [jugal], which may be the result of intraspecific fighting (p. 126); septic bites in theropods (p. 127); general comments on dinosaur paleopathology (pp. 134-135). Osteopathy unillustrated. Format: Popular. [DHT]).

Berghaus, C.B. and Gabriel, D.L. 1988. The Impact of Horns on Evolution and Behavior in Ceratopsians Based on the Examination of a New *Torosaurus* Skull. (Abstract). In: International Symposium on Vertebrate Behavior as Derived from the Fossil Record. Sept. 8-10, 1988. Bozeman, Montana, no pagination.

(Horns are superbly designed and engineered elements in regard to weaponry applications. Horn-like organs have evolved independently on several occasions in phylogenetically distinct vertebrate taxa (Geist, 1965). The horns of ceratopsians are analogized with the true horns (*sensu* Modell, 1969) of modern bovids in light of research, morphology, development, and function. Milwaukee Public Museum (M.P.M.) #6841 is a skull, plus associated post-cranial material, of a large *Torosaurus* recovered from the Hell Creek Formation on the east side of the Fort Peck Reservoir, Montana. The immense skull exhibits injuries and subsequent bone healing and remodelling, analysis of which offers an interesting view of the life history of this individual. Ramifications concerning the function of horns plus their role in and influence on the behavioral repertoire and evolution of ceratopsians are interpreted from this unique specimen. [Author's abstract]. A full paper has never been published; second author is deceased).

Bilbey, S.A. 1999. Taphonomy of the Cleveland-Lloyd Dinosaur Quarry in the Morrison Formation, Central Utah- A Lethal Spring-Fed Pond. pp. 121-135. In: Vertebrate Paleontology in Utah. Edited by D.D. Gillette. Utah Geol. Surv., 99-1:121-133.

(NOT SEEN. NOT INDEXED. Mass mortality?).

Blasius, W. and Kaiser, H.E. 1980. Phylogenese und Ontogenese des Schmerzes. [Phylogeny and Ontogeny of Pain]. Naturwiss. Runds., 33(7):265-273.

(Discussion of evidence and significance of pain in plants and animals; past and present. Mentions of fused tail vertebrae in the American Upper Jurassic sauropod *Apatosaurus*, rib fractures in the Upper Jurassic sauropod *Brachiosaurus brancai* from Tendaguru (Africa). Language: German; English translation available. [DHT]).

Blows, W.T. 1978. Reptiles on the Rocks. Isle of Wight Mus. Pub., 2:1-60.

(The author collected a partial skeleton of a Lower Cretaceous *Iguanodon* from Hanover Point on the Isle of Wight (England) in 1972. On page 42 he notes that the right ischium was fused to the right ilium, an anomalous condition, but the etiology is not attempted. The specimen was subsequently redescribed by Blows in 1989. [DHT] Format: Popular / Semi-Technical).

____ 1989. A Pelvic Fracture in *Iguanodon*. Archosaurian Articulations, 1(7):49-50.

(In this article, pathologies involving fusion of the right ilium and ischium (at the ilio-ischial joint) in the large Lower Cretaceous *Iguanodon* are documented. An unhealed mid-shaft break to the right ischium might be related to the pathology above, or it might have been caused by post-mortem crushing. The author's speculation on the etiology of these pathologies include a fall, accidental breakage during lowering of the body to rest, and mating trauma. [DHT]. See Blows, 1978. Format: Semipopular).

____ 2001. Dermal Armor of the Polacanthine Dinosaurs. pp. 363-385. In: The Armored Dinosaurs. Edited by K. Carpenter and J.I. Kirkland. Univ. Indiana Press, Bloomington. xv + 526 pp.

(See figure 17.6(B). Armor of *Stegopelta landerensis* (FMNH UR88) shows possible osteopathy. The lower three raised bosses on part of the sacral shield show slightly depressed circular features. They are not commented on in the text, but they appear similar to circular lesions affecting Late Cretaceous ankylosaur armor found in Dinosaur Provincial Park, Alberta. [DHT]).

Blumberg, B.S. and Sokoloff, L. 1961. Coalescence of Caudal Vertebrae in the Giant Dinosaur *Diplodocus*. Arthritis and Rheumatism, 4(6):592-601.

(The coalescence, seen frequently in the caudal vertebrae of the giant dinosaur *Diplodocus longus*, has been re-examined. A comparison with vertebral fusion in contemporary species suggests that the changes in the dinosaur were of traumatic rather than rheumatoid type. [Author's abstract]. Illustrated. See Berman and Rothschild, 1991 for differing diagnosis; they convincingly suggested that diffuse idiopathic skeletal hyperostosis or DISH was the causative agent. [DHT]).

Bocherens, H. 1997. Chemical Composition of Dinosaur Fossils. pp. 111-117. In: Encyclopedia of Dinosaurs. Edited by P.J. Currie and K. Padian. Academic Press, San Diego. xxx + 869 pp.

(Excellent overview of the chemical composition of dinosaur bone. Topics reviewed: molecules; collagen and other proteins; DNA; other organic molecules; chemical elements; isotopes and conclusions. [DHT]).

Bohlin, B. 1953. VI. Vertebrate Paleontology. Fossil Reptiles from Mongolia and Kansu. The Sino-Swedish Expedition, Publ. 37:1-113. 9 plates. Statens Etnografiska Museum, Stockholm.

(Page 45, documents the occurrence of split carinae on tooth of a large theropod dinosaur from the Minhe Formation in China. See Erickson, 1993a,b, 1995 who described similar anomalies in Late Cretaceous tyrannosaurid teeth. The tooth is illustrated. [DHT]).

Borkent, A. c.1993. Were the Dinosaurs Bothered by Biting Midges? An Examination of the Ceratopogonidae (Diptera) in Cretaceous Amber, With a Discussion of Their Phylogenetic Relationships, Patterns of Diversification, Palaeoecology and the Evolution of the Bloodsucking Habit. manuscript.

(Published as Borkent, 1995).

____ 1995. Biting Midges in the Cretaceous Amber of North America (Diptera: Ceratopogonidae). Backhuys Publishers, Leiden. 237 pp.

(Describes new genera and species of blood-sucking biting midges recovered from Late Cretaceous amber of Alberta and Manitoba, Canada, and New Jersey, USA. The author believes two or three species of these midges fed on the blood of dinosaurs, biting around the eyes of hadrosaurs and undersides of highly vascularized frills of ceratopsians. See also Borkent, c.1993; Pellegrino, 1985 and Grogan and Szadziewski, 1988. [DHT]).

Bowler, S. 1992. All in the Family? New Sci., 136(1845):18.

(Short note on the discovery by G. Muyzer and P. Sandberg of the molecule of the protein osteocalcin in dinosaur bones 75 million years old. Preservation of delicate molecules is related to the way the bones are fossilized and their subsequent history in the rock surrounding them. Relatively cool temperatures preserves osteocalcin. Impermeable rocks protect the fossil bone from fluid contaminants that circulate underground. [DHT] Format: Popular).

Braman, D.R. (Editor) 1992. *Centrosaurus* Bonebed. pp. 23-25. In: Field Trip Guidebook to the Geology and Palaeontology of Dinosaur Provincial Park. Royal Tyrrell Museum of Palaeontology, Drumheller. Alberta Community Development. May, 1992. 53 pp.

(Mass mortality of Late Cretaceous ceratopsian *Centrosaurus apertus*. See Currie, 1981, Currie and Dodson, 1984, and Ryan et al., 2001, for details. [DHT]).

Breithaupt, B.H. 1985. Nonmammalian Vertebrate Faunas from the Late Cretaceous of Wyoming. Wyoming Geol. Assoc. Guidebook, Ann. Field Conf., 36:159-175.

(Includes small theropod *Paronychodon* teeth in faunal lists from the Late Cretaceous "Mesa Verde" and Lance Formations of Wyoming, USA; pp. 165 and 169 respectively. Teeth of this type are aberrant teeth of better known taxa of small theropod dinosaurs. See Currie, Rigby and Sloan, 1990:117 and Baszio, 1997 for discussion. Unillustrated. [DHT]).

____ 1997. Howe Quarry. pp. 355-356. In: Encyclopedia of Dinosaurs. Edited by P.J. Currie and K. Padian. Academic Press, San Diego. xxx + 869 pp.

(Upper Jurassic Howe Quarry, near Shell, Wyoming, USA. Mentions the 1991 discovery of a nearly complete *Allosaurus* skeleton nearby. This animal bore at least 14 pathologies; see entries under Laws, R., and Hanna, R., in this bibliography. Unillustrated. [DHT])

____ 1998. The *Allosaurus* "Big Al": Its Place in Time and Space. (Abstract). pp. 2-3. In: The Dinofest Symposium. Edited by D.L. Wolberg, K. Gittis, S. Miller, L. Carey and A. Raynor. The Academy of Natural Sciences, Philadelphia, Pennsylvania. April 17-19, 1998.

(Subadult *Allosaurus*, northern Wyoming, USA. The abstract mentions the presence of "multiple pathologies;" see entries under Hanna, R., Laws, R., and Travsky, R. for more specific details. [DHT]).

Brett-Surman, M. 1989. A Revision of the Hadrosauridae (Reptilia:Ornithischia) and Their Evolution During the Campanian and Maastrichtian. Ph. D. thesis, George Washington Univ., Washington, 271 pp.

(On page 77-78, the author notes that with advanced age in hadrosaurs, the neural spines ".... are roughened, much expanded, thickened, and seem to flare outward when viewed in anterior aspect." [Similar effects can be observed in pathological caudal neural spines of hadrosaurs. DHT, pers. obs.]. Brett-Surman (p. 80) correctly warns that care must be taken to accurately determine pathological or age-related skeletal modifications that occur in hadrosaur skeletal material. Page 107 reviews the status of *Barsboldia*; this Late Cretaceous Asian lambeosaurine hadrosaur having "club-like" distal neural spines; again, similar traits can be found in pathologic hadrosaur caudal neural spines from Alberta, Canada. That this clubbing is a growth feature related to old age is stated on page 169. On pages 123-124, the present status of the Asian hadrosaur *Nipponosaurus* is discussed. Unusual development of the third metacarpal is briefly considered as possibly pathological. [DHT]).

Brochu, C.A. 2000. Postcranial Axial Morphology of a Large *Tyrannosaurus rex* Skeleton. (Abstract). Jour. Vert. Paleo., 20(3):32A.

(The author notes: "There is extensive fusion of medial elements in the anteriormost segments, which would limit mobility of the gastral complex. There are several abnormalities, including healed fractures in the trunk ribs and fused caudal vertebrae that appear not to result from fracture. Exostotic bone in the fused caudals grew around caudal muscular bands, preserving a natural mold of the tail musculature").

Brokx, W.A. and Schulp, A.S. 1998. Sauropods Limping on the Ramp. pp. 2-3. Abstracts Volume. 2nd Symposium on Mesozoic Vertebrate Faunas of Central Europe, Deva, Romania. October 15-17.

(NOT SEEN).

____, ____ and Biermann, C. (in prep.). Strain Analysis on Dinosaur Trackways from the Fumanya Quarry, Pyrennes, Spain.

(NOT SEEN).

Brown, B. 1917. A Complete Skeleton of the Horned Dinosaur *Monoclonius*, and Description of a Second Skeleton Showing Skin Impressions. Bull. Amer. Mus. Nat. Hist., 37(10):281-306.

(Brown's *Monoclonius* from Alberta = *Centrosaurus*. This is the first mention of the discovery of *Centrosaurus* bonebeds in what is now Dinosaur Provincial Park, Alberta, Canada. Brown writes (p. 284): "There is no record of an occurrence of two or more specimens of *Triceratops* having been found together in one place, but three *Monoclonius* quarries [= bonebeds] were observed by the writer in the Belly River strata [= Dinosaur Park Fm] of the Red Deer River and in one quarry no less than eleven individuals were determined from fragmentary skulls. In this particular quarry every bone exposed was that of *Monoclonius* or *Ceratops* and no other vertebrate fossils were represented. This purely circumstantial evidence of occurrence may or may not have value in considering their habits, but it would seem to indicate that the Belly River genera were gregarious." As we now know, these bonebeds represent mass mortality occurrences. [DHT]).

____ and Schlaikjer, E.M. 1937. The Skeleton of *Styracosaurus* with the Description of a New Species. Amer. Mus. Novit. 955:1-12.

(Fusion of dorsal vertebrae 4 and 5 in the ceratopsian *Styracosaurus parksi* (AMNH 5372) collected from the Late Cretaceous (Campanian) Dinosaur Park Formation of Dinosaur Provincial Park, Alberta, Canada is noted. Etiology of the fusion is not discussed or figured. [DHT]).

Browne, M.W. 1997. Pity a Tyrannosaur? Sue Had Gout. pp. 51-53. In: The Science Times Book of Fossils and Evolution. Edited by N. Wade. The Lyons Press, New York.

(Gout in an unspecified Campanian-aged tyrannosaur phalanx (collected from Dinosaur Provincial Park, Alberta, Canada) and metacarpal of "Sue," a Late Cretaceous *Tyrannosaurus*. Includes mentions of other pathologies affecting this specimen such as limping brought on by a badly healed leg [fibula] fracture and intraspecific face-biting lesions. Osteopathy unillustrated. Format: Popular. [DHT]).

Bryant, J.M. 1998. A Complete *Allosaurus*.... Part 1. The Fossil Record (Dallas Paleon. Soc.), 14(11):5-7.

(In commenting on the Upper Jurassic *Allosaurus* pathologies observed from material recovered from the famous Cleveland-Lloyd Quarry, Bryant states these ".... indicate a good deal of violent activity." Format: Popular. Osteopathy unillustrated. [DHT]).

Burgess, K. 1996. Dinosaur Provincial Park — Croc's Skull and Exciting End to Fossil Season. The Brooks Bulletin [Brooks, Alberta, Canada], Wednesday, Sept. 4, 1996:A1.

(This newspaper article relates the discovery and collection of a complete *Leidyosuchus* crocodile skull from the 76 million-year-old Upper Cretaceous deposits of Dinosaur Provincial Park, Alberta, Canada. This was found in a multigeneric bonebed deposit (Bonebed 47) by the senior editor (DHT). Includes comments on the possible origins of these and other (monospecific) dinosaur bonebeds. Seasonal monsoonal flooding resulting in the mass mortality of many animals is suggested by Tyrrell Museum of Palaeontology scientist Dr. Dave Eberth. Carcasses and bones of the drowned animals would be pooled together into small pockets and be buried. Format: Popular. [DHT]).

Burnham, D. 1992. "Sue" and the Protection of Fossil Resources. Geol. Today, 8(6):206-209.

(Yet another of the numerous articles to come out this year regarding the FBI seizure of a nearly complete Late Cretaceous *Tyrannosaurus* skeleton from the Black Hills Institute of Hill City, South Dakota, USA. Numerous Black Hills Institute articles regarding the seizure and the specimen's scientific importance relate to the paleopathological conditions present on the skeleton. In this article, a broken leg, broken tail, wounds on one side of the face, and a bite to the neck by another *Tyrannosaurus* leaving a snapped off tooth embedded in a cervical rib are noted. [DHT] Format: Semi-Popular).

____, Derstler, K. and Linster, C.L. 1996. A New Specimen of *Velociraptor* (Dinosauria: Theropoda) from the Two Medicine Formation of Montana. (Abstract). p. 33. In: Dinofest International, Program and Abstracts. Arizona State University, April 18-21, 1996. Edited by D.L. Wolberg and E. Stump.

(Includes mention that the specimen was found ".... in an accumulation of partly articulated hadrosaur skeletons, presumably *Maiasaura*." [Is this a mass mortality event?]. The *Velociraptor* was later formally named *Bambiraptor*. [DHT]).

Burton, J. and Dixon, D. 1984. The Age of Dinosaurs- A Photographic Record. Sphere Books Ltd., London, 96 pp. (Also released as: Time Exposure. Beaufort Books, New York, 1984).

(Mention that frill damage in the Late Cretaceous ceratopsian *Triceratops* is attributed to intraspecific shoving matches. [DHT]. Format: Popular).

Byers, J.A. 1987. Why the Deer and the Antelope Play. Nat. Hist., 96(5):54-60.

(Juvenile ibex *Capra* sp. kept in the Brookfield Zoo in lllinois, USA have a reconstructed rock outcrop that they enjoy playing on. This play repertoire included running onto the outcrop and leaping off of a high point and twisting the body in mid-air prior to landing on all four feet. While apparently fun for the young Ibex, this behavior has got its hazards. Byers states that at any one time during scientific observations of the 14 kids, one could be seen limping because of a slip or fall incurred during play. Given the greater heights involved for wild Ibex kids, some must certainly fall and perish or be seriously injured while engaging in this activity. The author po5ders if dinosaurs may have also engaged in play behavior. Format: Popular. [DHT]. Juvenile dinosaur bones sometimes show healed injuries. Could they have been injured in play too?).

C

Campagna, T. 2000. The PT Interview: Michael Triebold. Prehistoric Times, 40:18-19.

(lncludes a picture of a hadrosaur dentary with extensive predator toothmarks along the ventral and lateral edges. Apparently both jaws show such bite marks and supposedly there is some evidence of healing! We have been unable to confirm this remarkable claim. Format: Popular. [DHT]).

Campbell, J.G. 1966. A Dinosaur Bone Lesion Resembling Avian Osteopetrosis and Some Remarks on the Mode of Development of the Lesions. Jour. Roy. Microsc. Soc., 85(2):163-174.

(Thin sections of a 70 million dinosaur bone (BMNH R. 5505-06), possibly from Szentpeterfalva, Romania, 70 Ma site, with a lesion encircling the bone shaft are described and illustrated. The alleged instance of osteopetrosis reported in a Nopcsa specimen from the Cretaceous of Transylvania, has an intact cortical surface with spiculated surface bone. Cavitation of the spicules was noted. Known dinosaur fauna from the area include *Mochlodon* (*Rhabdodon*), *Orthomerus*, *Struthiosaurus*, and *Titanosaurus*. He diagnosed osteopetrosis, claiming that reptiles "are not known to be susceptible to the development of hypertrophic osteopathy." Also figured in Swinton, 1934, and later redescribed and refigured in Reid (1990). [DHT]).

Carpenter, K. 1979. Vertebrate Fauna of the Laramie Formation (Maastrichtian), Weld County, Colorado. Contri. Geol., Univ. Wyoming, 17(1):37-49.

(Study of a tooth provisionally referred to the large, Late Cretaceous *Tyrannosaurus* shows that the crown was broken horizontally and polished, suggesting it was broken during the life of the individual but was used for an undetermined period before it was finally shed. Occurrences of similar tyrannosaurid teeth are not uncommon finds in the Late Cretaceous deposits of Alberta, Canada (DHT, field observation). [DHT]).

____ 1982. Baby Dinosaurs from the Late Cretaceous Lance Formation, USA and a Description of a New Species of Theropod Dinosaur. Univ. Wyoming, Contri. Geol., 20(2):123-134.

(A hatchling-sized dentary of an unspecified small theropod [= *Troodon* ?] has an anomalous dorsobuccal twist present at the symphysis. This would cause the first dentary tooth to project obliquely away from the jaw. The author suggests this might be a modification to allow the hatchling to slit through the eggshell with the tooth, or, a pathological feature (ie. birth defect); see Carpenter, 1999. Some other teeth described in this paper are actually aberrant teeth of better known small theropod taxa. See Currie, Rigby and Sloan, 1990:117 for discussion. [DHT]).

____ 1987. Paleoecological Significance of Droughts During the Late Cretaceous of the Western Interior. pp. 42-47. 4th Symp. Mesozoic Terr. Ecosyst., Short Papers. Edited by P.J. Currie and E.H. Koster. Occ. Pap. Tyrrell Mus. Paleo., Drumheller, 3.

(Drought and its effect on extinct and extant large-animal populations. Drought, thirst, poor herbage and other factors could contribute to some dinosaur mass mortality events documented in the fossil record. [DHT]).

____ 1988a. Evidence of Predatory Behavior by *Tyrannosaurus*. (Abstract). In: International Symposium on Vertebrate Behavior as Derived from the Fossil Record. Museum of the Rockies, Bozeman, Montana, September 8-10, 1988, p. 6.

(A section of mutilated caudal neural spines in a specimen of the hadrosaur *Edmontosaurus* suggests attack by a very large predator believed to have been *Tyrannosaurus*. The bite was quick and fractured several neural spines. Bone regrowth "froze" the neural spines in their mangled position, but did not mask tooth punctures, nor an obliquely sheared off neural spine. Bone regrowth indicates that the hadrosaur survived the attack and that damage was not caused by scavenging. This suggests that large theropods, *Tyrannosaurus* in particular, could actively hunt and attack large prey species. [Author's abstract]. See Carpenter, 1998 (2000).

____ 1988b. Dinosaur Bonebeds and Mass Mortality: Implications for the K-T Extinction. In: Global Catastrophism in Earth History: An Interdisciplinary Conference on Impacts, Volcanism and Mass Mortality. Lunar and Planetary Inst. Contr. 673:24-25.

(NOT INDEXED).

____ 1990. Variation in *Tyrannosaurus rex*. pp. 141-145. In: Dinosaur Systematics: Perspectives and Approaches. Edited by K. Carpenter and P.J. Currie, Cambridge Univ. Press.

(Asymmetrical fusion of the last cervical and first dorsal vertebrae in AMNH 5027 is noted and figured. Etiology of the condition is not attempted. [DHT]).

____ 1993. Did Pachycephalosaurs (Ornithischia: Dinosauria) Really Butt Heads? p. 24. In: The Marshall Lamber Symposium. Edited by A.J. Kihm and J.H. Hartman. North Dakota Geological Society, Bismark, 86 pp.

(Refutes earlier suggestions of head-butting in Late Cretaceous pachycephalosaurids. Rather, several types of flank-butting behavior are envisioned. Ornate squamosal horns in *Stygimoloch* were ".... an adaptation for causing maximum pain locally during [intraspecific] flank butting....." See also Tanke, 1988a who had suggested this earlier. Other citations of interest: Carpenter, 1993, 1998; Goodwin et al., 1998. Unillustrated. [DHT]).

____ 1996. A New Look at *Stegosaurus*. Dinosaur Discoveries, 1:6-7.

(lncludes mention of a tail spike that looked like "melted wax." Evidently the spike was fractured in life and became infected. This infection was beginning to affect another tail spike and was still active when the animal died. Osteopathy unillustrated. Format: Popular. See McWhinney, Rothschild and Carpenter, 1998; 2001. [DHT]).

____ 1997. Agonistic Behavior in Pachycephalosaurs (Ornithischia: Dinosauria): A New Look at Head-Butting Behavior. Contrib. Geol., Univ. Wyoming, 32(1):19-25.

(The hypothesis that pachycephalosaurid dinosaurs used their massive domed heads in agonistic head-to-head butting is reexamined. It is questionable whether such behavior was possible because of the small contact area of opposing heads. lnstead, flank-butting is suggested based on analogy with extant African antelopes. Two types of flank-butting are recognized on the basis of dome structure. Type One is seen in *Pachycephalosaurus*, *Prenocephale*, and *Stegoceras*, all of which have tall, rounded frontoparietal domes. Such domes would maximize the mass of the head in flank-directed blows. Pain would be felt by the opponent without serious injury. Type Two is seen in *Stygimoloch*, in which squamosal horns are developed along the posterior margins of the dome. These horns seem to be an adaptation for causing maximum pain locally during flank-butting without causing serious injury. The horns were not sharp, but blunted [sic]. [Author's abstract]. See also Tanke, 1988a; Goodwin et al., 1998. lllustrated).

____ 1998. Armour of *Stegosaurus stenops*, and the Taphonomic History of a New Specimen from Garden Park, Colorado. Modern Geol., 23:127-144.

(lncludes mention of pathologic tail spikes in *Stegosaurus* and fighting behavior in this form. See McWhinney, Rothschild and Carpenter, 1998, 2001. [DHT]).

____ 1998 (not published until 2000). Evidence for Predatory Behavior by *Tyrannosaurus*. pp. 135-144. In: Aspects of Theropod Paleobiology. GAIA, 15. Edited by B.P. Perez-Moreno, T. Holtz Jr., J.L. Sanz, and J. Moratalla. 403 pp.

(Evidence for predatory behavior in the fossil record is rare, especially for dinosaurs. Two unambiguous examples document instances of

predator-prey relationships among the dinosaurs. The first example is of the small predator *Velociraptor* OSBORN 1924 buried with its prey, *Protoceratops* GRANGER & GREGORY, 1923. As interpreted, the right forearm of the *Velociraptor* is between the clenched beak of the *Protoceratops*, the left hand of the *Velociraptor* is grasping the face of the *Protoceratops*, and the sickle claw of the right foot of the *Velociraptor* is extended into what was the throat of the prey. The second example is a section of mutilated caudal neural spines in an adult specimen of the hadrosaur *Edmontosaurus* LAMBE, 1920. The damage suggests an attack by a very large theropod believed to have been *Tyrannosaurus* OSBORN, 1905. Bone regrowth indicates that the hadrosaur survived the attack, and that the damage could not have been caused by scavenging. These two examples suggest that both small and large theropods, *Velociraptor* and *Tyrannosaurus* in particular, could actively hunt and attack prey species. [Author's abstract]. Osteopathy illustrated; See also Carpenter, 1988a).

____ 2000. Eggs, Nests, and Baby Dinosaurs. Indiana Univ. Press, Bloomington. xi + 336 pp.

(The author provides a good review of abnormal conditions found in eggs of modern vertebrates and in dinosaurs. Topics regarding dinosaur eggs include: multi-layered eggshell, abnormally thin or thick mamillary layer in relation to crystalline layer and thin eggshells. Includes comments and descriptions on intraspecific fighting, monospecific bonebeds containing juvenile material, pathologic juvenile *Troodon* jaw, pathologic juvenile *Maiasaura* metatarsal. The following are illustrated: *Megaloolithus* (multilayered eggshell, p. 79); *Maiasaura* (extra spherites, p. 107); hatchling-sized *Troodon* dentary with outward twist at distal end, p. 198; *Maiasaura* hatchling with "twisted" 4th metatarsal, p. 199. [DHT]).

____, Hirsch, K.F. and Horner, J.R. 1994a. Introduction. pp. 1-11. In: Dinosaur Eggs and Babies. Edited by K. Carpenter, K.F. Hirsch and J.R. Horner. Cambridge Univ. Press, Cambridge. ix + 372 pp.

(Pages 4-5 include a general discussion on dinosaur eggshell pathology types, especially of the multi-layered variety. Unillustrated. [DHT]).

____, ____ and ____ 1994b. Summary and Prospectus. pp. 366-370. In: Dinosaur Eggs and Babies. Edited by K. Carpenter, K.F. Hirsch and J.R. Horner. Cambridge Univ. Press, London. ix + 372 pp.

(Mention of dinosaur egg pathology only. NOT INDEXED. [DHT]).

____ and Smith, M. 2001. Forelimb Osteology and Biomechanics of *Tyrannosaurus rex*. pp. 90-116. In: Mesozoic Vertebrate Life: New Research Inspired by the Paleontology of Philip J. Currie. Edited by Darren Tanke and Kenneth Carpenter. Indiana University Press, Bloomington. xviii + 577 pp.

(Although proportionately the forelimb is very small, the mechanical advantage reveals an efficiently designed force-based system (vs. a velocity-based system) used for securing its prey during predation. In addition, the M. biceps is shown to be 3.5 times more powerful than the same muscle in the human, the straight, columnar humerus provides maximum strength to mass ratio to counter the exertion of the M. biceps, and the thick cortical bone indicates bone selected for ultimate strength. Such mechanical adaptations can only indicate that the arms were not useless appendages, but were used to hold struggling prey while the teeth dispatched the animal. *Tyrannosaurus rex* was therefore an active predator and not a mere scavenger, as has been suggested. [Author's abstract]. An avulsion injury affecting the humerus is illustrated and discussed).

Chang, K. 1998. Dinosaur Embryos Uncovered - Thousands of Eggs Strewn Across Site in Argentina. Found on Internet on November 19, 1998 at: http://www.abcnews.com/sections/science/DailyNews/dinoeggs981117.html

(Three page article relating the discovery of Late Cretaceous titanosaur sauropod eggs and embryos in Patagonia, Argentina. Presence of embryonic skin is also confirmed. A flood is believed to have smothered and buried the unhatched eggs. See also Anonymous, 1998e. [DHT]).

Chapman, R.E., Rasskin-Gutman, D. and Weishampel, D.B. 1996. Sexing Dinosaurs. p. 37. In: DinoFest International Symposium. Program and Abstracts. April 18-21, 1996. Arizona State University, Tempe. Edited by D.L. Wolberg and E. Stump.

(NOT SEEN. NOT INDEXED).

Charig, A.J. 1979. A New Look at the Dinosaurs. Heinemann, London, in association with the British Museum (Natural History), 160 pp.

(NOT SEEN. NOT INDEXED. Format: Popular).

____ 1993. Disaster Theories of Dinosaur Extinction. Mod. Geol., 18(3):299-318.

(NOT SEEN. NOT INDEXED).

____ and Horsfield, C.M.B. 1975. Before the Ark. BBC Publ., London: 160 pp.

(NOT SEEN. NOT INDEXED. Includes dinosaur egg pathology. Format: Popular).

Chenoweth, W.L. 1987. The Riggs Hill and Dinosaur Hill Sites, Mesa County, Colorado. pp. 97-100. In: Paleontology and Geology of the Dinosaur Triangle. Guidebook for 1987 Field Trip, Sept. 18-20, 1987. Edited by W.R. Averett. Museum of Western Colorado, Grand Junction.

(Includes mention on page 99 of Riggs, 1903 comments on Upper Jurassic sauropods *Apatosaurus* (*Brontosaurus)* with broken and healed ribs, one showing a pseudoarthrosis or "false joint" development. Unillustrated. [DHT]).

Cherfas, J. 1990. Genes Unlimited. New Sci., 126(1712):29-33.

(Dinosaur DNA, DNA studies. Format: Popular. [DHT]).

____ 1991. Ancient DNA: Still Busy After Death. If Not a Dinosaur, A Mammoth? Science, 253:1354-1356.

(A review of the latest research and discoveries concerning the growing field of subfossil and fossil DNA analysis. While most of the article deals with the uses of DNA analysis in an archaeological context, there is reference to the 7,000 ybp Windover Indian material from central Florida peatbogs that has yielded DNA from brain remains. The sidebar article "If not a Dinosaur, a Mammoth?" includes discussion of the results of DNA analysis of the Russian mammoth "Dima" *Mammuthus primegenius*. [DHT]).

Chiappe, L. 1998. Dinosaur Embryos - Unscrambling the Past in Patagonia. Nat. Geogr., 194(6):34-41.

(Mass mortality of Late Cretaceous sauropod embryos; skin impressions of high quality, Argentina. Format: Popular. See Chiappe et al., 1998 for detailed description. [DHT]).

____, Coria, R.A., Dingus, L., Jackson, F., Chinsamy, A. and Fox, M. 1998. Sauropod Dinosaur Embryos from the Late Cretaceous of Patagonia. Nature, 396:258-261.

(Mass mortality of sauropod eggs and embryos. Thousands of eggs were found over an area covering a square kilometer. Numerous specimens contain embryonic material and some preserve excellent skin impressions. Well illustrated. See Chiappe et al., 1999. [DHT]).

____, Jackson, F., Dingus, L., Grellet-Tinner, G. and Coria, R. 1999. Auca Mahuevo: An Extraordinary Dinosaur Nesting Ground from the Late Cretaceous of Patagonia. (Abstract). Jour. Vert. Paleo., 19(3):37A.

(Discovered in 1997 in rocks of the Late Cretaceous Rio Colorado Formation in northwestern Patagonia (Argentina), Auca Mahuevo provides the only reliable evidence of sauropod embryos, contained inside eggs of megaloolithid microstructure. Auca Mahuevo is also remarkable because of its enormous size, with egg layers extending laterally for several kilometres. Initially identified on the basis of one egg layer (layer 3 of our stratigraphic section), three additional egg layers (layers 1, 2, and 4; layer 1 being the oldest) have since been discovered. A high concentration of eggs is present at Auca Mahuevo: 30 clusters of eggs were mapped in a 600 square meter area of the egg layer 3 and over 200 eggs were found distributed over a quarry of 30 square meters of this same egg layer. Embryonic remains are also strikingly abundant — at least 1/3 of the *in situ* eggs examined contain bones. In addition, dozens of egg fragments on the surface of egg layer 3 produced casts of embryonic skin. Microstratigraphic cross-sections of egg layer 4 reveal that the clusters of eggs appear to be associated with ancient, small-scale topographic features. In some instances, the clusters of eggs appear to sit directly on these surfaces. The distribution of the eggs as well as the characteristics of the egg-bearing sediments rule out the possibility of any significant post-laying transport. Consequently, Auca Mahuevo stands out as an important site, clarifying aspects of the reproductive biology of sauropod dinosaurs and providing uncontroversial evidence of their gregarious nesting behavior. [Author's abstract]. Egg mass mortality).

Chin, K. 1991. Petrographic Analysis of a Presumed Dinosaurian Coprolite from the Upper Cretaceous Two Medicine Formation, Montana. (Abstract). Jour. Vert. Paleo., 11(3):22A.

(A plant-bearing coprolite was found near bone beds of *Styra-*

cosaurus and *Prosaurolophus* and near isolated fossils of *Euoplocephalus, Edmontonia, Orodromeus*, a lambeosaurid, carnosaurs, turtles, and plant aggregates ("dubiocoprolites"). The permineralized coprolite consists of two cylindrical parts, each approximately 3 x 4 x 15 cm, one with a conspicuous fusiform end. The size, age and setting of the specimen suggest that it was produced by a herbivorous dinosaur. Combined histological and biogeochemical analyses of the coprolite reveal the nature of its original organic matter and provide evidence of diet and gut processes. Thin sections of the sample indicate that the animal ingested a variety of plant materials. Seeds, stem tissue, leaf blades, petioles, and fragments of unidentifiable plant tissue were observed. The number of small seeds in the sample suggest that the herbivore may have pursued a high quality plant diet. Alternatively, the seeds may have been accidently ingested with the dinosaur serving as an unwitting dispersal agent. Detailed analyses of the organic chemical composition of the sample reveals that it contains unaltered components of vascular plants, notably higher in n-alkanes and aromatic triterpenoids. Other constituents, specifically hopanoids, are attributable to bacterial sources. The preservation of clearly-recognizable organic components derived from plant tissues suggests a comparatively inefficient digestive process possibly equivalent to foregut fermentation. This preliminary study illustrates the potential of combined visual and biogeochemical analyses in the description and characterization of dinosaur coprolites and their implications for diet and digestion. [Author's abstract]).

____ 1994. On the Elusive Trail of Fossil Dung. pp. 285-294. In: Dino Fest. Edited by G.D. Rosenberg and D.L. Wolberg. The Paleontological Society Special Publ. No. 7.

(Includes brief comments on the potential of paleofeces or coprolites for paleoparasitological studies. Illustrated. [DHT]).

____ 1997. Coprolites. pp. 147-150. In: Encyclopedia of Dinosaurs. Edited by P.J. Currie and K. Padian. Academic Press, San Diego. xxx + 869 pp.

(Good review with bibliography. Unillustrated. [DHT]).

____, Tokaryk, T.T., Erickson, G.M. and Calk, L.C. 1998. A King-Sized Theropod Coprolite. Nature, 393:680-682.

(Bone-filled *Tyrannosaurus* coprolite collected from the Late Cretaceous Frenchman Fm. of S.W. Saskatchewan, Canada. This specimen shows that *Tyrannosaurus* did in fact have bone-crunching capabilities [see various citations under Erickson, G.M.]. [It has also been suggested that large theropods such as tyrannosaurs could have damaged (fractured) their teeth during accidental tooth strikes against prey bone- in this case the bone-filled coprolite shows the tooth on bone contacts were certainly not accidental!]. Illustrated. [DHT]).

Chinnery, B.J. and Trexler, D. 1999. The First Bonebed Occurrence of a Basal Neoceratopsian, with New Information on the Skull Morphology of *Leptoceratops*. (Abstract). Jour. Vert. Paleo., 19(3):38A.

(Late Cretaceous Two Medicine Formation, Montana, USA. At least 6 subadult animals of a new species of *Leptoceratops* were recovered. [It is unstated whether or not this site represent a mass mortality bonebed. [DHT]).

Chinsamy, A. 1994. Dinosaur Bone Histology: Implications and Inferences. pp. 213-227. In: Dino Fest. Edited by G.D. Rosenberg and D.L. Wolberg. The Paleontological Society Special Publication No. 7.

(This report provides some basic information on bone microstructure, specific details regarding the nature of dinosaurian bone histology, and includes a discussion of the physiological patterns of bone deposition. Furthermore, it demonstrates that although bone histology is not directly correlated with thermoregulatory status, it does, nevertheless, provide pertinent insights into the complex questions of bone depositional rate, overall growth rate, and growth strategy. [Authors' introduction, in part]).

____ and Dodson, P. 1995. Inside a Dinosaur Bone. Amer. Sci., 83:174-180.

(Detailed discussions on the histological findings of taxonomically diverse dinosaurs. Years ago, it was a widely accepted view that dinosaurs were more like extant reptiles in their physiology. However, the past few decades have seen a trend where many dinosaurs were compared physiologically to modern mammals and birds. Findings presented in this paper indicate that dinosaurs do not compare to any one extant group (reptile, mammal, bird) exclusively, but had widely differing physiologies particular to that dinosaur family. [Could bone fracture repair rates and bone responses to disease have been altered accordingly?]. Well illustrated with color photographs. [DHT]).

____ and Raath, M.A. 1992. Preparation of Fossil Bone for Histological Examination. Pal. Afr., 29:39-44.

(Technical description of the techniques used to prepare fossilized bone or wood samples for histological examination by light microscopy. Illustrated. [DHT]).

____ and Barrett, P.M. 1997. Sex and Old Bones? Jour. Vert. Paleo., 17(2):450.

(Response to Martill, Barker and Dacke, 1997. In that paper, it was suggested that in a "brooding" Late Cretaceous *Oviraptor* skeleton, if the animal was female, examination of medullary bone histology might reveal, like female birds, features of calcium depletion due to egg production. Here, Chinsamy and Barrett point out that the bone histology of animals like *Oviraptor*, basal birds and other non-avian theropods does not show medullary bone and thus male/female differences at the bone microstructure level should ".... be regarded with extreme caution." Unillustrated. [DHT]).

Choy, D.S. and Altman, P. 1992. The Cardiovascular System of *Barosaurus*: An Educated Guess. Lancet, 340:534-536.

(In a novel paper, the authors include the suggestion that probable high blood pressure in the Jurassic sauropod *Barosaurus* would predispose it to coronary heart disease and stroke. In older animals, sudden exertion or overloading the cardiovascular system would have resulted in a tendency to faint. The authors state that consciousness would soon be regained after falling to the ground and the blood pressure differential disappeared. [But at what cost? Surely an animal of such large proportions as *Barosaurus* would have suffered bone or other trauma while falling to the ground in a fainting spell]. [DHT]).

Christiansen, P. 1996a. The Evidence for and Implications of Gastroliths in Sauropods (Dinosauria, Sauropoda). GAIA, 12:1-7.

(In the American Late Jurassic *Seismosaurus hallorum*, two clusters of gastroliths were found *in situ*, one in the pelvic region and the other at the base of the neck. Explaining the possible reason for the positioning of the latter cluster, the author postulates that ".... sauropods coughed up their gastroliths just before death, as seen in modern birds in stress situations....." Gastroliths in the neck region have been cited by a few authors as possible evidence of choking to death- Christianson's suggestion sounds more plausible. Unillustrated. [DHT]).

____ 1996b. The "Whiplash" Tail of Diplodocid Sauropods: Was It Really a Weapon? pp. 51-58. In: The Continental Jurassic. Edited by M. Morales. Museum of Northern Arizona Bulletin 60.

(The popular theory that the longtailed diplodocid sauropods employed rapid, whiplike movements of their large tails as a means of defence against theropods is based on rather weak evidence and does not seem to be supported by anatomical characters. Morphology of the centra and zygapophyses indicate only limited lateral mobility and the caudal flexors appear to have been too small to be able to move the huge tails rapidly. Fusion of adjacent centra [DISH] is quite common in long-tailed and short-tailed sauropods alike and would have restricted mobility, laterally as well as dorsoventrally. Sauropods with tail clubs have shorter and stockier tails, although the morphology is quite similar to that of diplodocid sauropods, but the action of the tail club probably would not require the rapid and forceful lateral swings it would take to set up a whiplash action in the long thin distal tail sections of diplodocids. [Author's abstract]. Illustrated).

Chubb, T.A. 1989. Dinosaurs Victims of Cyanide Poisoning? Discussion. EOS, Trans. Amer. Geophys. Union, 70(40):873-874.

(Presents the unlikely hypothesis that dinosaurs went extinct after they ingested cyanide released into the biosphere immediately after a comet/earth impact 63 million years ago. Full of untestable assumptions. [DHT]).

Claessens, L. 1996. Dinosaur Gastralia. Morphology and Function. Unpublished M.Sc. Thesis, Utrecht University, Holland.

(Gastralia basket in USNM 8367 *Allosaurus* specimen was erroneously described by Gilmore, 1920 as having 7-9 rib sections or segments per row. Direct examination by DHT revealed numerous examples of healed and poorly healed fractures forming pseudoarthroses. To Gilmore (who was evidently unaware of the osteopathies affecting this region of the specimen), this created the false impression of a much more complex gastralia rib arrangement. [DHT]).

____ ms. Dinosaur Gastralia. Morphology and Function. Manuscript in progress, to be submitted to Journal of Vertebrate Paleontology.

(Pathological *Allosaurus* gastralia. See Claessens, 1996 for details. [DHT]).

Clark, J.M., Norell, M.A. and Chiappe, L.M. 1999. An Oviraptorid Skeleton from the Late Cretaceous of Ukhaa Tolgod, Mongolia, Preserved in an Avianlike Brooding Position of an Oviraptorid Nest. Amer. Mus. Novit., 3265:36 pp.

(Includes mention of the right ulna in this specimen showing a healing fracture callus affecting the right ulna. The callus is preserved two-thirds of the way down the shaft. Illustrated. [DHT]).

Clarke, J.B. and Barker, M.J. 1993. Diagenesis in *Iguanodon* Bones from the Wealden Group, Isle of Wight, Southern England. Kaupia, Darmstadter Beirage zur Naturgeschichte, 2:57-65.

(Documents the unusual occurrence of fossilized bacterial mucilage films within a vertebra of the Lower Cretaceous *Iguanodon*. Illustrated. [DHT]).

____ and ____ 1995. Abnormal Histology in an *Iguanodon* Caudal Centrum from the Lower Cretaceous of the Isle of Wight. Paleontology, 38:905-914.

(The abnormal histology of a ?pathological *Iguanodon* (Dinosauria; Ornithischia) caudal vertebral centrum is described and comparisons made with normal iguanodontid histology. The abnormal bone exhibits rapidly generated radial growth patterns; in the cancellous zone, areas of primary bone predominate and there is a distinctive contorted vascularity throughout. The similarities of the observed deformations to known mammalian pathologies such as local trauma, Paget's disease, haemangioma and vitamin deficiency are discussed. Further systematic surveys to ascertain details of dinosaur bone histology and variation are required. [Authors' abstract]. Well illustrated).

Clos, L.M. 1996. Social Behavior in Dinosaurs. Jour. Amateur Paleo., 2(4):6-13.

(Includes mention of healed damage in Late Cretaceous ceratopsian frills incurred during intraspecific fighting. Unillustrated. Format: Popular. [DHT]).

Clouse, V.R. 1995. Paleogeography of an Extensive Dinosaur Nesting Horizon in the Judith River Formation of North-Central Montana. Geol. Soc. Amer. Abstr. With Progr., 47th Ann. Meeting, Rocky Mountain Section. Montana State Univ., Bozeman, Montana, May 18-19, 1995:6.

(Dinosaur nest sites, containing multiple egg nests yielding whole and partial eggs, embryos and baby bones, have now been documented within the Upper Cretaceous Judith River Formation of Hill County, Montana. These sites provide a unique opportunity to study dinosaur nesting behavior in what has traditionally been viewed as a "lowland" setting. Fine-grained floodplain sediments yielding the nest sites cover at least 100 [square] km.

The sites appear to have similar taphonomic histories, and virtually all of the sites are closely associated with a regional datum consisting of three superposed bentonite beds. Data suggest that the nest sites are preserved within a very thin stratigraphic interval that was more conducive to preservation than surrounding facies. Limited exposures and faulting make it difficult to accurately place the nesting horizon within the Judith River section. The nesting horizon may be preserved in strata deposited near the end of the Claggett regression, which would essentially locate the sites in a more upland paleoenvironment. Alternatively, the nesting horizon may be preserved in response to a major change in depositional regime associated with the Bearpaw transgression. Sedimentologic data and well-logs are currently being analyzed to place the nesting horizon within a more detailed stratigraphic and paleogeographic framework. [Author's abstract]. Mass mortality of hadrosaur eggs and embryos; see also Clouse and Horner, 1993).

____ and Horner, J.R. 1993. Eggs and Embryos from the Late Cretaceous (Campanian) Judith River Formation of North-Central Montana. (Abstract). Jour. Vert. Paleo., 13(3):31A.

(Two separate nesting localities were discovered in fine grained flood plain facies associated with caliche layers in the middle one-third of the Judith River Formation in Hill County, Montana.

The nesting localities, each containing multiple egg nests, yield eggshell fragments, eggs and embryos of dinosaurian and non-dinosaurian taxa. At least three eggshell morphotypes are represented from each of the localities. Initial preparation of the specimens indicate that both nesting localities contain hadrosaurid eggs, some with well developed embryos. A clutch of nineteen small, smooth-shelled eggs encompassing an embryo of an unidentified, non-dinosaurian taxon, is associated with one of the nesting localities. [Author's abstract]. See Clouse, 1995).

Cohen, S., Cruickshank, A., Joysey, K., Manning, T. and Upchurch, P. 1995. The Dinosaur Egg & Embryo Project- Exhibition Guide. Rock Art, Leicester. 16 pp.

(Simply amazing specimens. Chinese Late Cretaceous therizinosaur eggs and beautifully preserved embryos in perfect detail. The fossils were etched out of calcite-filled eggs with weak acetic acid. Possible skin, cartilage and muscle matter are preserved. Some features resemble moulds which may have formed during decomposition of the egg. DNA analysis was attempted, but without success. [DHT]).

Colbert, E.H. 1947. The Little Dinosaurs of Ghost Ranch. Nat. Hist., 56:392-399, 427-428.

(Briefly suggests that the mass mortality event of Triassic *Coelophysis bauri* preserved at Ghost Ranch, New Mexico, USA was due to a volcanic holocaust. Format: Popular. See Schwartz and Gillette, 1994 for revised discussion. [DHT]).

____ 1961. Dinosaurs. Their Discovery and Their World. E.P. Dutton Co., New York, xiv + 300 pp.

(On pages 255-256, Colbert considers and refutes the suggestion of disease as the cause of extinction in the dinosaurs. Format: Popular).

____ 1983. Dinosaurs: An Illustrated History. Hammond, Inc., New Jersey, 224 pp.

(On page 203, the author briefly discusses the role of disease as a possible factor in dinosaur extinction. He concludes that while some dinosaur groups might die out from disease, it is unlikely one disease could effectively wipe out all the diverse numbers of families and taxa currently recognized. [DHT] Format: Popular).

____ 1989. The Triassic Dinosaur *Coelophysis*. Mus. Northern Arizona Bull. 57, 160 pp.

(Includes mention of mass mortality, pp. 14-17. The world famous Ghost Ranch quarry in New Mexico, USA contains the skeletal remains of hundreds of individuals all piled atop each other. Remains occur as isolated bones or partial/complete skeletons. The fact that the site in fact represents a mass mortality is confirmed, but what the agent was that killed and brought the animals to this spot is unclear. Entrapment by quicksand or floodwaters is briefly suggested. It does seem evident that what killed the animals also caused them to be buried together in profusion. Several adult animals contained the skeletal remains of juvenile *Coelophysis*, cannibalism is implicated, pp. 141-144. Illustrated. [DHT]).

Coombs, W.P. 1975. Sauropod Habits and Habitats. Palaeogeogr., Palaeoclimat., Palaeoecol., 17:1-33.

(Includes mention of tail fusions in Upper Jurassic *Diplodocus*, distal tail injuries in *Cetiosaurus*; use of tail in sauropods as a weapon. Osteopathy unillustrated. [DHT]).

Cooper, D. Manuscripts in progress.

(NOT SEEN. NOT INDEXED. MANUSCRIPTS IN PROGRESS. Paleopathology of Early Cretaceous *Iguanodon* and *Neovenator*).

Cooper, J.E. and Jackson, O.F. 1981. Introduction. pp. 3-8. In: Diseases of The Reptilia. Volume 1. Edited by J.E. Cooper and O.F. Jackson. Academic Press, New York, xi + 383 pp. + xxxii.

(Figures a healed ischial fracture in the Lower Cretaceous *Iguanodon* and includes a brief comment on the possible role of disease as an extinction factor in dinosaurs. [DHT]).

Cope, E.D. 1876. Descriptions of Some Vertebrate Remains from the Fort Union Beds of Montana. Proc. Acad. Nat. Sci., Philadelphia, 28:248-261.

(First formal description of the teeth of the Late Cretaceous small theropod *Paronychodon lacustris*; pp. 256-257. With their unique longitudinal ridging affecting both sides of the tooth crown, these teeth are considered by some to represent anomalous teeth of other small theropod taxa. See Currie, Rigby and Sloan, 1990 and Baszio, 1997 for discussion. Unillustrated. [DHT]).

Coria , R.A. 1994. On a Monospecific Assemblage of Sauropod Dinosaurs from Patagonia: Implications for Gregarious Behavior. pp. 209-213. In: Aspects of Sauropod Paleobiology. Edited by M.G. Lockley, V.F. dos Santos, C.A. Meyer and A. Hunt. GAIA, No. 10. Lisbon. 279 pp.

(A monospecific bone bed of the cetiosaurid sauropod *Patagosaurus*

fariasi is reported. Its implications for hypotheses of dinosaur gregarious behavior are discussed. Taphonomic data suggest catastrophic mass accumulation of the assemblage. Associated juveniles and adults suggest the remains of a social group or herd, and might extend parental care among cetiosaurids. [Author's abstract]).

Cox, B. 1976. Fossilised Fury. Nature, 260:748-749.

(Review of some of the latest research into speculated behavior of fossil vertebrates, as evidenced by their cranial structures compared to analogous extant vertebrates. Horned dinosaurs with "non-locking" horns are considered to be more dangerous during intraspecific bouts of an aggressive nature (*sensu* Farlow and Dodson, 1975) [DHT]).

Coy, C. 1997. Ghost Ranch. p. 277. In: Encyclopedia of Dinosaurs. Edited by P.J. Currie and K. Padian. Academic Press, San Diego. xxx + 869 pp.

(Upper Triassic *Coelophysis* quarry, Chinle Formation, Ghost Ranch, New Mexico, USA. Comments on the mass mortality bonebed there and suggests drowning as an etiology. Many, mostly complete skeletons are preserved there. Unillustrated. [DHT]).

Crichton, M. 1990. Jurassic Park. Alfred A. Knopf, New York. xi + 400 pp.

(NOT INDEXED. Science fiction novel whose plot involves the development of a tourist theme park containing real live dinosaurs. This is achieved by cloning dinosaurs from their DNA recovered from blood-sucking mosquitoes preserved in amber. The storyline includes several references to the study of paleopathology and related fields. Opisthotonus is discussed on page 57. One of the cloned *Stegosaurus* dies of an undetermined intestinal illness (p. 130). A hypsilophodont falls and breaks its neck (p. 130). Veterinarians scrub the teeth of *Tyrannosaurus* so it does not get tooth decay (p. 132). Hypsilophodonts scratch themselves to relieve itchy skin- either an allergic reaction or fungus (p. 138, 140). Female *Triceratops* fight and kill each other in dominance fights (p. 140, 369). *Stegosaurus* suffer from tongue blisters and diarrhea- two died (p. 140, 156-159). A hypothetical parasite, *Phagostomum venulosum*, is found in dinosaur dung (p. 141). Fossilized dinosaur bone can tell you about some of the diseases that afflicted them (p. 394).

The book was released as a highly successful movie on June 11, 1993, and became one of the largest grossing movies of all time. Format: Science-Fiction. The book was reviewed by a vertebrate paleontologist, see: Weis-hampel, D. 1991. Amer. Jour. Phys. Anthrop., 85(2):239-240. [DHT]).

____ 1995. The Lost World. Ballantine Books, New York. xiv + 430 pp.

(Sequel to the popular book and movie "Jurassic Park." Includes some references relevant to this bibliography. Working from the paperback version, on pages 237-238, a pack of feeding *Velociraptor*, engage in intense intraspecific fighting, killing and cannibalism. Some animals show "healed scars" on their bodies. A man stepping on the leg of a baby *Tyrannosaurus* caused it to scream "in pain," p. 259. Later on (p. 281) this animal is examined and a fracture of the mid-fibula is diagnosed. Young *Velociraptor*'s showed healing scarring on their bodies, p. 356. Intra- and interspecific biting transmits a "fatal prion disease called DX," p. 428. Format: Science-fiction. [DHT]).

Croft, L.R. 1982. The Last Dinosaurs- A New Look at the Extinction of the Dinosaurs. Elmwood Books, 79 pp.

(Suggestion that climate warming and other factors led to cataract development in dinosaurs, resulting in blindness and ultimately, extinction of the entire group. The author suggests that development of crests, horns, frills, and knobs of bone over the eyes acted as sun shades to protect the sensitive eye. This novel, if not outlandish suggestion has not gained any acceptance in the paleontological community. [DHT]).

Cronkite, W. 1991. Dinosaur! The Tale of an Egg. A&E, Lumivision.

(This television program, the third in a series of four, examines dinosaur behavior as interpreted from the fossil evidence. A short segment with the senior editor [DHT] includes a discussion of hadrosaur paleopathology. Multiple rib fractures in *Prosaurolophus maximus* (ROM 787) are shown and attributed to fighting injuries in adult males. A broken and healed proximal caudal neural spine of a generically indeterminate hadrosaur (TMP67.8.52) is examined, mating trauma is a suggested etiology. Format: Popular. [DHT]).

Cruickshank, A.R.I. 1977. Report on Karoo Palaeontology Symposium. South Afr. Jour. Sci., 73:232-234.

(Includes mention of work being done by B.W. Oelofsen on pathological thinning of dinosaur eggshell and dinosaur extinction. See Oelofsen, 1978. Unillustrated. [DHT]).

Currie, P.J. 1981. Hunting Dinosaurs in Alberta's Great Bonebed. Can. Geogr., 101(4):34-39.

(Popular account of the excavations and interpretation of the Late Cretaceous (Campanian) *Centrosaurus* bonebed (Bonebed 43, Quarry 143) in Dinosaur Provincial Park, Alberta, Canada. A massive "monospecific" or low diversity bonebed dominated by the remains of the ceratopsian *Centrosaurus* are believed to represent a mass mortality event, preserving the disarticulated remains of part of a herd (young, subadults and adults) of migrating animals which perished trying to cross a water-swollen river. Such tragic mass mortality events occur with some frequency among extant herding ungulates such as the American Buffalo *Bison bison* or Wildebeest *Connochaetes taurinus*. See Currie and Dodson (1984) for technical description of this site as well as works by Michael Ryan. More recent work (1995-1998) on other *Centrosaurus* bonebeds (BB's 30, 41a, 91) and yet others recently discovered or relocated within the Park indicates that many are probably collectively related and preserve two or three mass drowning events, one preserved in white sandstone facies and one in dark gray, carbonaceous mudstone (siltstone) facies. If so, the numbers of animals lost in each mass drowning event would perhaps exceed 10,000. [DHT]).

____ 1982. G.A.C. Palaeontology Division Fieldtrip- Dinosaur Provincial Park, September 19, 1982. 11 pp.

(Essentially an overview of the Quarry 143 *Centrosaurus* bonebed in Dinosaur Provincial Park, Alberta, Canada; caused by a mass mortality event. See Currie and Dodson, 1984 for details. [DHT]).

____ 1985. Cranial Anatomy of *Stenonychosaurus inequalis* (Saurischia, Theropoda) and its Bearing on the Origin of Birds. Can. Jour. Earth Sci., 22:1643-1658.

(A cranial roof specimen (TMP79.8.1) of this small theropod (now referred to *Troodon formosus*) collected from Quarry 144 in the Campanian Dinosaur Park Formation of Dinosaur Provincial Park, Alberta, Canada exhibits an infolded, circular deformity of the rim of the left sagittal crest. The author suggests it was formed by the presence of a cyst. A healing bite lesion could also be considered; see Tanke and Currie, 1998 (2000). Illustrated. [DHT]).

____ 1987. New Approaches to Studying Dinosaurs in Dinosaur Provincial Park. pp. 101-117. In: Dinosaurs Past and Present. Volume II. Edited by S.J. Czerkas and E.C. Olson. Nat. Hist. Mus. Los Angeles County. xiii + 149 pp.

Mention of preservation of Late Cretaceous biting flies in Alberta, Canada amber, pp. 105, 107. Research into Late Cretaceous *Centrosaurus* and *Styracosaurus* mass mortality bonebeds in Dinosaur Provincial Park, Alberta is also related; pp. 110-111, 114. Format: Popular. [DHT]).

____ 1988. The Discovery of Dinosaur Eggs at Devil's Coulee. Alberta, 1(1):3-10.

(A popular account relating the discovery of Late Cretaceous hadrosaur eggs, nest and embryonic remains at Devil's Coulee, south of Lethbridge, Alberta, Canada. [These hadrosaurs were later described as *Hypacrosaurus stebingeri*, n. sp.]. Illustrated. [DHT]).

____ 1989. Long-Distance Dinosaurs. Nat. Hist., 6/89:60-65.

(Includes mass mortality of no less than 13 juvenile Late Cretaceous ankylosaurs, *Pinacosaurus*, which were overwhelmed and suffocated (still grouped together in their standing positions) in a high-energy sandstorm, Gobi Desert, China. [DHT]).

____ 1996. The Great Dinosaur Egg Hunt. Natl. Geogr., 198(5):96-111.

(Dinosaur DNA in eggs. Format: Popular. [DHT]).

____ 1997a. *Gorgosaurus*? Hip and Tail. p. 3. In: Field Experience - Summer 1996. Royal Tyrrell Museum of Palaeontology Field Experience 96 update: 4 pp.

(A Royal Tyrrell Museum of Palaeontology internally generated newsletter sent to Field Experience 96 participants who worked with museum staff in Dinosaur Provincial Park and Devil's Coulee, Alberta in the 1996 field season. A very large (>8 meters long) Late Cretaceous tyrannosaurid *Gorgosaurus* (TMP94.12.602) was found to have had a fractured and healing right fibula. [Preparation revealed this was a split that ran lengthways over at least 10 cm of the mid-shaft region of this bone]. A possible etiology for this injury is being whacked on the leg by an ankylosaur tail club during a failed predation attempt. Excavation of the find

continued during the summer of 1997. At that time it was discovered that several bilateral dorsal ribs of approximately mid-body position showed well healed fractures and one gastralium showed an imperfectly healed fracture forming a pseudoarthrosis. [Subsequent preparation has revealed face-bite lesions also undergoing active healing and the left sagittal crest appears to have either been bitten off (with subsequent healing) or has been totally resorbed. There are three prominent triangular exostoses developed on the posterior face of the sagittal crest, all are directed posteriorly]. [DHT]).

____ 1997b. Dromaeosauridae. pp. 194-195. In: Encyclopedia of Dinosaurs. Edited by P.J. Currie and K. Padian. Academic Press, San Diego. xxx + 869 pp.

(Includes brief comments on the *Velociraptor* and *Protoceratops* specimens found locked together in combat. Unillustrated. [DHT]).

____ 1998 (not published until 2000). Possible Evidence of Gregarious Behavior in Tyrannosaurids. GAIA, 15:271-277. In: Aspects of Theropod Paleobiology. Edited by B.P. Perez-Moreno, T. Holtz Jr., J.L. Sanz, and J. Moratalla. 403 pp.

(Mass mortality. The author reports on the articulated and disarticulated remains of 7+ *Albertosaurus* collected from a monospecific bonebed located in Dry Island Buffalo Jump Provincial Park, Alberta, Canada. At the end of the 2001 field season, the number of *Albertosaurus* from this site stood at 13. The etiology of the mass death is unknown. [DHT]).

____ 2002. Report on Fieldwork in Mongolia, September 2001. pp. 8-12. In: Alberta Palaeontological Society, Sixth Annual Conference, Abstracts Volume. Mount Royal College, Calgary, Alberta. January 26-27, 2002. v + 77 pp.

(Records the discovery of a second specimen of a fused pygostyle of the Upper Cretaceous (Nemegt Formation) oviraptorid *Nomingia*. After the description of the original specimen, some thought the fusion of the distalmost caudal vertebrae (the "pygostyle") actually represented a pathology. The discovery of this second specimen refutes that hypothesis. Unillustrated. [DHT]).

____ and Dodson, P. 1984. Mass Death of a Herd of Ceratopsian Dinosaurs. pp. 61-66. In: 3rd Symp. Mesozoic Terr. Ecosystems, Short Papers. Edited by W.-E. Reif and F. Westphal, Tubingen (ATTMEPTO Verlag).

(First formal description of a mass death (mass mortality) assemblage of the Late Cretaceous (Campanian) ceratopsian *Centrosaurus*, collected from Quarry 143 (bonebed 43) in Dinosaur Provincial Park, Alberta, Canada. Hundreds, perhaps thousands of animals perished. A mass drowning is hypothesized for the demise of this dinosaur herd. Unillustrated. See also Currie, 1981; Ryan, 1992; Ryan and Russell, 1994; Ryan et al., 2001. [DHT]).

____, Rigby, Jr., J.K., and Sloan, R.E. 1990. Theropod Teeth from the Judith River Formation of Southern Alberta, Canada. pp. 107-125. In: Dinosaur Systematics: Perspectives and Approaches. Edited by K. Carpenter and P.J. Currie, Cambridge Univ. Press.

(Judith River Fm. now = Dinosaur Park Fm. On pages 117-118, the authors address and figure teeth of the problematic "tooth-genus" *Paronychodon*, erected by Cope (1876). This small theropod has teeth of the typical gross morphology, except for the presence of well defined ridging on the lingual surface, plus, some specimens show pitting of the enamel surface. The authors suggest that this ridging is a growth abnormality possibly caused by the prolonged contact of the tooth against the medial wall of the tooth socket during its early development. See Baszio, 1997. [DHT]).

____ and Zhao, Xi-Jin. 1993. A New Carnosaur (Dinosauria, Theropoda) from the Jurassic of Xinjiang, People's Republic of China. Can. Jour. Earth Sci., 30:2037-2081.

(The type specimen of a relatively complete skeleton of *Sinraptor dongi* (n. fam.= Sinraptoridae) is described and well illustrated. There are some brief mentions of paleopathology found on this specimen. Healed bites affecting the dentaries are attributed to possible intraspecific fighting; three of the teeth show premortem breakage of the tips with subsequent wear facets; one rib shows an imperfectly healed fracture. [Actually several other skull elements bear healed toothmark lesions and several other contiguous dorsal ribs bear healed fracture calluses. Lesions are not illustrated. Pathology of this specimen will be considered more fully elsewhere. See Tanke and Currie, 1998 (2000). A popular article on the cranial pathologies of this specimen can be found on the Internet at: http://dns.magtech.ab.ca/dtanke [DHT]).

____ and Jacobsen, A.R. 1995. An Azhdarchid Pterosaur Eaten by a *Velociraptor*ine Theropod. Can. Jour. Earth Sci., 32:, 922-925.

(The tibia from a disarticulated and incomplete skeleton of the Late Cretaceous pterosaur *Quetzalcoatlus* recovered from Dinosaur Provincial Park, Alberta, Canada exhibited toothmarks and a partially embedded tooth of the small theropod *Saurornitholestes langstoni*. During feeding, the tooth had apparently become stuck in the pterosaur bone and snapped off during feeding or attempts at removal. Three distinct fractures of the tooth can be identified. These had occurred prior to the tooth becoming stuck in the bone. Illustrated. [DHT]).

____ and Koppelhus, E. 1996. 101 Questions About Dinosaurs. Dover Publ., Inc., Mineola, New York. 67 pp.

(States that only 2 fossil mosquitoes have been found in amber - one from Alberta, Canada and the other from Japan; biting flies [which could have fed on dinosaur blood] are commonly found in amber, p. 14. The possibility of a poison gland in *Dilophosaurus* (as seen in the movie "Jurassic Park") is said to be unproven at this time, p. 34. Mentions of occurrences of healed fractures of fingers, toes, ribs and leg bones in unspecified dinosaurs as being "very painful." Frills of young horned dinosaurs fractured and then healed asymmetrically into adulthood. One hadrosaur with a jaw fracture ".... caused some messy problems in the growing teeth....;" infected shallow wounds lead to abscess development and leave "gaping holes;" mentions of arthritis in bone joints and report of bone cancer noted, p. 36. Teeth of theropods sometimes broke during feeding, p. 40. Caries (tooth decay) is unknown in dinosaurs- their teeth were replaced before caries could manifest. Oral abscesses in several hadrosaur specimens noted, p. 41. Format: Popular. Osteopathy unillustrated. [DHT]).

____ and Dong, Z. 2001. New Information on Cretaceous Troodontids (Di-nosauria, Theropoda) from the People's Republic of China. Can. Jour. Earth Sci., 38:1753-1766.

(Right metatarsal I of a specimen of *Sinornithoides* exhibits a pathology in the form of a "bony callosity" at mid-length. This anomaly is larger the bone's distal end. Etiology undetermined.. The pathology is figured (fig. 10d,e). [DHT]).

Czerkas, S.J. 1997. Skin. pp. 669-675. In: Encyclopedia of Dinosaurs. Edited by P.J. Currie and K. Padian. Academic Press, San Diego. xxx + 869 pp.

(Excellent overview of soft tissue (skin) preservation in dinosaurs. Well illustrated. [DHT]).

____ and Czerkas, S.A. 1990. Dinosaurs- A Complete World History. B. Mitchell, 247 pp.

(Mention on pages 228-229 of traumatic cranial (frill) pathology in the Late Cretaceous ceratopsians *Pentaceratops*, *Torosaurus*, and *Triceratops*. The authors suggest such injuries were caused by aggressive intraspecific behavior. Format: Popular. [DHT]).

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Dal Sasso, C. and Signore, M. 1998a. Exceptional Soft-Tissue Preservation in a Theropod Dinosaur from Italy. Nature, 392:383-387. (Abstract in: Dal Sasso and Signore 1998b. *Scipionyx samniticus* (Theropoda, Coel-urosauria) and Its Exceptionally Preserved Internal Organs. Jour. Vert. Paleo., 18(3):37A).

(Albian (113 mya) juvenile (hatchling?) maniraptoran theropod (*Scipionyx samniticus*) of uncertain familial affinities with exquisite soft tissue preservation. The animal lays curled in the classic opisthotonic condition, with the tail (largely missing) and neck tightly flexed. Details of musculature, muscle fibers [m. caudifemoralis], liver traces, possible tracheal rings and intestines are preserved. Feathers were not seen. Illustrated. [DHT]).

Daniel, J. 1997. Re: Ceratopsian Pathology and Dinosaur Arthritis (NOT!). Found on Internet 12/01/2000 at: http://www.cmnh.org/fun/dinosaur-archive/1997Feb/0003.html

(Response to Tanke, 1997a. Daniel states that arthritis is a condition most prevalent in older animals and that most dinosaurs did not reach an old age. See Tanke, 1997b for response. [DHT]).

Dantas, P., dos Santos, V.F., Lockley, M.G., and Meyer, C.A. 1995. Footprint Evidence for Limping Dinosaurs from the Upper Jurassic of Portugal. pp. 43-48. In: Aspects of Sauropod Paleobiology. Edited by M.G. Lockley, V.F. dos Santos, C.A. Meyer and A. Hunt. Gaia, No. 10. Revista de Geosciencias. Museu Nacional de Historia Natural,

Lisbon.

(Late Jurassic, Cabo Espichel, Portugal. Large limping theropod as demonstrated by alternating step lengths. Seven "limping" theropod trackways are documented worldwide. A sauropod trackway also showed similar anomalies, with injuries either affecting the right foot or right side. This is the second record worldwide of "limping" sauropods. Limping trackways may be more common than previously supposed. Etiology of the limping is unknown. Congenital affliction is considered. The animal may favor one foot as it was looking one direction while at the same time proceeding in another direction. Or, aspects of being right or left-footed could also be considered. Unillustrated. [DHT]).

Das, S.K., Doberenz, A.R. and Wyckoff, R.W.G. 1967. The Lipids in Fossils. Comp. Biochem. Physiol., 23:519-525.

(Lipid components such as fatty acid esters, cholesterol esters, free fatty acids and phospholipids (phosphatidyl ethanolamine and lecithin) were found in well-preserved bones of Pleistocene age. Half of the older specimens (to Paleozoic) contained fatty acids and two still retained phosphatidyl ethanolamine. A method for identification of the phosphorus from the phospholipid fraction by a new soft X-ray spectrometer is given. The presence of fatty acids in fossils is a function primarily of the conditions of preservation rather than age. [Author's abstract]. Lipids were found in the following: Late Pleistocene mammoth *Mammuthus columbi*; Pleistocene horse *Equus occidentalis*; Pleistocene sabre-toothed cat *Smilodon californicus*; Pleistocene camel *Camelops sp.*; Pleistocene lion *Panthera atrox*; Pleistocene tortoise *Testudo sp.*; unspecified Miocene sirenian bone; Oligocene unspecified mammal bone; Eocene sawfish *Pristis*; Late Cretaceous hadrosaur; Jurassic unspecified dinosaur bone; unspecified Triassic phytosaur. [DHT]).

Dashzeveg, D., Novacek, M.J., Norell, M.A., Clark, J.M., Chiappe, L.M., Davidson, A., McKenna, M.C., Dingus, L., Swisher, C. and Altangerel, P. 1995. Extraordinary Preservation in a New Vertebrate Assemblage from the Late Cretaceous of Mongolia. Nature, 374:446-449.

(Ukhaa Tolgod, Gobi Desert, south-central Mongolia; Late Cretaceous assemblage. Repetitive mass mortality via rapid entombment in eolian sand of terrestrial vertebrates is documented. The site is remarkable in that many skulls and skeletons were found buried in a 4 square kilometer area. 8 unspecified oviraptorid skeletons (cf. *Ingenia*) were found exposed together at one site. Oviraptorid eggs with embryos were also collected. Many theropods were found at this new locality, one possibility for this unique occurrence are monospecific death assemblages. Another site yielded 7 unspecified ankylosaurs found close together. Several hundred lizard and mammal skulls and complete skeletons were also found, in one spot 5 unspecified placental mammals were found close together *in situ*. It is suggested many of the small mammals were buried in their burrows. Illustrated. [DHT]).

Dauphin, Y. 1990. Incidence de l'Etat Diagenetique des Coquilles d'Oeufs de Dinosaures sur la Reconnaissance de Morphotypes- Example du Bassin d'Aix en Province. [Implications of the Preservation of Dinosaur Eggshells for the Definition of Morphotypes- The Case of the Aix Basin]. Comp. Rend. Acad. Sci., 310(11):849-854.

(The review of literature shows that each author has defined new types of dinosaur eggshells in the Aix Basin, based on different criteria. Under these conditions, it may be difficult to compare these types. The microstructural examination shows that eggshells are not devoid of diagenesis. The diagenesis is variable according to the sites. Most criteria, qualitative or quantitative, depend on the preservation of eggshells. So they are not available to define morphotypes. [Author's abstract]. Language: French; with abridged English version. Unillustrated. Diagenetic factors resulting in "thinning" of eggshell were also noted by Penner, 1985. [DHT]).

____ 1991. Incidences de la Methode D'Analyse sur la Composition Chimique des Coquilles D'Oeufs Pathologiques du Bassin D'Aix-En-Provence. [Difficulties in the Method of Analysis of the Chemical Composition of Pathologic Eggshells from the Aix-en-Province Basin]. Ann. de Paleo. (Vert-Invert.), 77(2):107-122.

(The Rognacian layers of the Aix-en-Provence basin [France] are well known, because of the relative abundance of dinosaur pathologic bilayered eggshells. The association of quantitative and qualitative analyses of the chemical composition with microstructural data raises various questions. On one hand, an understanding of the "pathology" of the chemical composition depends on the choice of the analytical method: localized or not. On the other hand, the chemical composition of pathologic and normal eggshells is similar. Because of diagenetic processes, the chemical composition is not useful to know the origin and physiological mechanism of the pathology. [Author's abstract] Language: French).

Davis, P.G. 1996. The Taphonomy of *Archaeopteryx*. Bull. Nat. Sci. Mus., Tokyo, Ser. C, 22(3-4):91-106.

(Examines taphonomic aspects of the early bird *Archaeopteryx* and the small theropod *Compsognathus*. Specimens of these animals are often found with the head and neck strongly pulled or curved backwards over the hip region. Explanations for these conditions have varied, including poisoning; see Moodie, 1918d, 1923a; Dean, 1919). Davis (p. 97), identifies this condition as being ".... due to osmotic desiccation of the tendons caused by immersion in the hypersaline lagoon," sediments of which they are preserved in. Illustrated. [DHT]).

____ and Briggs, D.E.G. 1995. Fossilization of Feathers. Geology, 23(9):783-786.

Scanning electron microscopy of feathers has revealed evidence that a bacterial glycocalyx (a network of exocellular polysaccharide fibers) played a role in promoting their fossilization in some cases. This mode of preservation has not been reported in other soft tissues. The majority of fossil feathers are preserved as carbonized traces. More rarely, bacteria on the surface are replicated by authigenic minerals (bacterial autolithification). The feathers of *Archaeopteryx* are preserved mainly by imprintation following early lithification of the substrate and decay of the feather. Lacustrine settings provide the most important taphonomic window for feather preservation. Preservation in terrestrial and normal-marine settings involves very different processes (in amber and in authigenically mineralized coprolites, respectively). Therefore, there may be a significant bias in the avian fossil record in favour of inland water habitats. [Author's abstract]. Well illustrated).

Dean, B. 1919. Dr. Moodie's Opisthotonus. Science, 49:357.

(Critique of Moodie's 1918d paper on the occurrence of opisthotonus in fossil vertebrates. Dean presents another suggestion to account for the pulled back nature of the neck found occasionally in vertebrate skeletons. He notes that in a rotting carcass, the ligaments holding the neural arches together last longer than those holding the centra. As the latter come apart from each other, the greatly curved nature of the neck can be seen. See Moodie, 1919a, b for response to Dean's comments. [DHT] See also: Weigelt, 1927 [1989] and Davis, 1996).

de Camp, L.S. and de Camp, C.C. 1968. The Day of the Dinosaur. Doubleday and Co., New York, 319 pp.

(Scarred frills and broken horns in the Late Cretaceous ceratopsian *Triceratops* are attributed to intraspecific fighting and predator damage. [DHT]. Format: Popular).

DeFeo, D. 1997. Going Once...Going Twice...Gone Forever. Preserving America's Fossil Heritage. The Dinosaur Report, Winter, 1997:1, 5-8.

(Another in a plethora of articles on pathologies of "Sue" a Late Cretaceous *Tyrannosaurus*. A broken fibula may have been acquired when whacked on the leg by an ankylosaurs' tailclub. There may be an embedded *Tyrannosaurus* tooth in one of her ribs. Two caudal vertebrae were "crushed and displaced." The left side of the skull bears signs of trauma, perhaps incurred during struggles with a rival. Unillustrated. Format: Popular. [DHT]).

de Ricqles, A.J. 1980. Tissues Structure of Dinosaur Bone: Functional Significance and Possible Relation to Dinosaur Physiology. pp. 103-139. In: A Cold-Blooded Look at Warm-Blooded Dinosaurs. Edited by R.D.K. Thomas and E.C. Olson, Westview Press, Boulder. xxx + 514 pp.

(NOT INDEXED).

Derstler, K. 1996. The Forgotten Treasure — Dinosaurs from the Lance Formation of Wyoming. p. 44. In: DinoFest International Symposium. Program and Abstracts. April 18-21, 1996. Arizona State University, Tempe. Edited by D.L. Wolberg and E. Stump.

(Monospecific *Edmontosaurus* bonebed. Mass mortality event? [DHT]).

Desmond, A.J. 1976. The Hot-Blooded Dinosaurs. A Revolution in Paleontology. Dial Press, James Wade, New York, 238 pp.

(Dinosaur egg pathology, thinning of eggshell, p. 196. Includes comments on possible (but unlikely) strychnine poisoning as exemplified in the opisthotonic pose of a Late Cretaceous ornithomimid (see page 189),

suggested by Roy Moodie (1918d in this bibliography). See Dean, 1919; Swain, 1974, 1976 and Davis, 1996. Format: Semi-Popular).

Desse, G., Meunier, F.-J., Peron, M. and Laroche, J. 1981. Hyperostose Vertebrale chez l'Animal. [Hyperostosis of the Vertebrae in Animals]. Rhumatologie, 33:105-119.

(Ligamentous ossification [DlSH] in Lower Cretaceous *Iguanodon*, extant suids, ursids, canids, equids, cetaceans, pinnipeds, primates. Specifically illustrated are European wild boar *Sus scrofa*, dog *Canis familiaris*, horse *Equus caballus*, and perhaps in the fish *Trachurus trachurus*. Hero shrew *Scutisorex congicus*, natural hyperostotic pattern illustrated. Hyperostotic phenomenon of unknown etiology were identified in the fish *Drepane africana* (fin) and *Caranx*. Language: French. [BMR]).

Dingus, L. 1996. Great Fossils at the American Museum of Natural History — Next of Kin. Rizzoli, New York. 160 pp.

(Includes comments on pathologic conditions observed on the AMNH *Tyrannosaurus*, p. 88. Two neck vertebrae had fused, as had two dorsal vertebrae. The etiology of these fusions is unclear. Possibilities include injury, an "arthritic condition" or a "form of bone cancer." [This appears to represent a congenital fusion- BMR]. It is suggested the animal suffered some degree of pain from these pathologies. Healing rib fractures were also noted. Format: Popular. [DHT]).

____ 2000. Death in the Dunes. Nat. Hist., 109(6):50-55.

(The Late Cretaceous deposits of the Gobi Desert have been long recognized for the amazing preservation of dinosaurs and smaller vertebrates such as mammals and lizards. It has often been assumed that these animals were overwhelmed by sandstorms which still whip through the region today. At the Ukhaa Tolgod locality in southern Mongolia, the authors examined the regional geology and discovered the sands overlying the fossils are structureless, indicating they are not eolian in origin, but represent massive debris flows off of dunes that are estimated to have been ".... a probable 300 feet to more than 800 feet [high]." Such dunes, when wetted by thunderstorms can cause the sands to move like "wet cement," burying hapless victims in its path. Debris flows on smaller dunes in Nebraska, USA can move sediment blocks 900 feet long, 4 feet thick and 50 feet wide. Illustrated. [DHT]).

Dixon, D., Cox, B., Savage, R.J.G. and Gardiner, B. 1988. The Macmillan Illustrated Encyclopedia of Dinosaurs and Prehistoric Animals. Macmillan Pub. Co., New York, 319 pp.

(States that many skulls, horns, and neck frills of the Late Cretaceous ceratopsian *Triceratops* show damage as a result of intraspecific fighting behavior. [DHT] Format: Popular).

Dodson, P. 1971. Sedimentology and Taphonomy of the Oldman Formation (Campanian), Dinosaur Provincial Park, Alberta (Canada). Palaeogeogr., Palaeoclim., Palaeoecol., 10:21-74.

(Mass mortality. A total of 4 subadult hadrosaur skeletons were collected from Quarry 11 in the Campanian-aged sediments of Dinosaur Provincial Park by Levi Sternberg in 1920 and C.M. Sternberg in 1936. Referred originally to *Tetragonosaurus sp.*, this genus is now considered to represent immature (half grown) animals and is synonymous with the crested hadrosaur *Corythosaurus*. The presence of four skeletons in one quarry invites speculation that more skeletons might still be entombed at the site. Tyrrell Museum staff have kept watch for indications of additional remains but none has been seen so far. See also Evans, 2001, 2002. [DHT]).

____ 1996. The Horned Dinosaurs-A Natural History. Princeton University Press, Princeton. xiv + 346 pp.

(Includes mentions of osteopathy and related topics. Pages 26-27, injuries in Late Cretaceous ceratopsians are more rare than previously believed according to Darren Tanke at the Royal Tyrrell Museum. Specimens of chasmosaurine (long-frilled) ceratopsians (such as *Chasmosaurus*, *Pentaceratops*, *Triceratops* and *Arrhinoceratops*) are known which show extra fontanelles or "openings" in the frill (affecting the squamosal) and do not show signs of disease. These are often attributed to remnants of healed horn thrust injuries delivered by a conspecific. Dodson states he is aware of a *Centrosaurus* skull that shows a "dent" in the squamosal, but is unaware of any centrosaurines with extra squamosal openings as exemplified in the chasmosaurines. However, some such specimens are in fact known; see Tanke and Farke, ms. Pages 180-181 relate the senior editor's work at a *Pachyrhinosaurus* bonebed near Grande Prairie, Alberta, Canada where extensive excavations have yielded comparatively little in the way of paleopathology---again supporting the contention that ceratopsians may not have been as evil tempered as previously suggested. Osteopathy unillustrated. Format: Popular. [DHT]).

____, Behrensmeyer, A.K., Bakker, R.T. and McIntosh, J.S. 1980. Taphonomy and Paleoecology of the Dinosaur Beds of the Jurassic Morrison Formation. Paleobiology, 6:208-232.

(Mass mortality. The authors suggest that the Upper Jurassic Cleveland-Lloyd Dinosaur Quarry represents a predator [*Allosaurus*] trap; this conclusion confirmed by Richmond and Morris, 1996. [DHT]).

____ and Currie, P.J. 1990. Neoceratopsia. pp. 593-618. In: The Dinosauria. Edited by D.B. Weishampel, P. Dodson, and H. Osmolska, Univ. Calif. Press, Berkeley.

(Mention on page 617 of monospecific bonebed occurrences of various North American taxa, these bonebeds are attributed to mass mortality events. Mass drowning seems a plausible etiological agent for those preserved in active channel deposits, but other factors such as drought or fire deserve consideration for those sites preserved in more quiet water environments. Some skulls of *Arrhinoceratops*, *Centrosaurus*, *Chasmosaurus*, *Pentaceratops* and *Triceratops* with puncture wounds are known; these ["extra openings"] are considered here as injuries incurred during intraspecific strife. Osteopathy unillustrated. [DHT]).

____ (consultant) et al. 1990. Encyclopedia of Dinosaurs. Publications International, Lincolnwood, 256 pp.

(Notation that new discoveries of the unusual ceratopsian *Pachyrhinosaurus* from Alberta, Canada confirm that the bizzare fronto-nasal boss in this form is not pathological, as had been suggested earlier by D. Norman. Also includes mention of injuries in the frill of the ceratopsian *Triceratops*, received in battles over mates, leadership, or territory. [DHT]. Format: Popular).

____ and Smith, J.B. 1999. The Paleobiological Significance of Dinosaur Bonebeds. (Abstract). Jour. Vert. Paleo., 19(3):42A.

(It can be difficult to infer biology from isolated vertebrate fossils. Aggregational bonebeds provide geologic and relative context and thus are excellent windows into paleobiology. To use these windows, however, we must first strip away any taphonomic overprint, by accounting for such factors as catastrophic versus attritional mortality, degree of articulation, and relative storage time. Community taxonomic composition and structure are among the most important data provided by bonebeds. High diversity assemblages ("micro sites" in particular) can provide excellent community censuses using fewer localities and man-hours than are required for isolated occurrences. Bonebeds can thus permit detailed assessments of temporal and spatial community dynamics. Mono- and paucitypic bonebeds are usually time-averaged and do not record community composition; however, they can provide information about population dynamics and behavior, heterochrony, taxonomy, and physiology, particularly if they preserve ontogenetic series. Bonebed dimensions and composition can provide data about the circumstances of death and may also reveal interesting patterns about the biology of certain taxa. We can see this in certain ceratopsian bonebeds in Montana and Alberta which are 10+ km long and speak of catastrophic mortality of large, densely aggregated populations. *Psittacosaurus* and *Triceratops*, though very common taxa, tend not to occur in bonebeds. However, the related forms *Centrosaurus* and *Pachyrhinosaurus* are often found in bonebeds. Occurrence patterns such as these suggest a behavioral control (herding) on the genesis of ceratopsian bonebeds which might be observed in accumulations of other, similar taxa. [Author's abstract]).

Dollo, L. 1887a. (sometimes cited as 1886). Note sur les Ligaments Ossifies des Dinosauriens de Bernissart. [Note on the Ossified Tendons in the Bernissart Dinosaurs]. Arch. Biol., 7:249-264.

(Ossified tendons; Lower Cretaceous *Iguanodon*. Illustrated. Language: French. [DHT]).

____ 1887b. Les Ligaments Ossifies des *Iguanodon*. [The Ossified Ligaments of *Iguanodon*]. Rev. Quest. Sci., 21:305-307.

(NOT SEEN. NOT INDEXED. Ossified tendons, Lower Cretaceous *Iguanodon*. Language: French).

Dong, Z., Peng, G. and H., Daxi. 1989. The Discovery of the Bony Tail Club of Sauropods. Vert. Palasiat., 27(3):219-224.

(The bony tail clubs are present in *Shunosaurus lii* and *Omeisaurus tiefuensis* known from the Dashanpu Dinosaur Quarry at Zigong [China]. The bony tail clubs are formed by the fusion and swelling of the last several caudals. [Author's abstract; in part]. These have the outward appearances of being pathologically crushed and fused vertebrae- more study is needed. See also Zhang, 1988. Language: Chinese; English translation available. [DHT]).

Donnan, K.

(NOT SEEN. NOT INDEXED. Working on a book regarding the *Tyrannosaurus* specimen known as "Sue." May include paleopathology of this specimen. Contact senior editor or future updates of this bibliography regarding the status of this book project. [DHT]).

Douglas, K. and Young, S. 1998. The Dinosaur Detectives. New Sci., 158(2130):24-29.

(Includes brief comments on pathology and related topics in the Late Cretaceous *Tyrannosaurus*; namely: meat particles caught between tooth serrations could lead to infections [septic bite] if any prey animals escaped; bite strength; falls; teeth found bearing the scrape marks made by the teeth of conspecifics; gout and intraspecific face-biting. Format: Popular. Dental and osteopathy unillustrated. [DHT]).

Droscher, V.B. 1976. They Love and Kill— Sex, Sympathy and Aggression in Courtship and Mating. E.P. Dutton, New York: 363 pp.

(Discusses courtship and mating behaviors in mostly extant forms, where such activities are often violent in nature and lead to injuries.

Regarding dinosaurs, Droscher (p. 158) writes the following: "The custom of inflicting love bites on mates began long ago in the history of evolution. Scientists have found the marks of lethal bites on the heads of dinosaur skeletons hundreds of millions of years old. The teeth marks show that these plant-eating dinosaurs were bitten not by carnivores, but by other plant eaters. In prehistoric days, mating must have been an act of rape which frequently brought about the death of the female.

We can only guess that in the prehistoric world, animals had not yet developed courtship rituals, techniques in appeasing aggression, or signals to indicate friendly intentions. Thus the male dinosaurs may have had no choice but to attack the female, biting them until they submitted."

Unfortunately no additional details are provided. It would be interesting to know which dinosaur skulls Droscher is referring to. We are unaware of any descriptions matching this in the published literature. [DHT]).

Duchesne, L. and Leitch, A. 1993. *Velociraptor*. Canada: Les Editions Nublar. 24 pp.

(Includes comments on the fighting Late Cretaceous *Velociraptor* and *Protoceratops* found in Mongolia. Format: Popular (Childrens). [DHT].

Dughi, R. and Sirugue, F. 1957. Les Oeufs de Dinosauriens du Bassin d'Aix-en-Provence. [The Dinosaur Eggs from the Aix-en-Provence Basin]. C.R. Acad. Sci., Paris, 245:707-710.

(NOT INDEXED. Dinosaur eggshell pathology. Unillustrated. Language: French. [DHT]).

____ and ____ 1958a. Observations sur les Oeufs de Dinosaures du Bassin d'Aix-en-Provence: les Oeufs a Coquilles Biostratifiees. [Observations on the Dinosaur Eggs from the Aix-en-Provence Bassin: The Eggs with Biostratified Shells]. ibid, 246:2271-2274.

(Dinosaur eggshell pathology; first report on the multilayering phenomenon. Unillustrated. Language: French. [DHT]).

____ and ____ 1958b. Sur les Oeufs de Dinosaures du Bassin Fluvio-Lacustre de Basse-Provence. C.R. 83 Congr. Soc. Savantes, Paris Sci, 1958:183-205.

(NOT SEEN. NOT INDEXED. Dinosaur egg pathology, multilayered shell. Language: French).

____ and ____ 1976. L'Extinction des Dinosaures a la Lumiere des Gisements d'Oeufs du Cretace Terminal du Sud de la France, Principalement dans la Bassin d'Aix-en-Provence. Palabiol. Continentale, Montpellier, 7(1):1-39.

(NOT SEEN. NOT INDEXED. Pathologic dinosaur eggs, multilayering of eggshell. Language: French).

Duncan, R. (writer) 1991. In Search of the Dragon. Great North Productions Inc. and The Ex Terra Foundation. Thomson, A. (Producer). VHS, 96 minutes.

(Video documentary relating the excavation of Canadian and Chinese dinosaurs by representatives of the Royal Tyrrell Museum of Palaeontology (Drumheller, Canada), Canadian Museum of Nature (Ottawa, Canada) and the Institute of Vertebrate Paleontology and Paleoanthropology (Beijing, China) under the Ex Terra Project.

In the Gobi Desert, several discoveries were made relevant to this bibliography. At a Late Cretaceous multigeneric bonebed near Bayan Mandahu, Kevin Aulenback, a Tyrrell technician, relates the discovery and etiology of a pathologic hadrosaur fibula which shows a healing fracture of the fibula. A prominent fracture callus is visible. This bone shows some twisting of the two pieces prior to healing so they are no longer properly aligned. [It is unknown if this specimen was collected or not; Aulenback considers it unlikely [pers. comm. to DHT, August 9, 1999]. If it was collected, it would be in Beijing].

Also of interest is the discovery of a mass mortality occurrence of Late Cretaceous ankylosaurs of the genus *Pinacosaurus*. Evidently a group of juveniles were overwhelmed in a sandstorm. At time of filming at least 5 animals were present. [Subsequent excavations revealed more]. Format: Popular. [DHT]).

E

Eamon, J. 1991. Pipestone Dino No Fighter: Researcher. Interest in *Pachy-rhinosaurus* Sparks Three Scientific Papers. Grande Prairie Herald-Tribune, Oct. 18, 1991:9.

(Short article on D. Tanke's work on the Late Cretaceous ceratopsian *Pachyrhinosaurus* from the Campanian-Maastrichtian Wapiti Fm. of west-central Alberta, Canada. Traumatic pathology in this genus was found to be rare and suggests few actual fighting injuries were received from conspecifics. Horned dinosaurs are usually believed to have engaged in regular injury-causing behaviors with each other and predators. One result of detailed work on horned dinosaur bonebeds like the *Pachyrhinosaurus* site near Grande Prairie is the study of the types, frequency, and distribution of paleopathology within one taxon. Slowly a clearer picture of ceratopsian behavior is emerging- despite appearances, they were probably more peaceful than previously suspected. [DHT]. Format: Popular).

Eberth, D.A. 1996. Ceratopsian Bonebeds in the Dinosaur Park Formation (Campanian) of Southern Alberta: Bigger Than We Thought? (Abstract). Jour. Vert. Paleo., 16(3):32A.

(Nine monogeneric ceratopsian bonebeds have been identified in the exposures of the Judith River Group in Dinosaur Provincial Park. All nine occur in the lower half of the Dinosaur Park Formation. Eight of the nine bonebeds are dominated by the disarticulated remains of *Centrosaurus* and all occur in the lowest 11 m of the formation. One bonebed comprises the disarticulated remains of *Styracosaurus* and occurs 30m above the base of the formation. Of the bonebeds containing *Centrosaurus*, four are associated with thin (<50 cm thick) mudstone facies of overbank origin. The remaining four are associated with lags in vertically aggraded, sandy, channel fills. The *Styracosaurus* bonebed is a lag deposit associated with a lateral accretion surface of an estuarine channel.

Stratigraphic analyses revealed a non-random distribution with the mudstone bonebeds grouped in the lowest 3-6m of the formation and the sandstone bonebeds grouped in the lower 9-11m. These distributions suggest that the fossil assemblages in the mudstone and sandstone bonebeds are the preserved remains of two mass kills, each related to the coincidence of a major flooding event and the presence of a large population of ceratopsians in the field area. The *Styracosaurus* bonebed represents a separate kill event.

Excavations and mapping were carried out on two of the mudstone bonebeds in 1995. Both bonebeds appear to have covered an area of approximately 10,000 m2. Within excavated areas, the abundance of bone varies from 1-50 bones/m2. A minimum 300-400 individuals is estimated for each bonebed. Based on these estimates and if all four mudstone bonebeds are related to one another, then the size of the original *Centrosaurus* population may have ranged well in excess of 1,000 individuals. [Authors' abstract]. Mass mortality).

____ 1998. Clustered Ceratopsian Bonebeds, Southern Alberta, Canada: Primary Evidence for the Size of Ceratopsian-Herd Death Assemblages. (Abstract). p. 13. In: The DinoFest Symposium. Edited by D.L. Wolberg, K. Gittis, S. Miller, L. Carey and A. Raynor. The Academy of Natural Sciences, Philadelphia, Pennsylvania. April 17-19, 1998.

(The notion of herding ceratopsian dinosaurs, well established in the popular dinosaur literature, derives from know occurrences of bonebeds that comprise very high proportions (>90%) of ceratopsian remains. A three-year program to prospect for, excavate, and study these pauci-specific ceratopsian bonebeds in the Campanian succession of southern Alberta, Canada has revealed that, in areas where ceratopsian bonebeds occur, many are clustered stratigraphically and lithologically over distances of kilometers. A recent study of one such cluster along the South Saskatchewan River, north of Medicine Hat, shows that it compromises 14 separate bonebeds over a linear distance of 4 km, and that each bonebed can be correlated one to another using a succession of marker coals and carbonaceous shales. Furthermore, all of the bonebeds

occur in a 5-10 m thick mudstone facies assemblage that can be traced continuously for more than 10 km north-south, and thus, extends beyond the limits of the cluster.

Each bonebed covers an area of 1,000 to 10,000 m^2, is shallowly lenticular in cross-section, and has the potential of yielding 1-100 bones/m^2. Based on detailed taphonomic studies conducted in similar bonebeds 100 km west at Dinosaur Provincial Park, the minimum number of individuals (MNI) estimate for each bonebed ranges from 100's to 1,000's. Taken together, the estimated MNI for the 14 bonebeds in the cluster ranges from 1,000's to 10,000's.

The occurrence of geographically restricted cluster of bonebeds within a more laterally extensive host mudstone facies indicates that we have recorded, for the first time, a cross-section through an actual death assemblage of ceratopsians that stretched north-south for 4 km across the Campanian coastal plain. Given that the modern exposure in the area is limited to a 1-2 km wide, north-south-oriented river valley, that the exposed death assemblage cross-section is 4 km, and assuming a non-linear form for the death assemblage, the cluster of bonebeds probably extends west and east of the known distribution into the sub-surface, and thus indicates even more individuals than we have so far estimated.

Taphonomic work conducted on this and similar clusters in Dinosaur Park indicates that the cause of death was a coastal flood similar to the kind that episodically drowns the coastal plain of modern Bangladesh during the rainy season. The occurrence of a cluster suggests that carcasses derived from a drowned "herd" of ceratopsians were concentrated and stranded in a number of shallow topographic lows as flood waters drained from the coastal plain. Data from clustered bonebeds will provide opportunities to approximate original herd size, demographic structure, and perhaps some aspects of herd behavior. [Author's abstract]. The bonebeds are dominated by the ceratopsian *Centrosaurus*).

____, Currie, P.J., Coria, R.A., Garrido, A.C., and Zonneveld, J.-P. 2000. Large-Theropod Bonebed, Neuquen, Argentina: Paleoecological Importance. (Abstract). Jour. Vert. Paleo., 20(3):39A.

(Exposures of the Huincul Member (Rio Limay Formation, Cenomanian) yield extremely rare but important dinosaur remains. Most occur as isolated elements or partial skeletons, and only two bonebeds are known: each distinctly monotaxic. We excavated the remains of a new carcharodontisaur in one of the bonebeds, and studied associated redbeds in the middle Huincul Member. These alluvial facies record evidence for ephemeral and/or seasonal flow in a semi-arid-to-arid climate. The bonebed and all other fossil sites that we examined occur stratigraphically at or above a transitional interval where a mudstone and ribbon-sandstone facies-assemblage passes up into a sandstone/conglomerate-sheet and calcrete assemblage. The transition reflects regional uplift in the south, an influx of coarser clastics, lower rates of subsidence relative to sediment supply, a likely increase in aridity, and the broadening and shallowing of channels.

The carcharodontisaur bonebed consists of disarticulated elements scattered throughout the base of a multistoried sheet-sandstone of channel origin. Elements experienced a complex history of exposure, reworking, large-vertebrate trampling, and post-burial differential compaction. MNI analysis indicates that at least six individuals contributed to the assemblage. Consistent taphonomic signals from the elements and a monotaxic bonebed composition indicate mass mortality of a group, and thus some form of pre-mortem community and/or social structure. The cause of death is unknown.

The rarity of fossils in the Huincul Member, their presence at or above the transitional interval, and the taphonomic complexity of the bonebed indicate that a combination of local-to-basic-scale physical and biological parameters controlled but worked against fossil preservation. At present, this large-theropod bonebed provides one our best insights to the vertebrate paleoecology of this unit. [Author's abstract]).

____ and McCrea, R.T. 2001. Were Large Theropods Gregarious? (Abstract). Jour. Vert. Paleo., 21(3):46A-47A. See also: Eberth, D.A. and McCrea, R.T. 2002. Were Large Theropods Normally Gregarious?. pp. 13-15. In: Alberta Palaeontological Society, Sixth Annual Conference, Abstracts Volume. Mount Royal College, Calgary, Alberta. January 26-27, 2002. v + 77 pp.

(Suggests that the *Albertosaurus* bonebed in Alberta, Canada was a mass mortality event related to drowning and a bonebed dominated by an unnamed carcharodontosaurid in Neuquen Province, Argentina was a drought-related mass mortality. [DHT]).

____ and ____ 2002. (See citation in Eberth and McCrea, 2001).

Edgar, B. 1998. Horizons: Scoop on Dinosaur Dung. Calif. Wild, 51(4):4, 5, 47.

(NOT SEEN. NOT INDEXED. Format: Popular).

Elisseyev, V.I. 1977. [On Rickets in Dinosaurs.] Soviet Weekly, April 23, 1981:_____.

(NOT SEEN. Language: Russian. See Anonymous, 1977a).

Erben, H.K. 1969. Dinosaurier: Pathologische Strukturen ihrer Eischale als Letalfaktor. [Dinosaurs: Pathological Structures of Their Eggshells as a Lethal Factor]. Umschau Wiss. Tech. 17/69:552-553.

(NOT SEEN. NOT INDEXED. Multilayering of dinosaur eggshell. Illustrated. Language: German. [DHT]).

____ 1970. Ultrastrukturen und Mineralisation Rezeter und Fossiler Eischale bei Vogeln und Reptilian. [Ultrastructure and Mineralisation of Recent and Fossil Eggshell in Birds and Reptiles]. Biominer. Res. Rept., 1:1-66.

(NOT SEEN. NOT INDEXED. Dinosaur egg pathology; "ovum in ovo." Abnormal eggs in extant testudinids *Geochelone elephantopus* and *G. sulcata*. Language: German).

____ 1972. Ultrastrukturen und Dicke der Wand Pathologishcher Eischalen. [Ultrastructures and Wall Thickness of Pathological Eggshells]. Akad. Wissen. Lit., Abh. Mat. Naturwiss. Klasse, 6:193-216.

(NOT SEEN. NOT INDEXED. Pathological eggs of extant testudinid turtle *Geochelone elephantopus* and *G. sulcata*; pathological dinosaur eggs, thinning of ceratopsian eggshell; multi-shelled egg in unspecified crocodilian; environmental conditions. Language: German).

____ 1975. Die Entwicklung der Lebewesen; Spielregeln der Evolution. [The Development of the Organism; Rules of Evolution]. Verlag Piper & Co., Munchen.

(NOT SEEN. NOT INDEXED. Pathological dinosaur eggs. Language: German).

____, Hoefs, J. and Wedepohl, K.H. 1979. Paleobiological and Isotopic Studies of Eggshells From a Declining Dinosaur Species. Paleobiol., 5(4):380-414.

(Late Cretaceous dinosaur eggshells from southern France and the Spanish Pyrennes, presumably belonging to the sauropod *Hypselosaurus priscus* Matheron [oogenus *Megaloolithus*], are almost entirely composed of primary calcite. Besides normal development of these eggshells, there appear two kinds of pathologic tendencies: bi- or multi-shells (infrequent), and shells with a reduced thickness (increasing in frequency until, in the uppermost horizon, they represent more than 90% of the sample). The extinction of the species is attributed primarily to the consequences of thinning of the eggshells.

The physiological mechanisms producing pathologic dinosaur eggshells are evaluated in the light of homologous phenomena occurring in living birds and reptiles. On this basis, it is concluded that in the late Maastrichtian populations of "*Hypselosaurus*," pathological eggshells were caused by hormonal imbalances of the vasotocin and of the estrogen levels. On the same basis it is postulated that the teratological shell repetition led to embryo suffocation and that the pathological reduction in shell thickness caused shell breakage and dehydration of the embryo. The lethal results are evident from the frequent absence of "resorption craters" in the mamillary knobs of pathological shells, a fact which indicates either lack of fertilization of the eggs or the perishing of the embryo prior to the calcification of its skeletal bones. A change in environmental conditions is the ultimate factor which caused hormonal imbalances and extinction. Such a change is indicated by a shift of the mean isotopic composition (δ180) of eggshell carbonates from -0.6% to -5.3% and by changes in Sr. Information of paleoclimate is primarily derived from eggshells of living birds and reptiles. The correlation between temperature and oxygen isotopic composition of waters (and related carbonates) is less distinct than for marine carbonates. δ13O ranges from -16.5 to -4.5 of eggshells of extant species indicate food from "normal" C3 metabolism and from C4 metabolism of plants in a dry climate. "*Hypselosaurus*" populations probably consumed "normal" C3 plants. Using isotopic calibration of eggshell carbonates for the interpretation of δ13O and δ18O) values of dinosaur eggshells, a slight change from higher to lower temperatures or a change from a dry to more humid climate during the time from Lower (and Middle) to Late Maas-trichtian can be assumed. The latter explanation is favoured because the exceptionally high Sr in the Early Maastrichtian eggshells could be a potential indicator of co-existing evaporites. [Author's abstract]. Thinning of eggshell may be due to the fact that different egg taxa are represented; see Penner, 1985).

____, Ashraf, A.R., Krumsiek, K. and Thein, J. 1983. Some Dinosaurs Survived the Cretaceous "Final Event." Terra Cognita, 3(2):211-212. (Abstract).

(NOT SEEN. NOT INDEXED. Pathological multi-layered dinosaur eggshell vs. environmental conditions. [DHT]).

Erickson, B.R. 1966. Mounted Skeleton of *Triceratops prorsus*. Sci. Pub. Sci. Mus., St. Paul, Minneapolis, 1:1-16.

(The skull of a Late Cretaceous ceratopsian *Triceratops*, collected from the Hell Creek Formation (Maestrichtian) of Montana, USA, bears a pathological lesion that punctures through the center of the left jugal, about halfway between the ventral rim of the orbit, and distal tip of the jugal. A close up view of the wounded area is presented, but the photograph (fig. 1) is not of good quality and not convincing. The lesion is better seen in Plate 1, fig. A. Also figured in Forster and Sereno, 1997. Format: Semi-popular/Technical. [DHT]).

____ 1988. Notes on the Postcranium of *Camptosaurus*. ibid, 6(4):1-13.

(An incomplete skeleton of the Late Jurassic *Camptosaurus* (SMM P84.15.5) disclosed severe compression fracturing of the centrum with callus indicative of healing. Erickson, (p. 4) states: "The injury to the back was probably more extensive than indicated and likely would have been reflected in missing vertebrae." The pathology is not figured in this paper, but can be seen in Sawyer and Erickson, 1985:fig. 8. [DHT]).

Erickson, G.M. 1993a. The Mystery of the "Split" Toothed Tyrannosaurs. (Abstract). Calif. Paleo. Abstracts, PaleoBios, 14(4), Supplement:5.

(During the summer field season of 1990, a Museum of Paleontology (UC Berkeley) crew unearthed an unusual tyrannosaur (presumably an albertosaurid) tooth in Late Cretaceous sediments (Prince Creek Formation) from the North Slope of Alaska. This tooth exhibited two striking anomalies. The first being a "split" anterior carina row, and the second an "extra" carina segment on the posterior face of the tooth.

I began an investigation of these particular phenomena by examining hundreds of isolated Late Cretaceous tyrannosaur teeth and several intact dentitions in hopes of documenting further instances of such anomalies. To provide a comparative base, all available large theropod teeth of non-tyrannosaur taxa were examined as well as the teeth of a Komodo monitor. The purpose of this investigation was to determine the frequency and character of such phenomena, to ascertain geographic and stratigraphic variability in these anomalies, and to document similar defects in other serrate toothed taxa. Finally, I hoped to establish a likely hypothesis for the cause of the tooth defects.

The results of this study reveal that approximately 10% of all tyrannosaur teeth have some degree of carina "splitting" and 0.4% have "extra serration rows." The dental anomalies were found in *Tyrannosaurus rex*, *Daspletosaurus sp.*, *Albertosaurus* sp., *Alectrosaurus olseni*, and possibly 3 other tyrannosaurs. Similar phenomenon were not observed in other non-tyrannosaurid taxa.

An application of "Wolpert's law of positional theory" is theorized as the mechanism by which these peculiar anomalies form. Trauma, aberrant tooth replacement, and genetic factors may have influenced the development of the dental defects.

Documentation and characterization of dental variation is important (even in reptilian research) as it may help alleviate the assignments of dubious taxa based on "apparently" new morphs of teeth. [Author's abstract]).

____ 1993b. The Evolution of Split Carinas in Tyrannosaur Teeth from the Late Cretaceous Western Interior. Jour. Vert. Paleo., 13(3):34A.

(During the summer of 1990 a UCMP crew unearthed an unusual tyrannosaurid tooth from the Prince Creek Formation of Alaska. This tooth has a split or fork in its anterior carina segment. An extensive survey of 993 shed tyrannosaur teeth from Montana, Alberta, and Alaska revealed that 12% have some sort of this developmental anomaly. The defect was confirmed in four genera (*Tyrannosaurus rex*, *Albertosaurus* sp., *Daspletosaurus* sp., and *Alectrosaurus olsoni*). Split carinas were found in both premaxillary and lateral teeth. Split carinas are distributed randomly in intact dentitions. Based on the lack of wear on the extra carina segments this anomaly probably had no functional significance. Similar split carinas were not found in a survey of non-tyrannosaurid taxa with serrated teeth.

Trauma, aberrant tooth replacement, and genetic factors were examined as possible causes for the formation of split carinas. Genetic expression seems the most likely cause based on similarities by analogy with extant mammalian genetic tooth anomalies. A genetic interpretation also explains the stratigraphic and temporal variabilities in the percentages of this anomaly between successive formations.

Incidence percentages of mammalian tooth anomalies have been used to chart the evolution and dispersal patterns of mammalian taxa (e.g. humans). A similar application based on split carina data suggests that one predominant albertosaurid, initially found in the Two Medicine Formation, came to dominate the Judith River lowlands. The predominant albertosaurid in Alberta during the Campanian/Maastrichtian time appears to have been evolutionarily continuous with the Alaskan tyrannosaurs, which up to now have not been identified to genus. *Tyrannosaurus rex* migrated into North America in Late Maastrichtian time from *Tarbosaurus bataar* stock (as proposed by P.J. Currie) and replaced the albertosaurids as the dominant tyrannosaur in North America. [Author's abstract]).

____ 1995. Split Carinae on Tyrannosaurid Teeth and Implications of Their Development. Jour. Vert. Paleo., 15(2):268-274.

(Examination of hundreds of shed and intact tyrannosaurid teeth from several taxa and formations revealed the presence of split carinae is widespread. Approximately 11% of the surveyed teeth showed some degree of expression of this trait. Split carinae were found in *Tyrannosaurus rex*, *Daspletosaurus* sp., *Albertosaurus* sp., and *Alectrosaurus olsoni*. The trait is also found in non-tyrannosaurids (e.g., *Allosaurus fragilis*). Trauma, aberrant tooth replacement, or genetic factors may have led to the development of split carinae, although the latter finds the most support. If the split carinae are caused by genetic factors, they may prove valuable in assessing the dispersion patterns and evolution of the tyrannosaurids. [Author's abstract]. Illustrated).

____ 1999. Breathing Life into *Tyrannosaurus rex*. Sci. Amer., 281(3):42-49. (Reprinted in: Paul, G.S. (Editor) 2000. The Scientific American Book of Dinosaurs. pp. 267-275. St. Martin's Press, New York. vii + 424 pp.).

(Includes comments on mass mortality of Late Cretaceous *Albertosaurus*, bite strength in *Tyrannosaurus*, possible bite-injury on *Edmontosaurus* tail and intraspecific face-biting behavior in tyrannosaurids and other large theropods generally. Osteopathy unillustrated. [DHT]).

____ and Olson, K.H. 1996. Bite Marks Attributable to *Tyrannosaurus rex*: Preliminary Description and Implications. Jour. Vert. Paleo., 16(1):175-178.

(Descriptions of unhealed bite marks (tooth punctures and tooth "puncture and pull" drag marks) on a Late Cretaceous *Triceratops* sacrum and left ilium and on an *Edmontosaurus* pedal phalanx. Mentions that tooth-marked dinosaur bone has, like pathological specimens, been overlooked by researchers until only recently. Illustrated. [DHT]).

____, Van Kirk, S.D., Su, J., Levenston, M.E., Caler, W.E. and Carter, D.R. 1996. Bite-Force Estimation for *Tyrannosaurus rex* From Tooth-Marked Bones. Nature, 382:706-708.

(Whether tyrannosaurs occupied a predatory or scavenging niche has been debated for nearly a century. Paleontologists have turned to the study of dental morphology to address this question, but the results have been highly disparate. Some contend that the tyrannosaur dentition was very strong and well suited for engaging and killing herbivorous dinosaurs. Others posit that tyrannosaurs ate carrion, because their teeth and/or jaws would fail during struggles with prey. The discovery of skeletal remains with bite marks from *Tyrannosaurus rex* makes it possible to estimate, through indentation simulations on bovine ilia, the bite forces produced by a *T. rex* during feeding. The estimates (6,410 to 13,400 N) rival the largest bite forces determined for any taxon to date and suggest that *T. rex* had very strong, impact-resistant teeth. Although these data do not prove that *T. rex* was predominantly predaceous, they indicate that its dentition could probably withstand the stresses associated with prey capture. [Author's introduction]. Illustrated. Includes mention of healed intraspecific bite marks on tyrannosaur cranial material and a hadrosaur tail with possible healed fractures of the neural spines; the fractures incurred during a failed *T. rex* predation attempt; see Carpenter, 1988a, 1998 (2000). [DHT]).

Eudes-Deslongchamps, M. 1838. Memoire sur le *Poekilopleuron bucklandii*, Grand Saurien Fossile, Intermediaire Entre les Crocodiles et les Lezards. [Memoirs on the *Poekilopleuron bucklandii*, Great Fossil Saurian, Transitional Between Crocodiles and Lizards]. Mem. St. Linn. Normandie, 6:37-146.

(Oldest reference to dinosaur paleopathology. A rarely cited paper which includes paleopathology. Page 64 describes pathologies present on the skeleton of the Jurassic megalosaurid *Poekilopleuron bucklandii*. Fusion of a chevron to a proximal caudal vertebra, and a pathological condition of an uncertain etiology effectively destroying the proximal articulating

surface of a pedal phalanx are figured. This specimen was unfortunately destroyed during fighting in World War ll, although some plaster casts of parts of the specimen were made (including pathologic elements?). [DHT]. Language: French; English translation of paleopathology section available).

Evans, D. 2001. The Hadrosaurs of Dinosaur Provincial Park. Can. Paleobiol., 6:5-9. See also: Notes on the Cranial Ontogeny of *Corythosaurus casuarius*. pp. 16-17. In: Alberta Palaeontological Society, Sixth Annual Conference, Abstracts Volume. Mount Royal College, Calgary, Alberta. January 26-27, 2002. v + 77 pp.

(Discusses the occurrence of four subadult hadrosaurs (*Corythosaurus casuarius*) found together in Quarry 11, Dinosaur Provincial Park, Alberta, Canada (Dinosaur Park Fm.; Campanian). This seems to represent part of a mass mortality event (and thus demonstrate social behavior), although the author does not speculate as to the cause of death. Format: Semi-Popular. [DHT]).

Ewert, M.A., Firth, S.J. and Nelson, C.E. 1984. Normal and Multiple Eggshells in Batagurine Turtles and Their Implications for Dinosaurs and Other Reptiles. Can. Jour. Zool., 62:1834-1841.

(The fine structure of normal and abnormally thick eggshells of the [extant] turtles *Melanochelys trijuga* and *Rhinoclemmys areolata* (Emydidae: Batagurinae) are described through the use of scanning electron microscopy. Eggshells of *R. areolata* differ from those of other turtles in having complex pores with basal openings partially occluded with crystallites. Each of the abnormally thick eggshells has the usual membrane and mineral layer incased within a second membrane and mineral layer, and, in one case, within yet a third membrane and mineral layer. lnformation on oviductal function and the structure of these and most previously reported multiple-shelled turtle eggs allow the hypothesis that such eggs arise from oviductal retention of normally shelled eggs of one clutch that become reshelled during shelling of eggs ovulated to form the next clutch. This is likely only in species that lay more than one clutch per season. Our evidence suggests that dietary inadequacy cause the retention. We propose that dinosaurs laid multiple-shelled eggs also had two or more clutches per season and that this multiple shelling was produced also by abnormal retention of eggs which, in turn, may have been induced by changes in diet. [Author's abstract]. Well illustrated).

F

Farlow, J.O. 1990. Review of: Dynamics of Dinosaurs and Other Extinct Giants. By R. McNeill Alexander, 1989, Columbia University Press, viii + 167 pp.

(Discussion on possible intraspecific fighting behavior in Late Cretaceous ceratopsians (especially the chasmosaurine *Triceratops*). lncludes a brief mention of possible fighting-related injuries found in the skulls of these dinosaurs. [DHT]).

____ and Brinkman, D.L. 1987. Serration Coarseness and Patterns of Wear of Theropod Dinosaur Teeth. (Abstract). p. 151. 21st Ann. Meeting, South-Central Section, Geol. Soc. Amer., Waco, Texas. Abstracts with Programs.

(Other types of wear seen on theropod teeth include various irregular gouges or tongue-shaped depressions; some heavily worn teeth appear to have been broken *in situ* in the dinosaur's jaw, with their shattered edges subsequently worn smooth. Large teeth show severe wear more often than small teeth, but this may be an artifact of our sample. Some of the wear on carnosaur teeth may represent abrasion against the "soft" tissues and/or bones of prey, or in some cases inadvertent tooth-against-tooth wear, but some wear is harder to interpret. [Author's abstract; in part]).

____ and ____ 1994. Wear Surfaces on the Teeth of Tyrannosaurs. pp. 165-175. In: Dino Fest. Edited by G.D. Rosenberg and W.L. Wolberg. The Paleontological Society Special Publ. No. 7.

(279 shed teeth of tyrannosaurids, collected from the Late Cretaceous Judith River Fm. [now Dinosaur Park Fm.] were examined for varying degrees of wear (none to extensive) and other features. 58 showed little to no wear. 83 showed slight to moderate wear. 87 showed heavy wear. Premortem tooth fractures with post-trauma wear and rounding were considered as heavy wear. Most heavy wear was concentrated near the tip of the tooth. 51 teeth were broken by modern erosion or were too badly preserved for determination. lsolated, unworn teeth may have been lost during feeding or fighting. Tyrannosaur teeth are compared to the enlarged upper canines (sabres) of the Pleistocene sabre-toothed cat Smilodon and Komodo dragon *Varanus*. Discussion on causes of wear in tyrannosaurid teeth follows. lllustrated. [DHT]).

____, ____, Abler, W.L. and Currie, P.J. 1991. Size, Shape, and Serration Density of Theropod Lateral Teeth. Mod. Geol., 16:161-198.

(Mention that teeth in theropods are often found with the tips broken off, and occasionally evidence is found of tyrannosaur teeth that were broken off *in situ* in the jaws, and the broken edges were then worn smooth, suggesting a slow tooth replacement rate. Also included in this paper is some particularly valuable data on the strengths of various extinct and extant carnivore teeth. [DHT]).

____ and Molnar, R. 1995. The Great Hunters- Meat-Eating Dinosaurs and Their World. Franklin Watts, New York, 64 pp.

(Popular book on carnivorous dinosaurs includes photo of healed toothmarks on an Upper Jurassic *Sinraptor dongi* dentary from China (p. 49) and a reconstruction of a fighting scene (pp. 50-51). See Tanke and Currie, 1995; 1998 (2000). [DHT]).

____, Smith, M.B. and Robinson, J.M. 1995. Body Mass, "Strength Indicator," and Cursorial Potential of *Tyrannosaurus rex*. Jour. Vert. Paleo., 15(4):713-725.

(We describe a new life restoration of *Tyrannosaurus rex*, based on a fairly complete skeleton (Museum of the Rockies [MOR] 555). From the volume of this model, we estimate the live mass of the full-sized dinosaur as approximately 6,000 kg. Because MOR 555 is representative of the gracile morph of *T. rex*, the mass of the robust morph may have been substantially greater. The "indicator of athletic ability" or "strength indicator" of MOR 555 is 7.5-9.0 METER2/giganewton, similar to previously reported results. The implication is that the cursorial potential of *Tyrannosaurus* was limited, a conclusion consistent with observed declines in sprint speed with increasing body mass in living animals, and also consistent with the tibia/femur length ratio, and the construction of the hip joint, of the dinosaur. Furthermore, mathematical models of the impact forces and decelerations that would affect a *Tyrannosaurus*, were it to fall while running at a high speed (20 meters/second), suggest that the animal would be killed in such an accident. We speculate that the top speed of adult individuals of this dinosaur species was about 10 meters/second. [Author's abstract]).

Fastovsky, D.E. and Weishampel, D.B. 1996. The Evolution and Extinction of the Dinosaurs. Cambridge University Press, London. xvi + 461 pp.

(lncludes comments on intraspecific aggression and fighting in ceratopsians, based mostly on several injured skulls, p. 186. Osteopathy unillustrated. [DHT]).

Favour, C.B., Ritts, R.E., and Bayles, T.B. 1956. Arthritis Research. New Engl. Jour. Med., 254:1078-1086.

(Detailed historical review of the study of arthritis and its treatment in man and animals. For dinosaurs; ".... it also has long been apparent that degenerative arthritis is in some way related to the trauma of use, either physiologic, as in the large joints of dinosaurs...," p. 1078. [DHT]).

Feduccia, A., Martin, L.D. and Simmons, J.E. 1996. Nesting Dinosaur. Science, 272:1571.

(Comments on the discovery of a "brooding" Late Cretaceous *Oviraptor*. This discovery and apparent behavioral implications are widely accepted as evidence of a dinosaur-bird connection. However, the authors point out that some extant reptiles also brood their eggs, and a that pathological Upper Jurassic dinosaur egg reported by Hirsch, Stadtman, Miller and Madsen, 1989 was of a pathology-type like that seen in extant reptile eggs ("commonly seen in marine turtles"), and "dramatically different" from that of birds, thus "degrading the dinosaur-bird connection." Unillustrated. [DHT]).

Felber, E.P., Currie, P.J. and Sovak, J. 1998. A Moment in Time with *Albertosaurus*. Troodon Productions Inc., Calgary. 47 pp.

(Fictional but fact-based account. lncludes some aspects of life behavior in the Late Cretaceous tyrannosaurid *Albertosaurus* relevant to this bibliography. Herbivorous ankylosaurs bear scars from the attacks of *Albertosaurus*, p. 8. An *Albertosaurus* gets hit in the face by the swing of an ankylosaurs tailclub, opening a serious flesh wound and snapping off 3 teeth, p. 8; leading to pain, p. 9. Another attack by the injured animal led to more serious wounds, in this case several broken ribs and a fractured fibula, p. 9. The leader of the tyrannosaur group bore numerous body scars from conflicts with conspecifics and prey, p. 12. When traveling as a group, the healthy members of the group slowed down in order to allow the injured and limping [p. 14] individual to catch up [epimeletic behavior], pp. 12-13. An affectionate bite between a male and the dominant female accidently results in a flesh wound to the latter, pp. 25-26. lnterspecific

fighting over food between *Albertosaurus* and another tyrannosaurid species (*Daspletosaurus*) is related, pp. 28-29. During a storm, the *Albertosaurus* group moves out of the open to avoid being hit by lightning, p. 29. Mass mortality of all nine *Albertosaurus* results after they were caught in a forest fire and were overcome by smoke inhalation, pp. 32-34. The Dry lsland Provincial Park, Alberta *Albertosaurus* mass mortality bonebed is briefly considered. A minimum of nine animals are represented, with body lengths of 4-9 meters. More than 6 *Albertosaurus* skeletons are known where the slender and elongate fibula shows a healed fracture, p. 40; one is illustrated on page 41 (TMP94.12.602, Quarry 220, Dinosaur Provincial Park, Alberta, Canada- [this is actually *Gorgosaurus*]); it is shaded gray in the accompanying color photograph. The possibility that intraspecific face-biting behavior is related to courting activities is considered, pp. 42-43. Format: Popular; Childrens. [DHT]).

Fiffer, S. 2000. *Tyrannosaurus* SUE — The Extraordinary Saga of the Largest, Most Fought Over T. *Rex* ever Found. W.H. Freeman and Co., New York. xvi + 248 pp.

(Mention of broken fibula (p. 2, 28, 223). Wounds on the face, previously interpreted as intraspecific bite marks may be areas of infection only (p. 223). Osteopathy unillustrated. [DHT]).

Fiorillo, A.R. 1991. Prey Bone Utilization by Predatory Dinosaurs. Palaeogeogr., Palaeoclimat., Palaeoecol., 88:157-166.

(Mention of D. Tanke's work on paleopathology in hadrosaurs and ceratopsians, and their application towards behavioral interpretation. [DHT]).

____ 1998. Bone Modification Features on Sauropod Remains (Dinosauria) from the Freezeout Hills Quarry N (Morrison Formation) of Southeastern Wyoming and Their Contribution to Fine-Scale Paleoenvironmental Interpretation. Mod. Geol., 23:111-126.

(Fiorillo describes and illustrates an unusual pitting phenomenon affecting the remains of several Upper Jurassic *Camarasaurus* skeletons. These "lesions" are manifested as variably developed circular to oval-shaped pit marks affecting the bone surface. Diameters of these ranged from 1 to 6 mm, with depths from 1-3 mm. lt was suggested that the markings were non-biologic in nature and probably the result of the low pH in the soil leaching and corroding the bone surfaces. [This pitting resembles some pathological pitting seen on some fossil bones- Late Cretaceous baenid turtle shell remains from Dinosaur Provincial Park, Alberta, Canada. [DHT]).

____ and Gangloff, R.A. 2000. Theropod Teeth from the Prince Creek Formation (Cretaceous) of Northern Alaska, with Speculations on Arctic Dinosaur Paleoecology. Jour. Vert. Paleo., 20(4):675-682.

(The authors mention the discovery of an isolated *Dromaeosaurus albertensis* tooth that shows several anomalies. There is presence of a split anterior carinae. There is also a ".... small line of 15 denticles near and separate from the posterior carina, but diverging towards the base of the tooth at an approximate 25 degree angle. The line of denticles is just above the base of the tooth." This specimen is unillustrated. The authors suggest this anomaly is related to abnormal tooth development or replacement. [DHT]).

Fischman, J. 1993. To Sex a *T. rex*. Science, 262:846.

(Late Cretaceous *Tyrannosaurus*. Possible male/female differences discussed. First chevron in female is smaller and further away from the tail. Males have a longer rod-like chevron positioned closer to the pelvis. This apparently served as an anchor point for the muscles of a retractable penis, much as in extant crocodilians. Adult males were smaller; females larger and more robust. lllustrated. See Larson, 1994a, b; 1995. [DHT]).

____ 1999. DINO Hunter. Discover, 20(5):72-76, 78.

(Article on Royal Tyrrell Museum paleontologist Dr. Philip J. Currie and his quest to relocate an *Albertosaurus* bonebed in Alberta, Canada first excavated by Barnum Brown of the AMNH in 1910. Using old photographs and fieldnotes the site was successfully relocated in 1997 and reopened in 1998. The Late Cretaceous site represents a mass mortality of the theropod *Albertosaurus*. Juveniles, subadults and adults are represented. 95% of the bone on site is referable to *Albertosaurus*. The cause of the mass mortality is unknown. Mention is made of another large theropod bonebed found in Argentina- this site is dominated by the remains of an animal closely related to *Giganotosaurus*. Format: Popular. [DHT]).

Fisher, D.W. 1981.The world of *Coelophysis*— A New York Dinosaur of 200 Million Years Ago. New York State Mus. Sci. Serv., Geol. Surv., Circ. 49:22 pp.

(See page 7. Suggests the mass mortality event of many *Coelophysis*, preserved at the Ghost Ranch Quarry, New Mexico, USA, was caused when the animals became entrapped in quicksand. Also comments on probable cannibalistic behaviors in this form. lllustrated. Format: Popular. [DHT]).

Folger, T. 1993. The Blood of the Dinos. Discover, 14(1):49.

(Review of the work by Americans R. Barrick and W. Showers on measuring oxygen 16 and 18 isotopes in modern animal and dinosaur bone in an attempt to determine whether the latter were "warm-blooded" or not. Similar readings between mammal and Late Cretaceous dinosaur bones would suggest they were in fact warm-blooded. [DHT] See Barrick and Showers, 1994. Format: Popular).

Folinsbee, R.E., Fritz, P., Krouse, H.R. and Robblee, A.R. 1970. Carbon-13 and Oxygen-18 in Dinosaur, Crocodile, and Bird Eggshells Indicate Environmental Conditions. Science, 168:1353-1356.

(Carbon 13 and Oxygen 18 in dinosaur eggshell).

Ford, T.L. 1998. How to Draw Dinosaurs - Those Hard-Headed Boneheads, the Pachycephalosaurs. Prehistoric Times, 31:12-15.

(Includes comments on the unlikely head-butting behavior in these Late Cretaceous forms. lllustrated. Format: Popular. [DHT]).

____ 2000a. A Review of Ankylosaur Osteoderms from New Mexico and a Preliminary Review of Ankylosaur Armor. pp. 157-176. In: Dinosaurs of New Mexico. Edited by S.G. Lucas and A.B. Heckert. New Mexico Museum of Natural History and Science Bulletin No. 17. 230 pp.

(Late Cretaceous *Shamosaurus scutatus*, Mongolia. Includes mention (p. 161) of a pit affecting the left outer edge of the second cervical ring that ".... may be pathologic." One of us [DHT] has seen this specimen and can confirm that the condition is indeed anomalous. Osteopathy unillustrated. [DHT]).

____ 2000b. Passive Aggressors? New Theories on Ceratopsian Behavior. Dinosaur World, 8:55-59.

(Includes comments on the famous *Velociraptor/Protoceratops* "fighting dinosaur" pair, possible mass mortality of *Protoceratops* juveniles and *Tyrannosaurus* vs. *Triceratops*. lllustrated. Format: Popular. [DHT]).

____, Kirkland, J.I. and Elder, W.P. 1998. The Surfing Nodosaur or Riding Up the Pacific Plate. (Abstract). pp. 16-17. In: The Dinofest Symposium. Edited by D.L. Wolberg, K. Gittis, S. Miller, L. Carey and A. Raynor. The Academy of Natural Sciences, Philadelphia, Pennsylvania. April 17-19, 1998.

(Includes mention of osteopathy affecting some of the scutes of this unspecified Late Campanian nodosaur collected during road construction in Carlsbad, California, USA. "lrregular pitting" of the of the dorsal surface apex of some scutes may be indicative of parasite activities. The second author has observed similar lesions in undescribed polacanthid material from eastern Utah, USA. DHT has observed similar rare osteopathy in undescribed ankylosaur scutes from the Campanian of Dinosaur Provincial Park, Alberta, Canada. [DHT]).

Forster, C.A. 1990a. The Cranial Morphology and Systematics of *Triceratops*, with a Preliminary Analysis of Ceratopsian Phylogeny. University of Pennsylvania Ph.D. thesis, xxiii + 227 pp.

(Includes notation and comments (pp. 81-82, 138) on pathological "extra openings" in the frills of Late Cretaceous chasmosaurine (ceratopsian) frills. The classic interpretation of the etiology of these wounds is male aggressive intraspecific behavior or interspecific fighting (vs. predaceous tyrannosaurids). She suggests that both male and females were affected by frill injuries and that interspecific fighting with other contemporaneous horned genera (*Diceratops*, *Torosaurus*) should also be considered. [DHT]).

____ 1990b. Evidence for Juvenile Groups in the Ornithopod Dinosaur *Tenontosaurus tilletti* Ostrom. Jour. Paleo., 64(1):164-165.

(Mass mortality. Describes two occurrences of juvenile aggregations of the Early Cretaceous *Tenontosaurus* collected from the Cloverly Formation of Big Horn County, Montana, USA. One site contained skeletal remains of several juveniles about 1/3 the size of an adult. Another site nearby contained at least 4 individuals slightly smaller than 1/3 adult size. Other occurrences of groups of juvenile dinosaurs are cited from the literature. Unillustrated. [DHT]).

____ 1996a. New Information on the Skull of *Triceratops*. Jour. Vert.

Paleo., 16(2):246-258.

(Late Cretaceous ceratopsian *Triceratops*. Includes mention on page 251 of "irregular perforations surrounded by bone overgrowth which may represent healed horn thrust punctures (e.g., SMM P62/1/1, USNM 1201, YPM 1823)." On page 253, commenting on a pathological orbital horncore of *Triceratops*, Forster states: "In one specimen (USNM 2147) the distal horn is offset from its broad base, and tapers quickly to a point above a large area of pathological bone, suggesting an injury to the horncore which subsequently healed." Osteopathy is unillustrated).

____ 1996b. Species Resolution in *Triceratops*: Cladistic and Morphometric Approaches. ibid:259-270.

(Comments on squamosal fenestrae found in Late Cretaceous chasmosaurine ("long-frilled") ceratopsians. Bilateral squamosal fontanelles (openings) in *Diceratops hatcheri* (USNM 2412) were considered by previous several author's as pathological in occurrence and that *Diceratops* was actually *Triceratops*. In this paper, Forster re-erects *Diceratops* as a valid taxon and states the squamosal fenestrae are a "real morphological entity." The *Diceratops* material is unillustrated. [DHT]).

____ and Sereno, P.C. 1997. Marginocephalians. pp. 317-329. In: The Complete Dinosaur. Edited by J.O. Farlow and M.K. Brett-Surman. Indiana Univ. Press, Bloomington. xiv + 752 pp.

(Includes brief comments on intraspecific fighting in Late Cretaceous ceratopsians and with several good photographs (p. 326) of a possible healed horn thrust injury in a *Triceratops* left jugal. This specimen was previously figured in Erickson, 1966. [DHT]).

Fraser, N.C. and Shelton, C.G. 1988. Studies of Tooth Implantation in Fossil Tetrapods Using High-Resolution X-Radiography. Geol. Mag., 125(2):117-122.

(The concept that reptilian tooth implantations fall neatly into a number of separate categories which can be used in phylogenetic studies is called into question. The use of microfocal X-radiography in preliminary studies of reptilian dentitions reveals that, at least in sphenodontids, there is no clear distinction between acrodonty and pleurodonty. Although the technique is used here specifically in connection with microvertebrates, it may have considerable potential in evaluating internal structures in a wide range of fossils. [Authors' abstract]).

Fritz, S. 1988. *Tyrannosaurus* Sex: A Love Tail. Omni, 10(5):64-68, 78.

(Discusses the work by Dr. Beverly Halstead on possible mating behavior in dinosaurs. Included are a series of paintings of various dinosaurs in speculative mating postures. Given the large size of some of the animals involved, some caution would be required to avoid injuries to either partner. Format: Popular. [DHT]).

Fukuda, Y. 1987. [Dinosaur Osteocytes]. Kaseki Kenkyukai Kaishi [Fossil Club Bulletin], 20(1):2-6.

(NOT SEEN. Language: Japanese).

G

Gallagher, W.B., Tumanova, T.A. and Dodson, P. 1998. CT Scanning Asian Ankylosaur Skulls: Paleopathology in a *Tarchia* Skull. (Abstract). Jour. Vert. Paleo., 18(3):44A-45A.

(See Tumanova, Gallagher, Dodson and Axel, 1998 for details. Unillustrated. [DHT]).

Galton, P.M. 1970. Pachycephalosaurids—Dinosaurian Battering Rams. Discovery, 6(1):23-32.

(Intraspecific head-butting behavior in Late Cretaceous pachycephalosaurids. Format: Popular. Illustrated. [DHT]).

____ 1998. Saurischian Dinosaurs from the Upper Triassic of England: *Camelotia* (Prosauropoda, Melanosauridae) and *Avalonianus* (Theropoda, ?Carnosauria). Palaeontographica, Abt. A, 250(4-6):155-172.

(Large prosauropod *Camelotia borealis*, basal Westbury Formation (Upper Triassic) of Wedmore, Somerset, England. Some of this material was referred to *Gresslyosaurus ingens* by Huene, 1907-1908. Galton describes a problematic pathological bone. Huene (1907-1908:fig. 108) considered the element as part of the distal part of a chevron. However, here Galton, p. 165, describes it as "very tentatively" being the distal part of the fibula. The bone demonstrates a pathological condition. Galton writes: "The large swollen region on the more proximal part of the bone is probably pathological (a healed injury) because its rough surface is covered with irregular bumps." The osteopathy of this bone is figured; see fig. 3,g-i. [DHT]).

Gardom, T. and Milner, A. 1993. The Natural History Museum Book of Dinosaurs. Virgin, London. 128 pp.

(Page 74 figures a pes of the Lower Cretaceous *Iguanodon* showing "hard frills of arthritic growth on the toe joints," although such growths are not evident in the picture- even to the trained eye. A healed fracture of the ischium in *Iguanodon* is figured on page 75. Format: Popular. [DHT]).

Garland, A.N. 1989. Microscopical Analysis of Fossil Bone. Applied Geochemistry, 4(3):215-229.

(This paper details the methodological approaches to the processing, sectioning and staining of "fossil" bone for light microscopy. The various post mortem histological appearances of such bone are described and the implications of these appearances are outlined. A brief consideration of the effect of post mortem soft tissue decomposition on bone preservation is presented. [Author's abstract]. Well illustrated).

Geis, D. 1959. Dinosaurs and Other Prehistoric Animals. Grosset and Dunlap, New York, 105 pp.

(Injuries in the Late Cretaceous *Triceratops* are caused by battles with the large predator *Tyrannosaurus*. [DHT] Format: Popular).

____ 1960. The How and Why Wonder Book of Dinosaurs. Wonder Books, Inc., 48 pp.

(The Late Cretaceous *Triceratops* battles with predators like *Tyrannosaurus*, causing injuries to the latter. [DHT] Format: Popular).

Gertsch, L. 1994. Dinosaur Tail Dynamics. pp. 25-38. In: The Dinosaurs of Wyoming. Edited by G.E. Nelson. Wyoming Geological Association 44th Annual Field Conference Guidebook. Casper, Wyoming.

(The impact of a tail on a body imparts energy to the body. Can that be damaging enough to dissuade an opponent? This paper explores the feasibility of dinosaurian tail-based defence, using an engineering mechanics approach.

The tail could be used for defense in three ways:
- As a whip (*Diplodocus*).
- As a club (ankylosaur).
- As an edged weapon (stegosaur).

The range of possible motions that can be inferred solely from fossil remains (tracks and bones) is broader than the actual ranges of motion of the animals. Accordingly, energy and momentum approaches were used to narrow the range of tail behavior from the possible to the probable.

None of these three tail designs could break bone easily. The most efficient weapon, in terms of energy expenditure versus damage caused, was the stegosaur's spikes. Angled backwards, on impact with another animal they sliced skin and muscle tissue and left deep, bloody scores. The tail club of the ankylosaur bruised unarmored flesh and could effectively shove an opponent off-course. The whip tail of the *Diplodocus*, the least efficient of the three for defence, nevertheless laid welts across the skin of an opponent. Delicate tissue such as eyes could be damaged by a direct hit. Future work will refine these models and apply them to other dinosaurs and their activities. [Author's abstract]).

Gevock, N. 2001. *T-rex* Likely Lived with Persistent Pains, Chronic Infections. Bozeman Daily Chronicle, Sunday, October 7, 2001:A3.

(Discusses Elizabeth Rega and Chris Brochu's work on *Tyrannosaurus rex* (see also Rega and Brochu, 2001). Holes in jaws might not be related to intraspecific biting behavior, but the fungal disease "lumpy jaw." Also includes mention of pyogenic infection of fibula, fractured ribs and fused caudal vertebrae. *T. rex* "healed more like a mammal than that of a reptile." Unillustrated. Format: Popular. [DHT]).

Gillette, D.D. 1991. *Seismosaurus halli*, Gen. et sp. Nov., A New Sauropod Dinosaur from the Morrison Formation (Upper Jurassic/Lower Cretaceous) of New Mexico, USA. Jour. Vert. Paleo., 11(4):417-433.

(Describes and illustrates an unusual hook-like projection present on the distal end of the left ischium of the type specimen. While anomalous, Gillette concludes the hook "may represent ossified tendons." [DHT]).

____ and Thomas, D.A. 1985. Dinosaur Tracks in the Dakota Formation (Aptian-Albian) at Clayton Lake State Park, Union County, New Mexico. New Mex. Geol. Soc. Guidebook 36, pp. 283-288.

(NOT SEEN. NOT INDEXED. A tail drag furrow associated with an ornithopod trackway (their fig. 13), was considered by Hunt and Lucas, 1998 as possibly having pathological origins. [DHT]).

Gilmore, C.W. 1906. Notes on Some Recent Additions to the Exhibition Series of Fossil Vertebrates. Proc. U.S. Nat. Mus., 30:607-611.

(A skull of the Late Cretaceous ceratopsian *Diceratops hatcheri* from

Wyoming, USA bears several symmetrical openings through what is normally a solid neck frill. In an earlier description, another worker considered these lesions pathological. However, Forster, 1996a,b considered these features as normal and specific characters for the genus *Diceratops*. [DHT]).

____ 1909. Osteology of the Jurassic Reptile *Camptosaurus*, with a Revision of the Species of the Genus, and Descriptions of two Species. ibid, 36:197-322.

(Isolated injuries to the ilium and basal tail of *Camptosaurus browni* (USNM 4282) are attributed to a female who received the injuries during mating. [DHT]. See Gilmore, 1912; specimen also figured in Moodie, 1923a and Lewin, 1982. [DHT]).

____ 1912. The Mounted Skeletons of *Camptosaurus* in the United States National Museum. Proc. U.S. Nat. Mus., 41:687-696.

(Isolated injuries to the ilium and basal tail of *Camptosaurus browni* (USNM 4282) are attributed to a female who received the injuries during mating. [DHT]. See Gilmore, 1909, specimen also figured in Moodie, 1923a and Lewin, 1982. [DHT]).

____ 1914. Osteology of the Armored Dinosauria in the United States National Museum, with Special Reference to the *Stegosaurus*. USNM Bull., 89:1-136.

(Includes mention of pathologic tail spike in *Stegosaurus*. The anteriormost of the two paired sets of spikes is usually the one damaged. See McWhinney, Rothschild and Carpenter, 1998, 2001. [DHT]).

____ 1915. On the Fore Limb of *Allosaurus fragilis*. Proc. U.S. Nat. Mus., 49:501-513.

(Mention on page 504 of the presence of a pathological left scapula in USNM 4734. This is figured in Moodie, 1923a and Rothschild and Martin, 1992:213, fig. 19-1. Etiology is not discussed, although a traumatic fracture with poor healing seems likely. [DHT]).

____ 1917. *Brachyceratops*, A Ceratopsian Dinosaur from the Two Medicine Formation of Montana. U.S.G.S. Prof. Pap., 103, 45 pp.

(Mass mortality of at least 5 Late Cretaceous juvenile horned dinosaurs whose disarticulated remains were found within a 6 X 7 foot (approx. 1.83 X 2.35 meter) area. Illustrated. [DHT]).

____ 1919a. A New Restoration of *Triceratops*, with Notes on the Osteology of the Genus. Proc. U.S. Nat. Mus., 55:97-112.

(On page 102, Plate 6, figs. 1-2 an adult *Triceratops* right scapula is described and figured. A large hook-like and anteriorly directed exostosis is present ventrally, just anterior to the mid-length of the element. Also described and figured (Plate 9), is a pair of adult *Triceratops* orbital horncores, that shows the right one apparently broken off at mid-length and healed over forming a rounded end. Both specimens are also figured in Moodie (1923a). [DHT]).

____ 1920a. Osteology of the Carnivorous Dinosauria in the United States National Museum, with Special Reference to the Genera *Antrodemus* (*Allosaurus*) and *Ceratosaurus*. Bull. U.S.N.M., 60, 154 pp.

(Pathologic dentary of *Labrosaurus ferox* USNM 2315. Numbers and arrangement of gastralia segments of *Allosaurus* are misinterpreted as 7-9 elements per row and actually represent numerous healed or poorly healed belly ribs forming false joints or pseudoarthroses (Tanke, pers. obs., 1996; Claessens, in preparation). Pathologic metatarsus of *Ceratosaurus nasicornus*; see Baur, 1890. Fibula of *Allosaurus* USNM 4734 is pathologic, having suffered a crush fracture which later healed. See Welles and Long, 1974 for a brief discussion of this specimen. [DHT]).

____ 1920b. The Horned Dinosaurs. Ann. Rpt. Smiths. Instit., 1920:381-387.

(On page 382, Gilmore briefly comments on the pugnacious nature of Late Cretaceous ceratopsians. He notes the presence of broken horns, fractured and healed jaws, frills pierced by holes and a *Triceratops* specimen that had half of one of its' orbital horns snapped off and showing subsequent repair (rounding over of stump). Unillustrated. [DHT]).

____ 1924. On the Genus *Stephanosaurus*, with a Description of the Type Specimen of *Lambeosaurus lambei*, Parks. pp. 29-48. In: Contributions to Vertebrate Palaeontology. Canada Dept. Mines, Geol. Surv., Mus. Bull. 38, Geol. Ser 43.

(In this formal description, Gilmore briefly (pp. 31-32) comments on the taxonomic position and severe oral pathology of several hadrosaur jaws described and figured by Lambe, 1902. Both of these were more fully described in Moodie (1930b). [DHT]).

____ 1929. Hunting Dinosaurs in Montana. In: Explorations and Field Work of the Smithsonian Institution in 1928:7-12.

(Mass mortality. Disarticulated remains of an unspecified number of small hadrosaurs were recovered from one quarry in Montana, USA. [DHT]).

____ 1930. On Dinosaurian Reptiles from the Two Medicine Formation of Montana. Proc. U.S. Nat. Mus., 77:1-39.

(USNM 11868 is a partial skeleton of the nodosaurid *Palaeoscincus rugosidens* from the Late Cretaceous (Campanian) of Montana, USA. The animal had slightly injured the right premaxilla during its life; now it bears a distinctive notch with healed bone showing rounded edges (see fig. 2, p. 6). On p. 19, Gilmore mentions of the pathological fusion of two caudal vertebrae from the anterior half of the tail. The bones are deformed, this damage being caused by an injury. These vertebrae are not figured. Moodie (unpublished manuscript) stated that when this individual was alive, the injury would have imparted a slight kink in the tail. There are also raised, circular bosses present in the central region of the vertebral endplates of cervical, dorsal, and caudal vertebrae. Gilmore considers these as notochordal projections. They increase in size posteriorly; on the posteriormost dorsal, they occupy one-half of the endplate. Such features can be seen in four of a series of illustrated vertebrae. [DHT]).

____ 1932. On a Newly Mounted Skeleton of *Diplodocus* in the United States National Museum. Proc. U.S. Nat. Mus., 81:1-21, 6 plates.

(A skeleton (USNM 10865) of the large sauropod *Diplodocus longus* from the Upper Jurassic Morrison Fm. of Utah, USA bears fusions affecting caudals 15-16, and 17-20. On pages 13-14, the possible etiology of this condition is discussed. Trauma is considered but abandoned, advanced age is also suggested. He subsequently determined that the fusion occurred proximal to any area which could have been in contact with the ground. Ultimately the author leaves the question an open issue. Later findings would now indicate such caudal fusions are evidence of DISH (diffuse idiopathic skeletal hyperostosis); see Rothschild and Berman, 1991. [DHT]).

____ 1935. On the Reptilia of the Kirtland Formation of New Mexico, with Descriptions of New Species of Fossil Turtles. ibid, 83:159-188.

(Includes brief notation of the "extra fontanelle" in the squamosal of the type specimen of the Late Cretaceous ceratopsian *Pentaceratops fenestratus*. Such features have been widely assumed in the past to represent horn thrust injuries received from conspecifics. [DHT]).

____ 1936. Osteology of *Apatosaurus*, with Special Reference to Specimens in the Carnegie Museum. Mem. Carn. Mus., 11(4):175-301.

(Tail fusions in sauropods. Probably examples of DISH; see Rothschild and Berman, 1991. Illustrated. [DHT]).

Ginsburg, L. 1964. Les Regressions Marines et le Probleme du Renouvellement des Faunes su cors des Temps Geologiques. [Marine Regressions and the Problems of Faunal Renewal Through Geological Time]. Bull. Geol. Soc. France, ser. 7, 6:13-22.

(NOT SEEN. NOT INDEXED. Pathological dinosaur eggs. Language: French).

Girouard, S. 1997. First Dinosaur from the Pacific Coast of British Columbia, from the Marine Trent River Formation. (Abstract). pp. 15-16. In: 2nd British Columbia Paleont. Symp., May 9-11, 1997, Vancouver.

(*Paronychodon*-type tooth found in a Late Cretaceous marine deposit, British Columbia, Canada. Such teeth are considered by some to be aberrant teeth of better known small theropod taxa; see Currie, Rigby and Sloan, 1990; Baszio, 1997. [DHT]).

Glut, D.F. 1982. The New Dinosaur Dictionary. Citadel Press, Secaucus, New Jersey, 288 pp.

(Page 249 mentions that the Late Cretaceous ceratopsian *Triceratops* was well equipped to defend itself against predators and conspecifics. Mention of frequent puncture wounds in *Triceratops* skulls and one *Triceratops* specimen where the brow horn was broken and healed. [DHT]. Format: Popular).

____ 2000. Dinosaurs - The Encyclopedia. Supplement 1. McFarland & Company, Inc., Jefferson. xii + 442 pp.

(See pp. 284-286. Essentially a repeat of Rothschild and Tanke, 1996, 1997. Osteopathy unillustrated. [DHT]).

____ and Dodson, P. (Consultant). 1991. Discover Dinosaurs. Publ. Inter.,

Ltd., Lincolnwood, Illinois. 44 pp.

(The entry for the Late Cretaceous ceratopsian *Pachyrhinosaurus* (p. 37), acknowledges that the fronto-nasal boss in this form is a normal feature, and not the remnants (scar) of a nasal horn snapped off during the individual's lifetime with subsequent imperfect healing. Format: Popular. [DHT]).

Godfrey, S.J. and Holmes, R. 1995. Cranial Morphology and Systematics of *Chasmosaurus* (Dinosauria: Ceratopsidae) from the Upper Cretaceous of Western Canada. Jour. Vert. Paleo., 15(4):726-742.

(The squamosals of the ceratopsian *Chasmosaurus* from Alberta, Canada occasionally show smooth edged "extra openings" which completely perforate the bone. The past scientific and popular literature has often ascribed these holes as evidence of healed or partially healed intraspecific horn thrust injuries or indications of previous predator bites, but in this paper (p. 734) the authors state: "In several specimens, the thin central portion is perforated...., but this condition is never bilateral, suggesting that they probably represent anomalies, pathologies, or resorption and are not of taxonomic significance." Such an opening is figured for *C. russelli* (p. 734). See also Tanke, ms. [DHT]).

Goldman, L. 1982. Techniques of the Study of Fossilized Arthropods of Medical Interest and Concern. Fossils Quart., 1(2):30-32.

(Arteriosclerosis is suspected in some polished thin sections of dinosaur bone, but no additional details are given. Arthritis is [improperly] acknowledged as being present in dinosaurs. Unillustrated. [DHT]).

Gonick, L. 1978. The Cartoon History of the Universe. Volume 1. The Evolution of Everything. Rip Off Press, San Fransisco:48 pp.

(This adult "underground" cartoon comic book reviews the cosmic beginnings and evolution of life on this planet. Page 31 shows a herd of sauropods moving in one direction and some accidently stepping on each other's tails; with the victims grimacing and exclaiming "Ow! My tail!" "Ow!" and "Ouch!" This scenario is possibly interpreted from caudal fusions which are not infrequently found in sauropods (see Rothschild and Berman, 1991). While such fusions are apparently not trauma-related, accidental intraspecific trampling of tails in sauropods were bound to occur on occasion. Format: Popular. [DHT]).

Goodwin, M.B. and Johnson, R.E. 1995. A New Skull of the Pachycephalosaur *Stygimoloch* Casts Doubt on Head Butting Behavior. (Abstract). Jour. Vert. Paleo., 15(3):32A.

(Head butting behavior in *Stygimoloch* appears unlikely based on a new skull (MPM 8111) from the Upper Cretaceous Hell Creek Formation of North Dakota. For the first time, the orientation of the heavily ornamented parietosquamosal shelf is confirmed along an unambiguous contact with the frontoparietal suture. The squamosal spikes are parallel to the horizontal plane and extend at a low angle posteriorly from the squamosal. The laterally constricted cranial dome slopes acutely in anterior view, creating a surface unsuitable for head-on contact. Contact with the spikes during head-to-head or head-to-flank encounters could not have been accomplished without overextending the neck. The cluster of squamosal nodes and spikes is most visible when the head is tilted slightly downward; they were best suited for display behavior, deflection of a blow to the head, and protection of the neck. [Authors' abstract; in part]. See Goodwin, et. al, 1998).

____, Buchholts, E.A. and Johnson, R. 1998. Cranial Anatomy and Diagnosis of *Stygimoloch spinifer* (Ornithischia: Pachycephalosauridae) with Comments on Cranial Display Structures in Agonistic Behaviour. Jour. Vert. Paleo., 18(2):363-375.

(A new skull of *Stygimoloch spinifer* (MPM 8111) from the Upper Cretaceous Hell Creek Formation of North Dakota is the most complete specimen discovered to date. .... cranial features indicate a different mode of agonistic behaviour than previously suggested for *Stegoceras* and *Pachycephalosaurus*. The high, narrow dome of *S. spinifer* is not suited for head-butting, and the orientation of its squamosal horns and ornamental nodes strongly suggest display functions. [Author's abstract; in part]. See also Goodwin and Johnson, 1995).

Gore, R. 1993. Dinosaurs. Nat. Geogr., 183(1):2-53.

(A review of the "current" state of dinosaur research. Unfortunately, the article relies mostly on work already conducted during the previous decade. The following paleopathology-related subjects are mentioned or discussed: p. 27 tail clubs in the Chinese Jurassic sauropod *Shunosaurus* [pathologically fused and malformed?]; possible choking on a gastrolith (stomach stone) in the American Jurassic sauropod *Seismosaurus* (p. 32); disease introduced by new migrant dinosaurs causes the extinction of established dinosaur faunas (p. 36); illness causing the death of a nest of *Maia-saura* nestlings is considered on page 42; although they are not identified in the figure caption, a *Tyrannosaurus* skull bearing pathological lesions (etiology= intraspecific face-biting?) is figured on page 43; and a "sick" Late Cretaceous *Triceratops* will be a character in an upcoming science fiction movie entitled "Jurassic Park" [see Crichton, 1990; Gerani and Wood, 1993] [DHT]).

Gould, G.C., Marcus, L.F., Gueziec, A.P., Daleo, G.F. and Reddy, D.P. 1996. Medical CT Scan Visualization and Its Applications for the Study of Fossils Using Data Explorer and Interformat. Jour. Vert. Paleo., 16(3):38A.

(The development and availability of state-of-the-art computer tomography (CT scans) of fossils shows potential for more detailed study of internal morphology (otherwise inaccessible using traditional methods), as well as greatly facilitating the reconstruction and modeling of critical fossils.

Until now, medical equipment could not provide the resolution necessary for the investigation of fossil material- the alternative is the use of industrial scanners which are both costly and not readily available to most paleontologists. New innovative techniques that bolster the threshold of fossil material (to match that of humans) eliminates the burden of having to manually change the settings on diagnostic medical equipment.

Data Explorer, an IBM workstation package specifically designed for medical use, affords an extremely versatile programming environment for visualizing, measuring, modeling and reconstructing organisms from CT scan and coordinate data. InterFormat, a medical image format conversion program for industry standard UNIX workstations, is employed for the conversion of raw CT data to a format readily usable by Data Explorer on an Silicon Graphics Image workstation.

Organisms already scanned include a giant fossil hedgehog skull, two theropod skulls, an oreodont and a metriorhynchid skull, and the mandible of a small living rodent. [Author's abstract]).

Grady, W. 1993. The Dinosaur Project: The Story of the Greatest Dinosaur Hunt Ever Mounted. The Ex Terra Foundation (Edmonton) and Macfarlane Walter & Ross (Toronto). 261 pp

(Includes mass mortality of *Hypacrosaurus* eggs at Devil's Coulee, Alberta, Canada and juvenile Late Cretaceous *Pinacosaurus*, Bayan Mandahu, China. Format: Popular. Illustrated. [DHT]).

Graham, D. 1992. Dinosaur Bone Shows Possible Cancer Effects, Physician Says. The San Diego Union, Monday, January 20, 1992:B1-B2.

(Work conducted on an Upper Jurassic *Allosaurus* humerus by Dr. Leon Goldman. See also Greenberg, 1992; Wycombe, 1992. [This lesion, though never investigated fully, appears to represent an infected fracture callus only]. Format: Popular. [DHT]).

Grant, L. 1991. Discover Bones. A Royal Ontario Museum Book, Kids Can Press, Ltd. Toronto. 96 pp.

(Mention on page 91 of intraspecific trampling injuries to the tail vertebrae of unspecified Late Cretaceous hadrosaurs. Vertebrae showed indications of cracking. Osteopathy unillustrated. Format: Popular (Childrens). [DHT]).

Greenberg, J. 1992. Dinosaur Bone Probed for Cancer. Los Angeles Times, Monday, January 27, 1992:B5.

(A quick announcement of L. Goldman's work on a possible chondrosarcoma found on a humerus of the theropod *Allosaurus* from the Late Jurassic of Utah, USA. Another researcher thinks the lesion might actually be a benign growth or a chronic infection from an injury the animal received during a fight. See also: Graham, 1992, Wycombe, 1992. We are unaware of any subsequent publication on this intriguing specimen. One of us [BMR] has examined the specimen firsthand and determined it is actually a healing infected fracture. Format: Popular. [DHT]).

Grierson, B. 1998. Writing Down The Bones. Western Living, 23(8):107-108, 110, 114, 117.

(Article on Tyrrell Museum paleontologist Dr. Philip J. Currie. Includes comments (p. 117) on the discovery of a pathologic unspecified tyrannosaur rib [gastralium; TMP97.12.229] by senior editor DHT in Campanian-aged sediments exposed in Dinosaur Provincial Park, Alberta, Canada. [The medial gastral section shows two healing fractures with prominent callus development positioned about 23 and 29 cm distal to the midline articulation]. In the article, DHT suggests the injury was caused by a fall. Osteopathy unillustrated. Format: Popular. [DHT]).

Grimaldi, D. 1993. Forever in Amber. Nat. Hist., 102(6):58-61.

(Page 60 includes an 85 mya midge in amber from New Jersey, USA with the question as to whether these midges dined on dinosaurs. Illustrated. Format: Popular. [DHT]).

Grogan, W.L. and Szadziewski, R. 1988. A New Biting Midge from Upper Cretaceous (Cenomanian) Amber of New Jersey (Diptera: Ceratopogonidae). Jour. Paleo., 62:808-812.

(The authors consider whether midges such as this fed upon the blood of contemporaneous dinosaurs. This idea was also suggested by Pellegrino, 1985 and Borkent, 1995. [DHT]).

Gross, J.D., Rich, T.H., and Vickers-Rich, P. 1993. Mesozoic Bone Infection- Chronic Osteomyelitis in a Hypsilophodontid Dinosaur in Early Cretaceous, Polar Australia. Nat. Geogr. Res. Repts., 9(3):286-293.

(The discovery of an intact partial skeleton of a dinosaur in the family Hypsilophodontidae has provided insights into the development of bone infection in dinosaurs. Originally diagnosed as a poorly healed and infected left tibia, it was rediagnosed as diseased with chronic osteomyelitis leading to growth delay. A comparison between the lengths of the diseased and normal tibiae of this animal provide a measurement of the rate of bone growth in this individual. There appear to be great similarities between the inflammatory and immune processes of this dinosaur and those of modern vertebrates. [Author's summary]. Illustrated. Also figured in Long, 1998).

Gurley, L.R., Valdez, J.G., Spall, W.D., Smith, B.F. and Gillette, D.D. 1991. Proteins in the Fossil Bone of the Dinosaur, *Seismosaurus*. Jour. Protein Chem. 10(1):75-90.

(Proteins have been successfully extracted from the fossil vertebra of a 150-million-year-old sauropod ("*Seismosaurus*") recently excavated from the Morrison Formation of New Mexico. HCl and guanidine-HCl extracts of the fossil bone and its sandstone matrix were concentrated, demineralized, and resolved into a number of different protein fractions by reversed-phase high-performance liquid chromatography (HPLC). One of these fractions had the same retention time as collagen. Amino acid analysis (Pico-Tag method) of these fractions confirmed they were proteins. Comparison of the correlation coefficients of the amino acid analyses with that of collagen standards indicated that none of the fractions contained significant amounts of collagen. Similar HPLC profiles were obtained for the HCl extracts of fossil bone and its sandstone matrix suggesting they contained the same proteins. However, different HPLC profiles were obtained when these HCl extracts were dried and reextracted with guanidine-HCl. These different fractions represent proteins unique to the fossil and were not found in the sandstone matrix. These differences were confirmed by amino acid analysis. Such information on fossil bone proteins might provide useful knowledge concerning the evolution of skeletal molecules and the fossilization process. Similar information on the proteins from geological matrix might provide useful fingerprints for reconstructing ancient environments and for assessing sedimentary rocks for fossil fuel exploration. [Author's abstract]).

Gurney, J. 1992. Dinotopia— A Land Apart From Time. Turner Publ., Inc, Atlanta. 159 pp.

(A science-fiction art/fantasy book about the mid-19th Century travels of two shipwrecked individuals stranded on the island "Dinotopia." Here, the native people live in complete harmony with dinosaurs and other prehistoric animals. Dinosaur injuries and pathology are woven into the intricate and clever storyline. A *Leptoceratops* suffers a minor flesh wound to one forelimb (p. 15) and sports a cloth bandage on the wound for the duration of the story. On page 33 two men work on the injured (type of injury unstated) foot of a "hard-working Brachiosaur." A "dignified elder" *Triceratops* wields a broken right orbital horn, about half of it is missing. This dinosaurs' name— "Brokehorn," pages 87 and 116. [A *Triceratops* partial skull, also showing a healed broken orbital horncore is housed at the USNM]. "*Camarasaurus* needs dental work often," page 110. An interesting read. Format: Science-Fiction/Fantasy. [DHT]).

____ 1995. Dinotopia- The World Beneath. Turner Publ., Inc., Atlanta. 159 pp.

(The *Triceratops* character "Brokehorn" reappears in this book. See Gurney, 1992 for details. Format: Science Fiction/Fantasy. [DHT]).

H

Hagood, A. 1971. Dinosaur - The Story Behind the Scenery. K.C. Publications, Las Vegas, 32 pp. (2nd edition: 1981).

(An account of the dinosaurs and natural history of Dinosaur National Monument, near Vernal, Utah, USA. Page 10 of the 1972 edition mentions fusion of two caudal vertebrae in the Late Jurassic sauropod *Camarasaurus* as possibly being caused by an accidental trampling injury received from another *Camarasaurus*. Page 9 (lower) of the same edition shows a photograph of this fusion. DISH seems a more likely diagnosis in this particular case. Format: Popular. [DHT]).

Halstead, L.B. and Halstead, J. 1987. Dinosaurs. Sterling Pub. Co., Inc., New York, 170 pp.

(Mention that intraspecific battles in the Late Cretaceous ceratopsian *Triceratops* caused injuries. Format: Popular).

____ and Middleton, J. 1972. Bare Bones- An Exploration in Art and Science. University of Toronto Press, Toronto, 119 pp.

(Page 43, small figure of a *Compsognathus* skeleton with the head pulled strongly backwards and comments that this type of pose had previously been misinterpreted as tetanus. Format: Popular. [DHT]).

Hamley, T. 1993. Intraspecific Aggression in a Permian Reptile. (Abstract). Jour. Vert. Paleo., 13(3):39A.

(Examples of vertebrate animal behaviour are rarely recorded in the fossil record. One of the best known, the "fighting dinosaurs" of Mongolia, a reported case of predation by a dromaeosaurid on a *Protoceratops* trapped in a swamp, has recently been reinterpreted as a case of scavenging and may be nothing more than post-mortem entanglement of the two carcasses. Behavioral inference is more often drawn from the literature of trace fossils, for example convergent trackways interpreted as predator-prey interaction, but this is only occasionally well documented and often open to simpler interpretation.

Recently, however, two fossil skeletons of the reptile *Owenetta* from the Permian of South Africa (Reisz, R.R. and Laurin, M., 1991. Nature 349: 324-326) were discovered preserved in such a way that analogy with modern lizards suggests the two were engaged in an intraspecific aggressive encounter. Taken to its logical conclusion, this analogy suggests some important behavioral and ecological attributes of *Owenetta*: *Owenetta* was probably territorial, the two individuals were most likely males, evenly matched and probably at the upper end of the species size range. [Author's abstract]).

Hammer, W.R. 1997. Jurassic Dinosaurs from Antarctica. pp. 249-251. In: Dinofest International- Proceedings of a Symposium Sponsored by Arizona State University. Edited by D.L. Wolberg, E. Stump and G.D. Rosenberg. The Academy of Natural Sciences, Philadelphia.

(Details as per Hammer and Hickerson, 1993. [DHT]).

____ and Hickerson, W.J. 1993. A Brief Review of Mesozoic Terrestrial Vertebrates from the Transantarctic Mountains Including Evidence of a Scavenging Theropod. Antarctic Journ. of the U.S., 28(5):33-35.

(Early Jurassic Falla Formation, Mount Kirkpatrick, Antarctica. A large theropod ischium showed evidences of bite marks by a scavenging theropod, and found a short distance away were several isolated theropod teeth ".... broken by contact with the ischium during scavenging." It is not entirely clear from the description whether these are shed teeth that were loose and thereby lost during feeding, or actually functional teeth physically broken during feeding. If the former, this citation is irrelevant to this bibliography. However it is included here as the author's state they were "broken" teeth. Illustrated. [DHT]).

____, ____ and Slaughter, R.W. 1995. Evidence of Theropod Behaviour from the Jurassic of Antarctica. Antarctic Jour., Review 1995:55-56.

(Cervical ribs of a ?prosauropod found lodged in the throat region of the theropod *Cryolophosaurus* suggest this predator may have choked to death on its meal. Other details as per Hammer and Hickerson, 1993. Illustrated. [DHT]).

Hanna, (nee Laws), R. R., see Laws, R.R.

Harding, M.W. 1988. The Dinosaur Dilemma. Privately published, 79 pp.

(Page 20 of this unusual but novel treatment of dinosaurian physiology includes some references to paleopathology in theropods. The author first talks of large theropods having their three main metatarsals fused together. This is only true for one specimen, the American Late Jurassic *Ceratosaurus* which is undoubtedly pathologic. Secondly, Harding speaks of the large North American Late Cretaceous tyrannosaurid *Tyrannosaurus* as having quote "Six bones of the back were welded together to produce a solid girder-like structure," and later "..... this stiff and seemingly BORN ARTHRITIC (author's emphasis) monster." While a partial neck fusion

involving two cervicals is known in one *Tyrannosaurus* specimen, and another specimen involves fusion of two dorsals, none exhibit total fusion as Harding implies here. [DHT]. Format: Semi-Popular).

Harlan, B. 1990. The *Rex* of All- *Tyrannosaurus* gigantus. News-week, October 1, 1990:63.

(Discovery of the largest known and most complete skeleton of *Tyrannosaurus rex* skeleton is documented. The author relates: "... the bones show evidence of injuries in the jaw and near the end of the tail, indicating "a very old individual who obviously led a long and perilous life." The use of "gigantus" in the article title is incorrect, there is no species of *Tyrannosaurus* called "gigantus." [DHT] Format: Popular).

Harris, J.D. 1997. A Reanalysis of *Acrocanthosaurus atokensis*, Its Phylogenetic Status, and Paleobiogeographic Implications, Based on a New Specimen from Texas. Masters thesis, Southern Methodist University, Dallas, Texas, USA. xix+ 204 pp.

(SMU 74646, a partial *Acrocanthosaurus* skeleton collected west of Fort Worth, Texas, USA. Twin Mountains Formation, late Aptian-early Albian age. Includes some osteopathy. Cervical vertebrae 3 and 4 show right lateral deviation of the neural spines. No other bones nearby were showing evidences of plastic deformation, so a possible congenital origin is posited; p. 44. Numerous dorsal ribs show healing fractures (see fig. 30, p. 96). These are manifested as solitary or double fractures with healing calluses evident. These ribs repaired with excellent realignment. One rib shows an imperfect repair and forms a pseudoarthrosis; pp. 97-98. One pathologic rib head bears a pit that may represent a healing bite puncture; p. 98. Some gastral elements show "peculiar distal ends" and might represent pseudoarthroses; p. 100. Neural spine of the ?16th caudal vertebra (fig. 26, p. 87) shows a marked deviation to the right. A pit on one lateral surface of the spine is considered to also be a tooth puncture bite wound; p. 89. Illustrated. See Harris, 1998 for formal description. [DHT]).

____1998. A Reanalysis of *Acrocanthosaurus atokensis*, Its Phylogenetic Status and Paleobiogeographical Implications, Based on a New Specimen from Texas. New Mex. Mus. Nat. Hist. Bull., 13:1-75.

(Osteopathy affecting ribs, gastralia and caudal neural spine, possible healed bite affecting neural spine. Details as per Harris, 1997. Illustrated. [DHT]).

Hatcher, J.B. 1901. *Diplodocus* (Marsh): Its Osteology, Taxonomy, and Probable Habits, with a Restoration of the Skeleton. Mem. Carn. Mus., 1:1-63.

("Coossified caudal vertebrae" [15th to 16th and l7th to 20th] in Upper Jurassic sauropod *Diplodocus* (USNM 10865). Hatcher suggested that these fusions may have happened where the animal rested this portion of its' tail on the ground thus making it susceptible to injury. That hypothesis was subsequently challenged (Gilmore, 1932), and a traumatic nature for this "anomaly" disproven; see Rothschild and Berman, 1991. [DHT]).

____ 1905. Two New Ceratopsia from the Laramie of Converse County, Wyoming. Amer. Jour. Sci., Ser. 4, 20:413-419.

(R.S. Lull adds his editorial comments at the end of this paper. Hatcher had suggested some extra fontanelles or openings in the frill of the Late Cretaceous ceratopsian *Diceratops* (=*Triceratops* to some authors) were normal, specific characters. Lull disagrees, suggesting they are pathologic and represent healed horn thrust injuries delivered by aggressive conspecifics. See Forster, 1996b for discussion. Illustrated. [DHT]).

____, Marsh, O.C. and Lull, R.S. 1908. The Ceratopsia. USGS Monographs XLIX. xxx + 300 pp. (Reprinted by Arno Press, 1980).

(Includes a few references to pathologic conditions affecting the skull found in Late Cretaceous Ceratopsia. An orbital horncore of *Triceratops sulcatus* (USNM 4276) evidently suffered a fracture in life with the distal portion being subsequently lost. On this, it is written: ".... the two [horncores] differ materially in size and form, this difference apparently having been due to an injury received by the one now available during the life of the animal. This horn core is very stout, but not elongate. It is truncated above in a peculiar wedge-shaped manner, as though the superior portion had been broken off in life and the injured bone had healed without exhibiting any exostosis or malformation. Its present form does not appear to be due to erosion after entombment," pp. 133-134. This specimen is figured, see fig. 112, p. 133.

Frill injuries (perforations) in *Diceratops* (see Plates 47 and 48) and left squamosal in *Triceratops elatus* (see Plate 43) are attributed to intraspecific fighting, p.193. [DHT]).

Hayden, T. 1999. Dinosaurs in the Dust. Newsweek, July 12, 1999:44-45.

(Mass mortality of Late Cretaceous titanosaur eggs, Patagonia, Argentina. Format: Popular. Illustrated. [DHT]).

Hawkes, N. 1995. _____. The Times, February 9, 1995:__.

(NOT SEEN. Lower Cretaceous *Iguanodon* with pathological vertebrae that during healing fused together into a deformed shape. Also noted in Anonymous, 1995d. [DHT]).

Hay, O.P. 1908. On the Habits and the Pose of the Sauropodous Dinosaurs, Especially of *Diplodocus*. Amer. Nat., 42:672-681.

(States that tough vegetation in the diet of Late Jurassic sauropod *Diplodocus* would have exposed the slender teeth to breakage or produced perceptible wear. However, such damage has yet to be documented. [DHT]).

Hecht, J. 1993. Last Gasp for the Dinosaurs. New Sci., 140(1898):11.

(Analysis of air pockets trapped in amber reveals that the amount of oxygen in Latest Cretaceous (about 65 million ybp) air dropped from 35% to 28% at the very end of the Cretaceous (about 63 million ybp). Resultant respiratory distress resulted in a decline in dinosaur diversity at the end of the Cretaceous, and ultimately, their extinction. Format: Popular. [DHT]).

____ 1995. The Bigger They Come the Harder They Fall. New Sci., 148(1998):18. Also found on Internet at: http://www.newscientist.com/nsplus/insight/*rex*files/bigger.html

(The Late Cretaceous dinosaur *Tyrannosaurus rex* has often been portrayed as an active and swiftly running animal. But at a weight of some 5-6 tons what would happen if it tripped and fell while running? Serious injuries and fatalities would result. See Farlow, Smith and Robinson, 1995; Hecht, 1998. Format: Popular. [DHT]).

____1996. Dinosaur Doctor Diagnoses the Disease of Dukes. New Sci., 154(2083):7.

(Another in the numerous popular science articles regarding Rothschild, Tanke and Carpenter's 1997 Nature article on gout in a *Tyrannosaurus* humerus and another unspecified tyrannosaurid pedal phalanx. This article errs in stating *T. rex* hand bones at the Tyrrell Museum also show gout. This specimen is actually a solitary pedal phalanx of an unspecified tyrannosaurid from the Dinosaur Park Formation (Campanian) of Dinosaur Provincial Park, Alberta. Illustrated with a cartoon. See also Rothschild, Tanke and Martin, 1997a. [DHT]).

____ 1998. The Deadly Dinos That Took a Dive. New Sci., 158(2130):13.

(Short article on rib fractures in Upper Jurassic *Allosaurus* and Late Cretaceous *Tyrannosaurus* being studied by Dr. Bruce Rothschild. Rib fractures in the former were apparently caused during falls while running, while those in the latter appear not to be related to forward falling. How they were caused in *Tyrannosaurus* is unclear. Format: Popular. Osteopathy unillustrated. [DHT]).

____ 2000. Fangs Bared - Meet the Venomous Dinosaurs. New Sci., 168(2265):24.

(See abstract in Rodriguez-De La Rosa and Aranda-Manteca, 2000. Format: Popular).

Heckert, A.B., Rinehart, L.F., Lucas, S.G., Downs, A., Estep, J.W., Harris, J.D., Reser, P.K. and Snyder, M. 1999. A Diverse New Triassic Fossil Assemblage from the Petrified Forest Formation (Revueltian:Early-mid Norian) near Abiquiu, New Mexico. (Abstract). New Mexico Geol., 21(2):42.

(Ghost Ranch, New Mexico, USA. One dinosaur specimen was found to be pathologic. The author's write: "An aberrant tetrapod specimen consists of a fused tibia-fibula-astragalus-calcaneum that is also fused proximally. This probably represents a large (>3 m body length) theropod with an as-yet undetermined pathology." Unillustrated. [DHT]).

Hedges, S.B. and Schweitzer, M.H. 1995. Detecting Dinosaur DNA. Science, 268:1191-1192.

(Critique of Woodward, Weyand and Bunnell, 1995 claim of the discovery of Late Cretaceous dinosaur DNA. The likely source of contamination was *Homo sapiens* DNA. See other critiques on pages 1192-1193. With response by Woodward on page 1194. [DHT]).

Helbling, , M. II, Rothschild, B.M. and Tanke, D.H. 2001. Mesozoic Neoplasia: A Family Affair. (Abstract). Jour. Vert. Paleo., 21(3):60A.

(Tumors have only rarely been recognized in extreme antiquity and confident diagnosis of tumors has been rarely possible beyond the Cenozoic. Those validated have been related to osteomas in mosasaurs and chance observation of hemangiomas and metastatic cancer in lapidary specimens of dinosaur bone. As the previously noted tumors were recognizable on x-ray and as vertebrae are commonly (in humans) afflicted by tumor and are of a size amenable to analysis, fluoroscopic x-ray survey of North American dinosaur vertebrae was conducted to assess occurrence and frequency of tumors. The C-arm of the fluoroscope limited analysis to vertebral centra less than 28 cm in diameter. The sample included 4299 vertebrae from 457 individuals.

Radiologic evidence of neoplasia was limited to one family, hadrosaurs. Within that family, only *Edmontosaurus*, *Hadrosaurus*, *Bactrosaurus*, *Gilmoreosaurus* and *Anatosaurus* were affected. The *Maiasaura* sample at time of abstract preparation was too small to rule out occurrence. Hemangiomas, present in *Edmontosaurus* at a frequency of 3% were absent in *Corythosaurus* (Chi square = 7.387, $p < 0.008$). Their absence in sauropods, ceratopsia, stegosauria, theropoda, ornithomimidae and ankylosauridae was statistically significant (at Chi square = 4.14, $p < 0.04$). Metastatic cancer, osteoblastoma and desmoplastic fibroma were found only in hadrosaurs and were extremely rare, with only one example of each.

This radioepidemiological study identifies apparent restriction of tumor occurrence to hadrosaurs. While the frequency of metastatic cancer and other tumors is below the threshold for family attribution, hemangiomas appear specific to hadrosaurs. Predisposition of hadrosaurs to this vascular tumor stimulates conjecture as to habitat an diet factors. [Author's abstract]).

Helder, M.J. 1991. Tour Guide-Royal Tyrrell Museum, Drumheller, Alberta. Creation Science Assoc. Alta., 35 pp.

(Creationist guidebook to the Royal Tyrrell Museum fossil galleries. On page 34 the author briefly comments on the pulled-back nature of the head in a specimen of the Late Cretaceous hadrosaur *Corythosaurus casuarius* (TMP80.40.1; Quarry 150, Dinosaur Provincial Park) on display in the galleries of the Royal Tyrrell Museum. Helder writes: "Note the posture of this creature, with head pulled back (in agony?)." More likely this is simply due to post-mortem contractions of the cervical ligaments (DHT, pers. field obs., see also Weigelt, 1927 [1989]; Davis, 1996), or postmortem movement of the large laterally compressed head by water currents. [DHT]).

____ 2000. Dinosaur Disasters. Found on Internet Nov. 28, 2000 at the Creation Science Association website at: http://freenet.edmonton.ab.ca/create/articles/fossils/drowned.html

(The Biblical Flood is implied as the cause of dinosaur mass mortality bonebeds (*Coelophysis*, *Pachyrhinosaurus*, *Centrosaurus*) and the reason the head/neck is often seen contorted and pulled back over the body in theropod dinosaurs. In commenting on a cast of the AMNH *Struthiomimus* and original *Albertosaurus* skeleton of TMP91.36.500, both on display at TMP, the author comments: "The stressed postures convey something of the horror of the disaster that overtook these creatures. These fossils convey a powerful message of death in a spectacular flood. Some might claim that seasonal floods were the agents of disaster. Everyone must admit however that the scale of flooding was highly unusual, like nothing seen today." Unillustrated. [DHT]).

Henikoff, S. 1995. Detecting Dinosaur DNA. Science, 268:1192.

(Critique of supposed discovery of Late Cretaceous dinosaur DNA made by Woodward, Weyand and Bunnell, 1995. See other critiques on pages 1191-1193. With response by Woodward on page 1194. [DHT]).

Heritage, J. 1980. The Mysterious World of Dinosaurs. Octopus, London, 96 pp.

(Fighting in the Late Cretaceous ceratopsian *Triceratops* is suggested by the occurrence of injured skulls of this taxon. [DHT] Format: Popular).

Hirsch, K.F. 1989a. A Look at Pathological Amniote Eggshell- Fossil and Modern. (Abstract). Jour. Vert. Paleo., 9(3):25A.

(Pathologic conditions are known from both fossil and modern eggshell; however, it is a topic little studied and still disputed. Pathologic eggshell is an indicator of an abnormal biological and environmental condition. oviductal retention of amniote eggs beyond the time of normal oviposition (egg-laying) may lead to the phenomena of multilayered eggshell in reptiles and to "ovum in ovo" in birds. Fossil multilayered eggshells were first reported from the Late Cretaceous of France, and later from India and Argentina. In 1988 such eggshells were recognized in the Late Cretaceous of Montana and the Jurassic of Utah. The "ovum in ovo" has a low preservation potential and has not yet been observed in the fossil record. Abnormal thinning of eggshell and change of its microstructure is demonstrated in condor eggs affected by DDT. Thinning of fossil eggshell in the Late Cretaceous of France and its relation to the extinction of dinosaurs have been disputed; they seem very questionable. Recognition of fossil pathological eggshell, except in the obvious multilayered specimens, is difficult due to variations in preservation and diagenesis. [Author's abstract]. Published posthumously in Hirsch, 2001).

____ 1989b. Interpretations of Cretaceous and Pre-Cretaceous Eggs and Shell Fragments. pp. 89-97. In: Dinosaur Tracks and Traces. Edited by D.D. Gillette and M.G. Lockley. Cambridge Univ. Press, Cambridge.

(Pathological dinosaur eggs (with multi-layering of the shell) from the Late Cretaceous of France and Spain. Illustrated. [DHT]).

____ 1994a. Upper Jurassic Eggshells from the Western Interior of North America. pp. 137-149. In: Dinosaur Eggs and Babies. Edited by K. Carpenter, K.F. Hirsch and J.R. Horner. Cambridge Univ. Press, London. ix + 372 pp.

(Describes pathologic dinosaur eggshell collected from Morrison Formation deposits in Colorado and Utah, USA. Page 142 and figures 10.4A-H describe, illustrate and discuss a multilayered dinosaur egg from the Cleveland-Lloyd Dinosaur Quarry located near Price, Utah, USA. See Hirsch, Stadtman, Miller and Madsen, 1988 for a more detailed assessment of this egg. Page 148 includes descriptions of two pathological dinosaur egg specimens from the "Young Locality" in Delta County, Colorado. See figures 10.6D and E. [DHT]).

____ 1994b. The Fossil Record of Vertebrate Eggs. pp. 269-294. In: The Paleobiology of Trace Fossils. Edited by S.K. Donovan. Johns Hopkins, Baltimore, Maryland. vii + 308 pp.

(Excellent overview. Of direct interest to this bibliography are the discussions and descriptions of pseudoeggs, egg taphonomy, silicified bacteria found in pore canal systems of dinosaur eggs, egg histology, egg paleobiochemistry and pathological multilayering of dinosaur eggshell. Well illustrated. [DHT]).

____ 2001. Pathological Amniote Eggshell - Fossil and Modern. pp. 378-392. In: Mesozoic Vertebrate Life: New Research Inspired by the Paleontology of Philip J. Currie. Edited by Darren Tanke and Kenneth Carpenter. Indiana University Press, Bloomington. xviii + 577 pp.

(NOT INDEXED. Pathologic eggshell results from abnormal biological or environmental conditions. Abnormal biological conditions like oviductal retention of amniote eggs beyond the time of normal oviposition (egg-laying) may lead to the phenomena of multilayered eggshell in reptiles and "ovum in ovo" in birds. The "ovum in ovo" has a low preservation potential and has not yet been observed in the fossil record. Fossil multilayered eggshells were first reported from the Upper Cretaceous of France and, later, from the Upper Cretaceous of India and Argentina. In 1988 such eggshells were recognized in the Upper Cretaceous of Montana and Jurassic of Utah.

Abnormal environmental conditions, such as the influence of DDT, result in the thinning of eggshell and changes in microstructure in condor eggs. Abnormal environmental conditions may have caused thinning in fossil dinosaur eggshell; however, a relationship between thinning in fossil dinosaur eggshell and the extinction of dinosaurs is disputed. Recognition of fossil pathological eggshell - except for the obvious multilayered specimens - is difficult due to variations in preservation and diagenesis. [Author's abstract].

____, Stadtman, K.L., Miller, W.E. and Madsen, J.H., Jr. 1988. A Pathological Jurassic Dinosaur Egg Containing an Early Stage Embryo from Central Utah (Abstract). Jour. Vert. Paleo., 8(3):17A.

(A recently discovered egg from the Upper Jurassic Morrison Formation of the Cleveland-Lloyd Dinosaur Quarry in Emery County, Utah, contains what evidently is an early-stage embryo and is encased by a pathological eggshell layer. The egg (about 110 x 60 mm) split open on one side before preservation; on the other side the halves are still somewhat hinged where the shell flexed during separation. A well-preserved eggshell (1.0 to 0.8 mm thick) covers the entire specimen. This primary shell, overlain by a pathological eggshell layer (0.5 to 0.4 mm thick), is smooth with an ornithoid type structure and an as yet undescribed angusticanaliculate-like pore system. In the lowest part of the egg an image of a very early stage embryo is visible in CAT scan. The well-preserved condition of the egg is peculiar from a taphonomic setting in which skeletal remains of the

dinosaurs are disarticulated and scattered. The excellent preservation, the presence of an embryo, and the pathological shell layer all suggest that the egg was retained in the uterine region of the female when it died. [Author's abstract]. See Hirsch, Stadtman, Miller and Madsen, 1989).

____, ____, ____, and ____ 1989. Upper Jurassic Dinosaur Egg from Utah. Science, 243:1711-1713.

(An isolated egg of an undetermined dinosaurian from the Upper Jurassic Morrison Formation of Utah, USA found in a rich multigeneric bonebed was found to be pathological in the form of multilayering of the shell. CT scan of Jurassic egg revealed a 38 by 6.4 mm radiodense object [at the bottom half of the egg], attributed to an embryo "in an early state of development." Richmond and Morris, 1996 refer this egg to ?*Allosaurus*. The multilayering of the shell occurs in extant females under stress- in this case, Richmond and Morris imply the "stress" was the female *Allosaurus* being permanently bogged down in sticky mud. [DHT]).

Hitchcock, E. 1844. Report on Ichnolithology, or Fossil Footmarks, with a Description of Several New Species, and the Coprolites of Birds, from the Valley of Connecticut River, and of a Supposed Footmark from the Valley of Hudson River. Amer. Jour. Sci., 47:292-322.

(Hitchcock's report of fossil tracks from the Triassic of Connecticut, USA includes a description of a trackway of a bipedal animal with an injury that caused one of the toes to be abnormally positioned. Hitchcock was so impressed by this fossilized occurrence that he named the animal *Sauroidichnites abnormis*. At the time of their description, the former existence of dinosaurs was not fully appreciated. Thus Hitchcock ascribed the footprints to those of extinct birds. In reality, *S. abnormis* was probably a small bipedal predaceous dinosaur. [DHT]).

Holland, W.J. 1906. The Osteology of *Diplodocus*. Mem. Carnegie Mus., 2:225-264.

("Coossified caudal vertebrae" in what turned out to be caudals 20-21 and 24-25 in Late Jurassic *Diplodocus* CM94. See Rothschild and Berman, 1991 for discussion of caudal vertebrae fusions in sauropods. [DHT]).

____ 1910. A Review of some Recent Criticisms of the Restorations of Sauropod Dinosaurs Existing in the Museums of the United States, with Special Reference to that of *Diplodocus carnegiei* in the Carnegie Museum. Amer. Nat., 44:259-283.

(A harsh critique of some of the outlandish lizard-like poses suggested for gigantic sauropods. During this era (and to this day), sauropods were correctly mounted in a mammal-like pose, with all four limbs positioned vertically, pillar-like, and underneath the body. Several other European researchers preferred the animals be mounted like extant lizards with sprawling limbs directed at right angles away from the body. In this study, Holland makes a strong case for the simple impossibility of a lizard-like pose, the most compelling argument being that in such a pose, the deep torso would have had to be carried lower than the legs and thus would have to be dragged along a groove in the ground. Tongue in cheek, Holland (p. 268) surmises: "This might perhaps account for his early extinction. It is physically and mentally bad to 'get in a rut.'" [DHT]).

Holmes, R.B., Forster, C., Ryan, M. and Shepherd, K.M. 2001. A New Species of *Chasmosaurus* (Dinosauria:Ceratopsia) from the Dinosaur Park Formation of Southern Alberta. Can. Jour. Earth Sci., 38:1423-1438.

(The Late Cretaceous specimen is a nearly complete skull and skeleton, collected near Irvine, Alberta, Canada; CMN 41357. Includes mention and discussion of orbital horncore resorption pits, and an extra fontanelle affecting the right squamosal. The authors do not consider the extra fontanelle as evidence for bone resorption or pathology, but do not offer any suggestions as to the cause of these anomalies, so often seen in *Chasmosaurus* skulls. The frill shows a variety of minor asymmetries. In another referred specimen (TMP87.45.1), and between epoccipitals two and three, the lateral edge bears a notch of unknown cause. These unusual features are figured. [DHT]).

Holmes, T. 1996. "Sue," the Magnificent *Tyrannosaurus*. Dino Times, 6(11):4-5.

(Late Cretaceous *Tyrannosaurus rex*. A "crushed fibula" [more correctly a healed fracture] is attributed to a possible whack on the leg by an ankylosaur tailclub. Another *T. rex* tooth is embedded in one of the ribs [doubtful; specimen seen by DHT, it needs to be seriously reevaluated]; the tail has two crushed and displaced [distal] tail vertebrae- stepped on or injured during a "mating ritual?" [probably non-traumatic DISH]; left side of skull is "deeply scored and torn" [the right side is affected too]- evidence for intraspecific fighting? Osteopathy unillustrated. Format: Popular. [DHT]).

Holtz, T.R., Jr. 1998. Evidence for the Predatory Nature of *Tyrannosaurus rex* and Other Tyrant Dinosaurs. (Abstract). pp. 26-27. In: The Dinofest Symposium. Edited by D.L. Wolberg, K. Gittis, S. Miller, L. Carey and A. Raynor. The Academy of Natural Sciences, Philadelphia, Pennsylvania. April 17-19, 1998.

(Whether *Tyrannosaurus* was an active predator or just a scavenger has come into much debate as of late. Holtz comments that the presence of "occasional pathologies" among a host of other anatomical characteristics indicates that *Tyrannosaurus* was capable of active predation as well as scavenging. Unillustrated. [DHT]).

Hong, Yang 1995. Authentication of Ancient DNA Sequence- A Reassessment of 18S rDNA Sequences from a Fossil Dinosaur Egg. Acta Palaeont. Sin., 34(6):657-673.

(Studies of ancient DNA from archaeological and paleontological material have provided new insight into our understanding of ancient life and molecular evolution over a large timespan. Because of the sensitivity of the PCR technique used for ancient DNA amplification, authentication of target DNA has become a serious consideration for ancient DNA workers. This paper discusses the current criteria (e.g. laboratory control, DNA behavior, phylogenetic test, and reproducible experiments) for establishing authentication of a putative DNA sequence. Based on these authenticating criteria, a reassessment was made for recently published DNA sequences which were claimed to have derived from a Late Cretaceous dinosaur egg.

An et al. (1995) published 18S rDNA sequences obtained through molecular cloning of PCR products amplified from extractions of a dinosaur egg inclusion. These short sequences (less than 200 bp) apparently belong to two groups that differ by, besides point mutations, two regions of insertion/deletion sequences (5 bp and 9 bp). Their conclusion that these sequences are of dinosaur origin was based on (1) no identical sequences were found in the EMBL database, and (2) high percentage of sequence similarity occurred between the putative dinosaur sequences and the 18S rDNA sequences from living vertebrate representatives. However, in the original sequence alignment, secondary structures of the 18S RNA molecule were not considered, and no phylogenetic test was performed. In this reanalysis, two consensus sequences (Dinoegg 1 and Dinoegg 2) from An et al. (1995)'s two groups of putative dinosaur sequences were realigned, according to current 18S RNA secondary structure models, with modern 18S rDNA sequences (from An's original publication and from the GenBank) to represent a range of living organisms from bacteria to human. Two types of phylogenetic analyses were performed on the data set using a parsimonious method (PAUP 3.1) with and without ambiguously aligned regions. The phylogenetic trees obtained from both tests show that (1) both putative dinosaur DNA sequences are consistently grouped outside of the vertebrate clade, (2) one of the two consensus sequences (Dinoegg 2) is closely related to higher plants; and the other (Dinoegg 1) remains nonresolved, but shows sister position with plants and invertebrates, and (3) the general topology of the trees and the relationship of branches are supported by relatively high bootstrap values. Therefore, the reanalysis strongly suggests that the 18S rDNA sequences in An et al. (1995) are of non-vertebrate origin and probably were derived from amplifications of homologous genes from plant and other non-vertebrate species, rather than from dinosaur remains.

This analysis illustrates the importance of proper DNA sequence alignments, especially of r RNA genes in which the establishment of homology can be problematical. In addition to a vigorous laboratory control, observations of DNA behavior, and database searching, phylogenetic testing is most critical for determining the taxonomic authenticity of ancient DNA sequences. [Author's abstract; modified slightly]. Language: Chinese; with English summary. Illustrated).

Hooker, J.S. 1987. Late Cretaceous Ashfall and the Demise of a Hadrosaurian "Herd." (Abstract). Abstracts with Programs, 40th Ann. Meeting, Rocky Mtn. Sect., Geol. Soc. Amer., Boulder, 19(5):284.

(Within the sediments of the Upper Cretaceous Two Medicine Formation of northwestern Montana is a mudstone lens containing the remains of several thousand hadrosaurian dinosaurs. The Two Medicine Formation is a 600 meter thick non-marine sequence deposited throughout Campanian time as part of a molasse-type clastic wedge.

The main quarry within the two square kilometer deposit has yielded thousands of disarticulated specimens representing the remains of at least thirty individuals. Test pits and bone concentration calculations provide a conservative estimate of five to ten thousand individual hadro-

saurs entrapped within this single deposit. With very few exceptions all skeletal material is referable to *Maiasaura peeblesorum*.

A combination of calcium carbonate and chalcedony have preserved the bones indicating an environment rich in free silica. The specimens show no signs of predation and appear to have been removed from the surface quickly, following a short period of transportation (suggested by lack of abrasion and breakage of fine processes). Several criteria such as bone orientation and sorting characteristics indicate the transport medium was fluid and relatively non-viscous.

The presence of small bentonite rip-up clasts within the deposit and a thin ash layer directly above it evidence the proximity of volcanic activity. These observations taken in conjunction with the type of preservation and other taphonomic results indicates this dinosaur aggregation was killed and later preserved by the same volcanic ash fall. [Authors' abstract]. Mass mortality).

Horner, J.R. 1984. The Nesting Behaviour of Dinosaurs. Sci. Amer., 250(4):130-137.

(Mass mortality of dinosaur eggs. lllustrated. [DHT]).

____ 1992. Cranial Morphology of *Prosaurolophus* (Ornithischia: Hadrosauridae) with Descriptions of Two New Hadrosaurid Species and an Evaluation of Hadrosaurid Phylogenetic Relationships. Museum of the Rockies Occasional Paper No. 2, Bozeman, iii + 119 pp.

(lncludes two figures on page 109 [*Kritosaurus navajovius* NMMNH P-16106] showing extensive healed scars of the posterior skull roof. No other details are given. Could these be the healed remnants of a predator's bite? Some lesions form rounded depressions while others are arranged in parallel rows. [DHT]).

____ 1994a. Steak Knives, Beady Eyes, and Tiny Little Arms. (A Portrait of *T. rex* as a Scavenger). pp. 151-164. In: Dinofest. Edited by G.D. Rosenberg and D.L. Wolberg. Paleontological Soc. Spec. Publ. No. 7.

(Comments on the fighting *Velociraptor/Protoceratops* specimen. Also includes comments on mass mortality bonebeds in Late Cretaceous dinosaurs. Monospecific bonebeds of the ceratopsians *Styracosaurus*, *Centrosaurus*, *Triceratops* and *Pachyrhinosaurus* are mentioned. Horner provides details on several hadrosaur mass mortality bonebeds in Montana:

1. A *Parasaurolophus* bonebed containing the remains of 1,000-2,000 animals.

2. The "Campasaur Pit," a *Maiasaura* bonebed. Remains representing 60 animals were recovered from a dig 100 feet long and 30 feet wide. The entire bonebed outcrops over a distance of 4 miles in length by 1/4 mile wide. Test pits dug at random throughout the bonebed yielded at least 30 bones per square meter. By extrapolation it is suggested that 10,000-15,000 *Maiasaura* perished simultaneously. The bones are preserved in a volcanic ash/mudstone layer suggesting a catastrophic volcanic event.

3. A *Hypacrosaurus* bonebed with ".... at least several hundred, if not a couple thousand...." animals represented. [DHT]).

____ 1994b. Comparative Taphonomy of Some Dinosaur and Extant Bird Colonial Nesting Grounds. pp. 116-123. In: Dinosaur Eggs and Babies. Edited by K. Carpenter, K.F. Hirsch, and J.R. Horner. Cambridge Univ. Press, ix + 372 pp.

(The author speculates that a Late Cretaceous hadrosaur (*Hypacrosaurus)* nesting ground discovered in northern Montana, USA, may have been wiped out by a volcanic event during the nesting season. [DHT]).

____ 1997. Rare Preservation of an Incompletely Ossified Fossil Embryo. Jour. Vert. Paleo., 17(2):431-434.

(Documents the preservation of cartilaginous structures in the early embryonic remains of an unspecified Late Cretaceous dinosaur. Well illustrated. [DHT]).

____ and Dobb, E. 1997. Dinosaur Lives. Harcourt Brace & Co., San Diego. viii + 244 pp.

(Contains many relevant dinosaur mass mortality items :

Mass mortality bonebeds:

1. Dino Ridge Quarry, Campanian Upper Two Medicine Formation, located near Landslide Butte, Montana, USA is a bonebed containing disarticulated adult and immature remains of the new centrosaurine ceratopsian *Einiosaurus* (p. 64). A rich bonebed, with up to 40 bones per square meter, dozens or more ceratopsians had died there (p. 66). The site was believed to have formed when drought conditions ensued and the ceratopsians congregated around ever-drying waterholes and depleting the local vegetation. The weakened animals died ".... of opportunistic disease, starvation, maybe even sunstroke." (p. 67).

2. Lambeosite, Campanian Upper Two Medicine Formation, located near Landslide Butte, Montana, USA; a hadrosaur bonebed consisting of disarticulated bones, dominated by a new species of the lambeosaurine *Hypacrosaurus stebingeri* (p. 65). Juveniles and adults are represented. A drought-related mass mortality seems responsible in the formation of this bonebed too (p. 67).

3. Westside Quarry, Campanian Upper Two Medicine Formation, located near Landslide Butte, Montana, USA; another monospecific hadrosaur bonebed, this time containing the abundant disarticulated remains (juvenile and adult) of *Prosaurolophus blackfeetensis* (p. 67-68). Drought is the suspected agent for the mortality of these hadrosaurs (p. 89).

4. Canyon Bone Bed (located close to Dino Ridge Quarry - #1 above). Another monospecific ceratopsian bonebed containing articulated skulls and disarticulated cranial and postcranial material of *Achelosaurus* (pp. 73-74). Juveniles and adults are represented.

5. Hillside Quarry, lowermost Two Medicine Formation (79.6 mya), located 60 miles from Landslide Butte, Montana, USA. Another hadrosaur bonebed, dominated by *Gryposaurus latidens* (pp. 82, 200). Several articulated skeletons were collected (p. 95).

6. West Hadrosaur Bonebed, a *Maiasaura peeblesorum*-dominated bonebed close to #5 above (pp. 88-89). Most of the material recovered came from juveniles. At least 9 half-grown animals are represented (p. 95). lt is believed to represent a drought assemblage (p. 89). Horner postulates that the juveniles might have been more susceptible to disease, and that they died there, with the older adults moving on (p. 89).

7. Blacktail Creek North, located near Blacktail Creek, Montana, USA. A site dominated by numerous juvenile *Hypacrosaurus* bones (p. 96). A nesting horizon with eggs and embryos in eggs was found nearby (p. 97).

8. Blacktail Creek *Hypacrosaurus* bonebed (p. 104).

9. Blacktail Creek *Prosaurolophus* bonebed (p. 104).

10. Jack's Birthday Site, Upper Two Medicine Formation, found near the mouth of Badger Creek, Montana, USA; a multigeneric bonebed, which includes "clusters" of bones representing disarticulated individual skeletons. 4 *Troodon* were collected there. Clusters of bones of the hadrosaurs *Prosaurolophus* and *Hypacrosaurus* were also documented (p. 106). Drought, botulism poisoning or disease may have played a role in the death of the animals; drought definitely played an important role (p. 107).

11. Rainbow Butte, Montana, USA. Early Cretaceous Cloverly Formation. John Ostrom's early 1960's *Deinonychus* site where remains of 5 skeletons were found intermingled with a *Tenontosaurus* (prey?, p. 120); unlikely according to Horner and Dobb, (pp. 121-122).

12. T&J Site, near Bozeman, Montana. Morrison Formation (Upper Jurassic) *Apatosaurus* bonebed dominated by juveniles, (pp. 125-127). Etiology unknown.

13. Mother's Day Site. Another *Apatosaurus* bonebed with animals the same size as the ones at the T&J site (#12 above) represented, (pp. 126-130). Hundreds of juvenile apatosaur bones were found. Curiously, most of the bones found were from the lower half of the body. lt is postulated that animals became bogged down in soft mud. Lower occurring bones encased in mud survived contemporaneous erosional processes, while those from the upper half of the body did not. lt is unclear whether the site represents a group trapped together, or individual animals trapped over a period of time. As such, its status as a true mass mortality event remains unresolved.

Egg sites:

1. Green mudstone layer (Datum Ash Layer), located north of Landslide Butte area, Montana, USA; it contains the abundant remains of *Hypacrosaurus* nesting horizons, with thousands of nests, hundreds of embryonic and neonate bones and countless eggshell fragments (pp. 71-72). C.W. Gilmore had previously used this layer as a datum, but thought the eggshell were freshwater clam remains. The site is huge, at least 1 mile (1.6 km) long and at least 1/4 mile (about 0.4 km) wide. lt is believed a volcanic ashfall originating from what are now called the Adell Mountains in west-central Montana covered the eggs and hatchlings and smothered them. Apparently older animals were able to walk away to safety (p. 73).

2. Unnamed site(s), located in the Blacktail Creek area, Montana, USA. *Hypacrosaurus* and *Troodon* eggs, babies and embryos (p. 104).

3. Egg White Site, located in the Milk River Badlands, northern Montana, USA. Lambeosaurine partial nest of eggs (p. 118).

4. Long Time Waiting. Milk River Badlands, northern Montana, USA. Lambeosaurine nests, (pp. 131-133).

5. Eggroll Site, Milk River Badlands, northern Montana, USA. Lambeosaur nest, pp. 131-133 (nest with 18-19 clustered eggs is figured

on p. 133).

Includes comments on Horner's visit to a White Pelican *Pelecanus erythrorhynchos* nesting colony, in Bowdoin National Wildlife Refuge, Montana, USA. Bones and carcasses of Pelicans in various stages of decay were seen; all were from juveniles, no adult skeletal remains were observed, pp. 139-140. Comparisons of this extant locality to Horner's fossil hadrosaur nesting grounds and baby hadrosaur bonebeds are made.

The hadrosaur *Edmontosaurus* lived in huge herds numbering in the thousands (p. 206); a *Pachyrhinosaurus* bonebed in Alberta, Canada contains the remains of at least a thousand animals, (p. 206) [this bonebed is located at Pipestone Creek, S.W. of Grande Prairie, Alberta- DHT]. The role of disease, introduced by immigrant dinosaurs from Asia is briefly discussed, (p. 216). Fossil blood and DNA studies in *Tyrannosaurus* are mentioned (p. 228); see entries under Schweitzer for specific details. Format: Popular. [DHT]).

____ and Gorman, J. 1985. Maia- A Dinosaur Grows Up. Museum of the Rockies, Bozeman, 31 pp.

(In this dinosaur book for children, the life story of a hadrosaurine hadrosaur (*Maiasaura peeblesorum*) is portrayed. The hatchling named "Crooked Leg" is factual, based on a pathological metatarsal; see Carpenter, 1999. Format: Popular. [DHT]).

____ and ____ 1988. Maia- A Dinosaur Grows Up. Star Classic Video, Running Press Video Group, Inc. Narrated by Judd Hirsch, illustrated by Doug Henderson, 30 minutes.

(A VHS video account of the Horner and Gormans 1985 book noted above, also produced for a juvenile audience. "Crooked Leg" also had a crooked tail, having hatched out of the egg that way. Of 20 eggs that hatched, two of Maia's littermates died of an unspecified sickness, 10 others died of predation or unspecified fates. Hypothetically, "Crooked Leg" lives at least one year, despite his handicaps. Also during the first year of his life, Maia accidently bites the end of his tail, during a scramble for food introduced into the nest by the mother. [DHT] Format: Popular Fiction (Childrens).

____ and Lessem, D. 1992. Digging Up *Tyrannosaurus rex*. Simon and Schuster, New York. 36 pp.

(Mention of no visible paleopathology on the new MOR *T. rex* skeleton collected from the Upper Cretaceous Hell Creek Fm. of Montana, USA. Format: Popular).

____ and ____ 1993. The Complete *T. rex*. Simon and Schuster, New York. 239 pp.

(A healed leg fracture in an MOR *Tyrannosaurus* specimen is implied from a histological thin section. Also, another example of continued widespread and improper usage of the term "arthritis" as being a common ailment in dinosaurs. Mention of possible healed caudal neural spine fracture in the hadrosaur *Edmontosaurus* incurred by a failed *Tyrannosaurus rex* predation attempt; see Carpenter, 1988a, 1998 (2000). Format: Popular. [DHT]).

____ and Makela, R. 1979. Nest of Juveniles Provides Evidence of Family Structure Among Dinosaurs. Nature, 282:296-298.

(Mass mortality of 15 juvenile (total length 1 meter each) Late Cretaceous hadrosaurs *Maiasaura peeblesorum*. Remains of 11 were found in a nest which formed a bowl-like structure and 4 more were found out of the nest about 2 meters away. All remains were found in a disarticulated condition. Illustrated. [DHT]).

Hotton, N. 1963. Dinosaurs. Pyramid Publications, New York, 192 pp.

(General comments acknowledging the occurrence of paleopathological conditions in dinosaurs (unspecified as to type(s)). Format: Popular).

Hoyle, F. , and Wickrama Singhe, N.C. 1978. Diseases From Space. J.M. Dent and Sons, Ltd.

(NOT SEEN. NOT INDEXED. Relevant?).

Hsu, K.J. 1980. Terrestrial Catastrophe Caused by Cometary Impact at the End of the Cretaceous. Nature, 285:201-203.

(Speculates that the extinction of "large land animals" [ie. dinosaurs] at the end of the Cretaceous occurred when they suffered total mass mortality [ie. extinction] due to a comet overheating the Earth's atmosphere upon entry. [DHT]).

Huene, F. von 1907-1908. Die Dinosaurier der Europaischen Triasformation mit Berucksichtigung der Aussereuropaischen Vorkommnisse. Geol. Palaeont. Abh., Suppl. 1:1-419. Jena.

(NOT SEEN. NOT INDEXED. See Galton, 1998).

____ 1928. Lebensbild des Saurischier-Vorkommens im Obersten Keuper von Trossingen in Wurttemberg. Paleobiology, 8:103-116.

(NOT SEEN. NOT INDEXED. Drought-related mass mortality, dinosaurs, Plateosaurus. Language: German).

Hunt, A.P. 1986. Taphonomy of the Cleveland-Lloyd Dinosaur Quarry, Morrison Formation (Late Jurassic), Emery County, Utah: A Preliminary Report. (Abstract). 4th North Amer. Paleo. Conv., Abstracts with Programs:A21.

(Suggests catastrophic origins for this predator-rich [*Allosaurus*] site. See Richmond and Morris, 1996 who suggest that the animals were bogged down in sticky, smectitic mud. Unillustrated. [DHT]).

____ and Lucas, S.G. 1998. Tetrapod Ichnofaunas from the Lower Cretaceous of Northeastern New Mexico, USA. pp. 163-168. In: Lower and Middle Cretaceous Terrestrial Ecosystems. Edited by S.G. Lucas, J.I. Kirkland and J.W. Estep. New Mex. Mus. Nat. Hist. Sci., Bull. 14. iv + 330 pp.

(Includes mention on page 167 of the documentation of an ornithopod trackway (*Caririchnium leonardii*) showing a limping animal; see Lockley, Hunt, Moratalla and Matsukawa, 1994 and Lockley and Hunt, 1995. Evidence of tail-dragging as manifested by a longitudinal furrow associated with tracks could be the result of ".... facilitation of balance in a wet and slippery substrate or a pathology." The latter specimen was described by Gillette and Thomas, 1985. Neither specimen is illustrated in this paper. [DHT]).

Hutt, S., Martill, D.M. and Barker, M.J. 1996. The First European Allosaurid Dinosaur (Lower Cretaceous, Wealden Group), England. N. Jb. Geol. Palaont. Mh., 1996(10):635-644.

(NOT LISTED IN PATHOLOGY INDEX. *Neovenator saleri*. Osteopathy not described or illustrated. However, the type specimen has numerous paleopathologies- midcaudal vertebrae fusion, healed fracture of mid-caudal vertebra transverse process; osteophytes affecting pedal phalanges; healed gastralia rib fractures, some forming false joints; early ?DISH development affecting distal caudal vertebrae; scapula fracture. See Cooper, D. [DHT]).

I

Irwin, A. 1998. Ancient DNA Ideas Fail To Pan Out. The Calgary Herald, Saturday, March 7, 1998:B15.

(Popular discussion on the failure to confirm the real presence of ancient DNA, including that of dinosaurs. The oldest DNA was recovered from a 50,000 year old Siberian mammoth. Early studies believed fossil DNA would be present and deliver incredible results. As one researcher puts it: "The mood was one of over-optimism." [DHT]).

Isaacs, W.A., Little, K., Currey, J.D., and Tarlo, L.B.H. 1963. Collagen and Cellulose-like Substance in Fossil Denture and Bone. Nature, 197:192.

(Upper Triassic (200 million years BP) prosauropod bone and dermal armour of Devonian ostracoderms were decalcified and examined with the electron microscope and electron diffraction. Electron micrographs revealed a fibullar structure which, on electron diffraction, showed a collagen pattern).

Ishigaki, S. 1986a. Morocco no Kyouryu. [The Dinosaurs of Morocco]. Tsukiji Shokan, Tokyo, 261 pp.

(Trackway of a small theropod showing an individual with an injured hind foot. From the trackway, it is evident that the animal was limping when it walked. See also Ishigaki, 1986b, 1988; Dantas, dos Santos, Lockley and Meyer, 1995. Language: Japanese. [DHT]).

____ 1986b. Dinosaur Footprints of the Atlas Mountains. Nature Study (Japan), 32(1):6-9.

(Limping dinosaur as exemplified in a mid-Jurassic theropod trackway from Morocco. It was first reported by Jenny and Josen, 1982. The external toe (digit IV) on the right pes is not angled outwards properly and is closely appressed to digit III. Language: Japanese; English translation available. See also Ishigaki, 1986a, 1988, Lockley, 1991, Lockley, Hunt, Moratalla and Matsukawa, 1994; Dantas, dos Santos, Lockley and Meyer, 1995. [DHT]).

____ 1988. Les Empreintes de Dinosaures du Jurassique Inferier du

Haut Atlas Central Marocain. [Dinosaur Footprints of the Lower Jurassic of the Atlas Mountains of Central Morocco]. Notes Serv. Geol. Maroc, 44(334):79-86.

(Includes figure (fig. 16), and brief description of small theropod trackway showing signs of a limping small theropod with an injured foot. See Ishigaki, 1986a, b). Language: French; English translation of relevant tracts available. [DHT]).

____ 1989. Footprints of Swimming Dinosaurs from Morocco. pp. 81-86. In: Dinosaur Tracks and Traces. Edited by D.D. Gillette and M.G. Lockley. Cambridge University Press, Cambridge. xvii + 454 pp.

(Middle Jurassic sauropod trackway (manus prints only) from Morocco (fig. 9.3), showing alternation of long and short steps, suggesting injury and limping. See Lockley and Rice, 1990, Lockley, Hunt, Moratalla and Matsukawa, 1994; Dantas, dos Santos, Lockley and Meyer, 1995. [DHT]).

J

Jackson, F.D., Solomon, S.E. and Varricchio, D.J. 1998. Pathological Eggshell: New Implications for Dinosaur Research. (Abstract). Jour. Vert. Paleo., 53A.

(A pathological condition consisting of closely adhering multiple eggshell layers has been described in dinosaur and modern testudine eggs. Based on this condition, previous authors hypothesized a "reptilian-like" reproductive system in the Dinosauria. This hypothesis, however, depends on the comparison of two phylogenetically distant taxa, turtles and dinosaurs, and incorrectly assumes the absence of this condition in modern birds. We report here the occurrence of multilayered eggshell in modern bird eggs.

A wide range of pathological conditions exist in avian eggs depending on the region of the oviduct where retention occurs and whether reverse peristalsis forces the egg back up the oviduct. Retention in the shell gland, without reverse peristalsis, results in secretion of a second shell layer over the primary layer, but without the additional yolk and albumen found in ovum in ovo . The length of the retention determines the thickness of this pathological layer.

Although significant differences exist in the reproductive tracts of turtles and extant birds, multiple layering occurs in both taxa. Pathological eggshell, therefore, provides no evidence of a "reptilian-like" reproductive system in dinosaurs. [Author's abstract]).

____, Garrido, A.C. and Loope, D.B. 2001. Sauropod Egg Clutches Containing Abnormal Eggs from the Late Cretaceous of Patagonia: Clues to Reproductive Biology. (Abstract). Jour. Vert. Paleo., 21(3):65A.

(An abnormality often reported in dinosaur eggshell consists of an unusually thick shell, with two or more superimposed layers. This condition is primarily reported in isolated eggshell fragments, but rarely *in situ* egg clutches. A similar condition occurs in the rigid-shelled eggs of some extant amniotes and results from egg retention by the female, a result of environmental or physiological stress.

A new dinosaur nesting locality from the Anacleto Formation of Patagonia, Argentina, has produced the first eggs containing Titanosaur embryos. A survey of over 300 partial, *in situ* egg clutches conducted during the 2000 and 2001 field seasons by the Los Angeles County Museum of Natural History and Carmen Funes Museum joint expedition revealed that six clutches contain one or more abnormal eggs. The unusually thick eggshell is comprised of an inner shell of normal thickness and structure, overlain by a thinner layer with an extremely rugose surface. Permineralized eggshell membrane separates some eggshell layers. Thin sections and SEM show that a range of eggshell abnormalities are present. This range is expressed in the same clutch and even within an individual egg.

The presence of both normal and abnormal eggs within the same sauropod clutch offers possible clues to sauropod reproductive anatomy. An archosaurian mode of reproduction distinguishes living crocodilians and birds from other sauropsids and supports the use of phylogenetic bracketing for inferences regarding dinosaur reproductive biology. However, caution is warranted. The range of morphological conditions found in the same sauropod clutch encompasses the spectrum of abnormalities found in eggs of both extant birds and other reptiles. This suggests that physiological inferences based on eggshell anomalies should be made carefully. [Author's abstract]).

Jacobs, L. 1993. Quest for the African Dinosaurs - Ancient Roots to the Modern World. Villard Books, New York. xviii + 314 pp.

(Includes mention on page 264 of the documentation of a limping dinosaur trackway at locality KB-17, Koum Basin, Cameroon. It is not specifically stated what type of dinosaur made the trackway. Trackway unillustrated. Format: Popular. [DHT]).

Jacobsen, A.R. 1995a. Predatory Behavior of Carnivorous Dinosaurs: Ecological Interpretations Based on Tooth Marked Dinosaur Bones and Wear Patterns of Theropod Teeth. Judith River Group (Upper Cretaceous, Campanian, Alberta, Canada). Cand. scient. thesis, University of Copenhagen, Denmark.

(The fossil material utilized in this study was recovered from the Late Cretaceous deposits of Dinosaur Provincial Park, Alberta, Canada. The thesis includes comments on the frequency of fractured teeth in Late Cretaceous tyrannosaurids, see pp. 39-40, 65-66. These would be damaged during feeding when the teeth were striking the prey bone with great force causing the tooth tip to fracture or spall off with varying severity. Many teeth so damaged were evidently retained in the jaws long after being broken and show subsequent wear facets. In her study, Jacobsen observed that 29% of randomly collected tyrannosaurid teeth in Royal Tyrrell Museum collections showed evidence of fracturing with subsequent wear facets developed. [This seems like an artificially high number based on broken and unbroken specimens I have observed in the field in Dinosaur Park- DHT]. The anterior edge of the tooth was usually affected. Several affected specimens are illustrated in this thesis. 7 of 332 tyrannosaurid bones examined also showed predator toothmarks, p. 64, but "this does not necessarily give evidence of cannibalism among tyrannosaurs. Rather, this reflects a great variety in the food items of tyrannosaurids," p. 73. Toothmarked tyrannosaurid teeth are ascribed to intraspecific fighting (*sensu* Tanke and Currie, 1995; 1998 (2000). A pterosaur (flying reptile) *Quetzalcoatlus* bone bears an embedded *Saurornitholestes* (small theropod) tooth which showed fracturing incurred well before becoming embedded and lost in the pterosaur bone, p. 67; see also Currie and Jacobsen, 1995; Jacobsen, 1998. [DHT]).

____ 1995b. Ecological Interpretations Based on Theropod Tooth Marks: Feeding Behavior of Carnivorous Dinosaurs. (Abstract). Jour. Vert. Paleo., 15(3):37A.

(Includes the observation of Late Cretaceous tyrannosaurid toothmarks on bones of conspecifics [examples of cannibalism?] and the small theropod *Saurornitholestes*, among other prey. See Jacobsen, 1998. [DHT]).

____ 1996. Wear Patterns on Tyrannosaurid Teeth: An Indication of Biting Strategy. (Abstract). Jour. Vert. Paleo., 16(3):43A.

(706 unspecified tyrannosaur [*Gorgosaurus* or *Daspletosaurus]* teeth from the Campanian Dinosaur Park Formation, Alberta, Canada in TMP collections were examined. 383 of these were either broken in the mouth (tip chipped off, or tooth snapped off near its' base) during heavy usage or showed wear facets. Of the 383 teeth, 49% had anterior wear facets, 29% were broken, 25% had lingual wear facets, 20% had posterior wear facets and 4% had labial wear facets. A few teeth had more than one wear facet. [Author's abstract; in part]. [DHT]).

____ 1998. Feeding Behavior of Carnivorous Dinosaurs as Determined by Tooth Marks on Dinosaur Bones. Hist. Biol., 13:17-26.

(Includes comments on tyrannosaurid toothmarks found on tyrannosaurid bones. Of 1,000 catalogued dinosaur bones examined for toothmarks in TMP collections (most collected from Dinosaur Provincial Park (DPP), Alberta), 2% were tyrannosaur, compared with 14% hadrosaur and 5% ceratopsian (most of the latter collected from mass mortality bonebeds were scavenging on carcasses increases the chances of toothmark preservation). Cannibalism in tyrannosaurs of DPP cannot be established as several tyrannosaurid genera were contemporaneous and interspecific predation among tyrannosaurs could have occurred. Alternatively, intraspecific biting behavior could also cause toothmarking. Illustrated. [DHT]).

Jain, S.L. 1986. Recent Dinosaur Discoveries in India, Including Egg Shells, Nests and Coprolites. (Abstract). p. 17. First Intern. Symp. Dinosaur Tracks Traces, Edited by D.D. Gillette, Albuquerque.

(Possible pathological Upper Cretaceous dinosaur eggshell material from Gujarat, India. See Jain, 1989. Unillustrated. [DHT]).

____ 1989. Recent Dinosaur Discoveries in India, Including Eggshells, Nests and Coprolites. pp. 99-108. In: Dinosaur Tracks and Traces. Edited by D.D. Gillette and M.G. Lockley. Cambridge University Press, Cambridge. xvii + 454 pp.

(One dinosaur nesting locality covers an area about 20 square km and all eggs appear unhatched- mass mortality? Pathological dinosaur

eggs with double-layered spheroliths were recovered from the Kheda district, Gujarat, India and are Late Cretaceous in age. Other eggshell material is quite thin, but it cannot be determined with certainty whether this is a pathological trait or not. Pathologic eggshell illustrated. See also Mohabey, 1984. [DHT]).

Janensch, W. 1929. Die Wirbelsaule der Gattung *Dicraeosaurus*. [The Vertebral Column of the Genus *Dicraeosaurus*]. Palaeontographica Suppl. VII(1)teil 2, lief.1:37-133.

(NOT SEEN. NOT INDEXED. Has paleopathology? Language: German).

____ 1934. Eine Halbseitige Uberzahlige Wirbelbildung bei einem Dinosaurier. [A Half-Sided Excess Vertebral Formation in a Dinosaur]. Sitz.-Ber. Ges. Naturf. Freunde, 1934:458-462.

(Describes and figures an unusual isolated dorsal vertebral centrum of the Upper Jurassic dryosaur *Dysalotosaurus* [now *Dryosaurus*] *lettowvorbecki*. The vertebra came from a juvenile individual and unfortunately the neural arch was not fused to the centrum. The right side of the centrum appears normal, but the left side preserves two centra, complete with two anomalous neural arch bases, which would, presumably, have carried two ribs. Similar anomalies have been observed in embryologic snakes and are believed to be caused by stresses on the tension side of the coiled up vertebral column (with subsequent repair) while still within the egg. See Tornier, 1902. Language: German; English translation available. [DHT]).

Janke, P.R. 1996. Report From *Rex*burg - The *Tyrannosaurus rex* Capital of the World. Found on Internet on Feb. 11, 1999 at: http://www.wmnh.com/wmrexbrg.htm

(Briefly mentions potential of Late Cretaceous *Tyrannosaurus* specimens for pathological research. [The skull of the Black Hills Institute specimen "Stan" is figured, note the anomalous openings in skull, especially affecting the right jugal and surangular. These openings might represent healed intraspecific bite trauma]. Format: Popular. [DHT]).

Jenny, J. and Josen, J.-A. 1982. Decouverte d'Empreintes de pas de Dinosauriens dans le Jurassique Inferier (Pliensbachien) du Haut-Atlas Central (Maroc). [Discovery of Dinosaur Foot Prints in the Lower Jurassic (Pliensbachien) of the Central High-Atlas (Morocco). C.R. Acad. Sci. Paris, 294(II):223-226.

(Dinosaur tracks have been newly discovered in the Pliensbachian Aganane Formation. This is the first evidence of dinosaurian life to have been found in this stratigraphic level in Africa. Tridactyl and ovaloid foot prints are found in tidal flat deposits. A footprint of a small bipedal carnivore shows an animal with a foot pathology. In this case, instead of the tridactyl foot having the toes more or less equally spread, digits lll and lV are held close together. See also Ishigaki, 1986 and Lockley, Hunt, Moratalla and Matsukawa, 1994 for additional descriptions and discussions. [DHT]. Language: French (with English abstract)).

Jerzykiewicz, T. 1989. 1988 Sino-Canadian Dinosaur Project Expedition Successful in Inner Mongolia. Geos, 18(4):1-6.

(Mass mortality of 6 Late Cretaceous *Pinacosaurus* and 5 *Protoceratops* due to suffocation by sandstorms; see Jerzykiewicz, 1998. Illustrated. Language: English and French. [DHT]).

____ 1998. Okavango Oasis, Kalahari Desert: A Contemporary Analogue for the Late Cretaceous Vertebrate Habitat of the Gobi Basin, Mongolia. Geosci. Canada, 25(1):15-26.

(Includes comments on mass mortality of unspecified eggs and dinosaurs (*Protoceratops*, ankylosaurs [*Pinacosaurus*]) from being suffocated by wind-blown sand or buried by silt-laden flood waters (see Loope et al., 1998). A photograph of the celebrated "fighting dinosaurs" *Velociraptor* vs. *Protoceratops*) is presented. [DHT]).

____, Currie, P.J., Eberth, D.A., Johnston, P.A., Koster, E.H. and Zheng, J.J. 1993. Djadokhta Formation Correlative Strata in Chinese Inner Mongolia: An Overview of the Stratigraphy, Sedimentary Geology, and Paleontology and Comparisons with the Type Locality in the Pre-Altai Gobi. Can. Jour. Earth Sci., 30:2180-2195.

(Includes mention of the mass mortality of no less than 13 Late Cretaceous juvenile armoured dinosaur *Pinacosaurus* which were overwhelmed and buried (still standing upright) in a strong Cretaceous sandstorm. [DHT]).

Ji, Q. and Ji, S. 1996. On Discovery of the Earliest Bird Fossil in China and the Origin of Birds. Chinese Geol., 233:30-33.

(NOT SEEN. NOT INDEXED. Cited in Dal Sasso and Signore, 1998 as including descriptions of soft tissue preservation in a small theropod. [DHT]).

Johnson, H. and Storer, J.E. 1974. A Guide to Alberta Vertebrate Fossils from the Age of Dinosaurs. Prov. Mus. Alta., Pub. No. 4, 129 pp.

(Several specimens figured in this popular fossil identification guide appear to be pathological. Figure 117 (p. 111) of a ceratopsian mid-caudal vertebra appears to show osteophytic development. Figure 122 (p. 115) also shows similar development on a ceratopsian phalanx. The present whereabouts of these specimens is unknown. Format: Popular. [DHT]).

Johnson, J. 1991a. Ancient DNA Gives Up Its Secrets. New Sci., 129(1759):24.

(Dinosaur DNA possibilities. Format: Popular. [DHT]).

____ 1991b. The Oldest DNA in the World. New Sci., 130(1768):44-48.

(Dinosaur DNA possibilities. Format: Popular. [DHT]).

Johnson, K.R. and Stucky, R.K. 1995. Prehistoric Journey - A History of Life on Earth. Roberts Rinehart Publishers, Boulder, Colorado USA. 144 pp.

(Includes mention of the *Coelophysis* mass mortality bonebed in New Mexico, USA (p. 65). Intraspecific strife in the pachycephalosaurid *Stygimoloch* is reconstructed in a painting on pages 80-81. The *Edmontosaurus* figured on pages 88-89 has a pathological anterior blade of the left ilium and neural spine trauma just anterior to the mid-point of the tail. Carpenter (1998) ascribed this trauma to the bite of a *Tyrannosaurus*. A painting of this animal with the healed tail trauma is presented on pages 90-91. Format: Popular. [DHT]).

Johnson, R. 1989. Preliminary Comments on the Reconstruction of a New Specimen of *Torosaurus*, with Notes on a Revision of the Genus and the Biomechanics of the Forelimb. (Abstract). Jour. Vert. Paleo., 9(3):27A.

(Mention of a puncture wound in the left squamosal of this Hell Creek Formation (Maastrichtian) specimen from northeastern Montana, USA. Intraspecific agonistic behavior is suggested as the cause of this injury. See also Johnson and Ostrom, 1995. [DHT]).

____ and Ostrom, J.H. 1995. The Forelimb of *Torosaurus* and an Analysis of the Posture and Gait of Ceratopsian Dinosaurs. pp. 205-218. In: Functional Morphology in Vertebrate Paleontology. Edited by J. Thomason. Cambridge University Press, Cambridge.

(The Milwaukee Public Museum (Milwaukee, Wisconsin, USA) exhibit of the rare Late Cretaceous *Torosaurus cf. latus* specimen includes a partial skull. Johnson, 1989 and more specifically, this paper, describe cranial paleopathology "....in the form of a healed puncture wound and companion "stress fracture" on the anterolateral surface of the left squamosal." Such "extra fenestrae or fontanelles" in ceratopsian frills are regularly associated with intraspecific fighting and healed horn thrust injuries. Curiously, the image presented in this paper shows the large, oval-shaped lesion positioned high up on the right squamosal- not the left. Perhaps the negative was printed backwards. [DHT]).

K

Kaiser, H.E. 1952. Die Entwicklung der Osteomyelitis seit dem Perm. [The Evolution of Osteomyelitis Since the Permian]. Monatsch. Vet.-Med., 7(14):275-279.

(A largely rambling discussion which includes cases of osteomyelitis and other bone conditions since the Permian, starting with examples in the American pelycosaur *Dimetrodon*, which represent osteopathy secondary to a bone fracture. Staphylococcal infection was implicated. Fusion of the caudal vertebrae of the Upper Jurassic sauropod *Apatosaurus* (ex "*Brontosaurus*") are associated to an osteomyelitic condition; although more recent studies [see Rothschild and Berman, 1991] have determined this fusion to actually represent DISH (diffuse idiopathic skeletal hyperostosis]. Osteomyelitis of a metatarsal in an Early Quaternary hippopotamus *Hippopotamus amphibius* is described an illustrated. Osteomyelitis of various bones of the Pleistocene cave bear *Ursus spelaeus* are also considered. [DHT]). Language: German: English translation available. [DHT]).

____ 1954a. Pathologische Erscheinungen an Knochen der Saurischier und Ornithischier (Dinosaurier). [Pathological Manifestations on the Bones of the Saurischians and Ornithischian (Dinosaurs)]. Zbl. Allg. Path. Path. Anat., 91:196-213.

(NOT SEEN. NOT INDEXED. Language: German).

____ 1954b. Eine Rippe mit Pathologischen Erscheinungen des Sauropoden *Brachiosaurus brancai* Janensch, dem Grossten Saurischier (Dinosaurier) des Tendagurumaterials aus dem Jungeren Jura. [A Rib with Pathological Manifestations of the Sauropod *Brachiosaurus brancai* Janensch, the Largest Saurischian (Dinosauria) of the Tendaguru Material from the Upper Jurassic]. Monatshefte Vet.-Med., 9(16):373-374.

(Describes healing rib fractures in the Upper Jurassic sauropod *Brachiosaurus*, collected from Tendaguru, Africa. Language: German; English translation available. [DHT]).

Kappleman, J. 1998. Lasers, Hi Res X-Ray CT, Hard Copy Output and Animations for Visual Laboratories, Multimedia Exams and Research. (Abstract). Jour. Vert. Paleo., 18(3):54A-55A.

(Advances in new technologies now make it possible to digitize the three-dimensional coordinates of nearly any specimen studied by vertebrate paleontologists. Commonly used instruments include a variety of laser scanners as well as conventional and high resolution X-ray CT and MRI. Laser scanners record topographic coordinates of the surface of the specimen by using either CCD cameras to digitize single contours of the specimen, or digitize individual points. Conventional medical CT has witnesses broad use in vertebrate paleontology but its application has been limited by its generally low energy levels and low resolution. High resolution CT offers a higher energy level which penetrates densely mineralized fossils, and provides a slice thickness between 10x — 100x finer than that of conventional CT which permits the imaging of tiny structures. Advances in a variety of reverse engineering technologies now make it possible to produce 3-D printouts of these datasets. These technologies are especially useful for reconstructing fragmentary fossils.

Once a 3-D dataset is acquired, off-the-shelf imaging and animation software can be used to produce detailed views of the specimen. Animations can range from slice by slice images to simple rotations of the rendered object (or selected parts of it). It is possible to produce mother more complex animations such as joint movements or the muscle contractions associated with joint movements. These sorts of animations are especially useful in the classroom and can be used to build virtual laboratories and multimedia exams. [Author's abstract]).

Kawakami, G. 1996. Report on the Study at the Royal Tyrrell Museum of Palaeontology, Alberta, Canada. Bulletin of the Hobetsu Museum, 12:9-15.

(Includes a photograph (figure 5) of the dinosaur paleopathology exhibit at the Royal Tyrrell Museum. This consists of a small case showing a normal hadrosaur proximal caudal neural spine and another with a healing fracture showing callus development; and a normal ornithomimid dinosaur pedal phalanx compared to a pathologic one showing a pathological "mushroomed" distal end of unknown etiology [infectious?]. Language: Japanese; with English abstract. Illustrated. [DHT]).

Kaye, T. 1997. Personal Communication to Senior Editor DHT, February 26, 1997.

(American amateur paleontologist Mr. Tom Kaye reports on asymmetry of the orbital horns of a Late Cretaceous *Triceratops* partial skull collected from the Hell Creek Formation near Lewistown, Montana, USA. One orbital horn is 24 inches long while the other is 31 inches in length. The specimen is now in the Field Museum, Chicago, Illinois, USA. [DHT]).

____ 1998. A New Theory on Mid Caudal Fusion in Sauropods. (Abstract). pp. 29-30. In: The DinoFest Symposium. Edited by D.L. Wolberg, K. Gittis, S. Miller, L. Carey and A. Raynor. The Academy of Natural Sciences, Philadelphia, Pennsylvania. April 17-19, 1998.

(It has long been known that *Diplodocus*, *Apatosaurus* and *Camarasaurus* often exhibit fusion of mid caudal vertebrae [diffuse idiopathic skeletal hyperostosis; *sensu* Rothschild and Berman, 1991]. Previous theories have proposed that tripodal stance, sexual function or other injury may be responsible for this feature. These conclusions have been called into question by recent examinations using X-rays and CAT scans.

It is well understood that a wide variety of living animals use a lateral motion of the tail as part of their natural gait. This theory examines swing dynamics and the resulting kinetic energy profile along the tail in dinosaurs. The mass of a sauropod tail decreases distally while the speed of lateral motion increases. The tail, when carefully measured dorsoventrally and laterally, is not a smooth taper but reduces in stages defined by the changing morphology of the transverse processes and chevrons. Incorporating a simple formula using tail mass estimated from diameter times velocity along many points on the swinging tail produces kinetic energy profile. This energy profile is not constant but peaks in different areas along the length, closely corresponding to the observed points of fusion. Vertebral fusion would theoretically cause this section to become less flexible by dissipating the energy further up and down the tail thereby smoothing out the energy profile. Subsequent construction of a mechanical model shows a higher flex angle in the same central area of the tail. Evaluation of other dinosaurs lacking fused vertebrae show a smooth energy distribution in the central tail region. The correlation of the peak energy with the location of caudal fusion suggests a plausible mechanical basis for the incidence of this trait in sauropods. [Author's abstract; with minor addition]).

Kellner, A.W.A. 1996. Fossilized Theropod Soft Tissue. Nature, 379:32.

(Unidentified Early Cretaceous small theropod remains from the Santana Formation of northeastern Brazil with phosphatized soft tissue preservation. Skin, nails, and striated muscle fibers were preserved in exquisite detail. There was no indication of feathers, scales or dermal ossicles. The absence of feathers (which apparently should have been present in the fossil specimen if they were there in life) flies in the face of some recent small theropod reconstructions showing a feathered body covering. This locality is famous for its fossil fish with soft tissue preservation (even fish with ectoparasites preserved in perfect detail). This new specimen allows us to examine details of dinosaur anatomy only dreamed of previously. Illustrated. [DHT]).

Kerourio, P. 1981. La Distribution Des "Coquilles D'Oeufs de Dinosauriens Multistratifiees" Dans le Maestrichtien Continental du Sud de la France. [The Distribution of Multistratified Dinosaur Eggshells in the Continental Maestrichtian of Southern France]. Geobios, 14:533-536.

(The study of the numerical importance and the distribution of dinosaurian multilayered eggshells, in the various continental Maestrichtian levels of southern France, make us declare that this type of pathological development must not be regarded, since it is very rare, as an element explaining the dinosaurian extinction at the end of the Cretaceous. [Author's abstract]. Language: French; English translation available).

Kielan-Jaworowska, Z. 1969. Hunting for Dinosaurs. MIT Press, Cambridge, Massachusetts. 177 pp. (Translated from the Polish version: Polowanie na Dinozaury).

(Multi-year expedition by Polish paleontologists to Mongolia in the mid 1960's. Includes several items of interest. A Late Cretaceous tyrannosaur *Tarbosaurus* skeleton showed the head to be pulled strongly backwards. It is stated: "Dead camels are often found in the desert in the same posture of agony, head thrown back and legs drawn up," p. 54. A photograph of the prepared tarbosaur specimen is shown on page 57. Another tarbosaur showed this body position, p. 158. One specimen of a younger tarbosaur being excavated in the field shows a tightly curved tail, p. 74. A Late Cretaceous ornithomimid also showed this characteristic "head thrown back" posture, p. 61. [Tyrannosaur and ornithomimids from Alberta, Canada are often found in this characteristic pose too]. The Nemegt Valley dinosaur fauna "were probably deposited by floods which caused mass slaughters [=mass mortality] of dinosaurs," p. 132. [DHT]).

____ and Barsbold, R. 1972. Narrative of the Polish-Mongolian Palaeontological Expeditions 1967-1971. Paleontol. Polonica, 27:5-13.

("Fighting" Late Cretaceous dinosaurs, predator *Velociraptor* and prey *Protoceratops*; locked together in mortal combat. See Barsbold, 1974, Osmol-ska, 1993; Maxwell and Ostrom, 1995; Unwin, Perle and Trueman, 1995).

Keiran, M. 1999. Discoveries in Palaeontology - *Albertosaurus* - Death of a Predator. Raincoast Books, Vancouver, B.C. 56 pp.

(Book on TMP91.36.500, a virtually complete skeleton of a subadult *Gorgosaurus libratus* co-found by the senior editor and Dr. Philip Currie. It was collected during the 1991 field season from Quarry 200 in the Late Cretaceous (Campanian) Dinosaur Park Formation of Dinosaur Provincial Park, Alberta, Canada and recently (February, 1997) installed in the Royal Tyrrell Museum of Palaeontology galleries. The specimen includes a number of interesting paleopathologies, including facial bites (intraspecific fighting), possible well-healed unilateral jaw (dentary) fracture; a mushroom-like hyperostosis of a right pedal phalanx (see p. 36; bone in bottom right corner of picture)and a fractured and well-healed (good realignment) right fibula at mid-shaft (see p. 37). The pulled back nature of the head over the pelvis is described on page 45 ands attributed to contraction of powerful neck and back tendons. An interesting color anomaly affecting a jaw lesion can be seen on the book's dust jacket. On the right dentary, at mid-length, a dorso-ventrally yellowish discoloration

can be seen which contrasts with the normal medium brown color. This "halo" of color surrounds to face-bite lesion. The cause of this discoloration is unknown, but might be related to differential bone composition during healing vs. normal bone. Illustrated. Format: Popular. [DHT]).

____ 2001. Discoveries in Palaeontology - *Ornithomimus* - Pursuing the Bird-Mimic Dinosaur. Raincoast Books, Vancouver. 56 pp.

(A virtually complete skeleton (TMP 95.110.1) of *Ornithomimus*, collected from the Campanian Dinosaur Park Formation in Dinosaur Provincial Park, Alberta, Canada exhibits several possible ante-mortem injuries. These do not show healing. Page 47 examines "Cause of Death." On the right side of the body, the humerus is broken at mid-shaft, with the broken ends overlapping each other, as if post-trauma muscle contractions pulled the two pieces together. The scapular blade, just posterior to the glenoid region, has completely broken transversely across the blade and the distal portion (glenoid/coracoid) deflected ventrally. There are several possible causes for these anomalies. One could be postfossilization crushing. Other bones do show this, but the bones themselves are crushed-they are not broken into separate pieces and then deflected or contracted. Another possiblity is that the carcass was stepped on by another dinosaur. However, fragile ribs very close by are not affected, suggesting another cause. The last idea is that the animal was running, slipped and fell, landing on its right shoulder, shattering the scapula and humeral shaft on impact. The animal died soon afterwards. A fictional narrative speculates that the animal was in "pain." Format: Popular. [DHT]).

Kiernan, V. 1993. Cool Response to Dinosaur "DNA." New Sci., 139(1881):5.

(*Tyrannosaurus* blood cells and DNA contained therein are disputed by various geneticists. Contamination from other sources causes the biggest headache for those trying to isolated fossilized DNA samples. [DHT]).

Kindle, E.M. 1919. Inequalities of Sedimentation. Jour. Geol., 19:339-366.

(Suggests that Late Cretaceous dinosaur bonebeds in what is now Dinosaur Provincial Park, Alberta, Canada were caused when famine or accident befell large herds of migrating animals. There is some mention of "animal graveyards;" see Kindle, 1921. [DHT]).

____ 1921. Animal Behaviour as a Factor in the Formation of Bone Beds. Can. Field-Nat., 35(2):33-34.

(Describes several fossil and modern mass death assemblages (flash floods/drowning in ceratopsian dinosaurs and extant cattle *Bos taurus*, buffalo *Bison bison* and guanaco *Lama guanaco*; drought/accidents/fires in American Bison *Bison bison*; starvation/cold in cattle and *Bison bison*) and attempts to correlate these to similar fossil deposits found in the Late Cretaceous of Alberta, Canada. However, Kindle errs in believing modern assemblages are formed by animals moving to a common area when they realize that death is near, or when dying from famine. These "animal graveyards" (witness the elephant graveyard) are legendary but are only myth. Dinosaur bonebeds are formed under much more complex situations (see Currie, 1981; Currie and Dodson, 1984; Ryan et al., 2001). [DHT]).

Kirkland, J.I. 1998. A Polacanthine Ankylosaur (Ornithischia: Dinosauria) from the Early Cretaceous (Barremian) of Eastern Utah. pp. 271-281. In: Lower and Middle Cretaceous Terrestrial Ecosystems. Edited by S.G. Lucas, J.I. Kirkland and J.W. Estep. New Mexico Mus. Nat. Hist. and Sci. Bull. 14.

(Pits on the fused scutes that form the sacral shield of *Gastonia* are speculated to have possibly been formed by the actions of parasites; see figure 8A. Intraspecific head-butting behaviour in this form is also postulated. [DHT]).

Klompen H. and Grimaldi, H. 2001. First Mesozoic Record of a Parasitiform Mite: A Larval Argasid Tick in Cretaceous Amber (Ascari: Ixodida: Argasidae). Ann. Entomol. Soc. Amer. 94:10-15.

(NOT SEEN. 90-94 million year old tick in amber from New Jersey, USA. The tick probably fed on seabirds but the media has championed the idea it fed on dinosaurs).

Knight, H.A. 1984. Carnosaur. Tom Doherty Associates Book, New York, 210 pp.

(Another fictional account of dinosaurs being brought to life through genetic engineering of fossil material. On page 66, is described a captive carnivorous *Megalosaurus* with uncertain physical problems which two zoo keepers erroneously ascribed to an undetermined sickness or a toothache. Format: Science Fiction).

Kohring, R. 1989. Fossile Eierschalen aus dem Garummnium (Maastrichtium) von Bastus (Provinz Lerida, NE-Spanien). Berliner Geowiss., Abh. (A), 106:267-275.

(NOT SEEN. NOT INDEXED. Pathological dinosaur eggs. Language: German).

Kuris, A.M. 1996. Trophic Transmission of Parasites and Host Behaviour Modification in Dinosaur Predator-Prey Dynamics. (Abstract). p. 226. In: 6th North Amer. Paleo. Conv., June 9-12, 1996, Washington. Edited by J.E. Repetski.

(Considering the large terrestrial dinosaurs of the Jurassic and Cretaceous periods, an ecological problem is evident. Did the very large herbivores fall prey to the large carnivores? If they did, how did the carnivores capture such prey? A key ecological principle in extant communities is pertinent here. Across all ecosystems, even the most efficient individual predators can kill prey that weigh only about twice their own weight. The large adult sauropods apparently reached weights of up to 90,000 kg. The largest predator, *Tyrannosaurus rex* weighed perhaps 6,000 kg. Could the large herbivores have been subdued by such a puny predator? Two hypotheses have been offered to address this issue. A third testable hypothesis is proposed here. 1) Social hunting extends by about one order of magnitude the size of prey that can be captured. 2) Adults of the largest sauropods may have had a refuge in size from predation. Death would have released these dinosaurs to carrion feeders. 3) I propose that large herbivorous dinosaurs were often infected with larval parasites that passed to their final hosts (carnivorous dinosaurs) via trophic transmission and that the behaviour of these parasitized large herbivores was modified so as to significantly increase their susceptibility to predators. This third hypothesis is based on three ecological principles that operate in present-day predator-prey dynamics. Firstly, herbivores are often infected with larval parasites. Secondly, these parasites are usually trophically transmitted to predator final hosts. Thirdly, these parasites often induce behaviour modifications of the intermediate hosts as to greatly increase their susceptibility to predators. All three hypotheses are potentially testable using the fossil record. Additional relevant features of parasite dynamics in dinosaur communities will be discussed. [Author's abstract]).

L

Labandiera, C. C. 1998. The Role of Insects in Late Jurassic to Middle Cretaceous Ecosystems. pp. 105-124. In: Lower and Middle Cretaceous Terrestrial Ecosystems. Edited by S.G. Lucas, J.I. Kirkland and J.W. Estep. New Mex. Mus. Nat. Hist. and Sci. Bull. 14. iv + 330 pp.

(Includes comments on evolution and fossil record of blood-sucking insects. Some of these species may have fed on the blood of dinosaurs; see Borkent, 1995. [DHT]).

Lambe, L. 1902. On Vertebrata of the Mid-Cretaceous of the Northwest Territory 2. New Genera and Species from the Belly River Series (Mid-Cretaceous). Contrib. Can. Paleo., III (2):25-81.

(Description of a wide variety of vertebrate fossils. Although not described as such, Lambe includes the only two confirmed or reported examples of massive dental pathology in hadrosaurs. The specimens, an unassociated maxilla and dentary, were collected August 1 and August 19, 1898 respectively in what is now known as the Dinosaur Park Formation (Campanian) of Dinosaur Provincial Park, Alberta, Canada (Gilmore, 1924:30). They are thus the first collected and illustrated examples of Canadian dinosaur paleopathology. The specimens are figured in Lambe's paper. Both specimens were later studied by Moodie (1930b). [DHT]).

____ 1917. The Cretaceous Theropodous Dinosaur *Gorgosaurus*. Geol. Surv. Canada Mem. 100, iii + 84 pp.

(In this classic description of a single tyrannosaurid skeleton from Quarry 36 in the Dinosaur Park Formation (Late Cretaceous, Campanian) of Dinosaur Provincial Park, Alberta, Canada, Lambe notes several paleopathologies. On pages 78-80: healed fractures were present on the right third dorsal rib, and right thirteenth and fourteenth ventral or gastral ribs (figured on p. 39). Roughened and thickened bone near the distal end of the left fibula, might be a healed bone fracture. Left metatarsal IV has roughened bone surfaces, related to disease. Digit III ungual of the right pes is described as abnormal (small, amorphous) in shape and diseased. The distal articulating end of the penultimate phalanx is similarly affected, but less so. [DHT]).

Lambert, W.D. 1990. The Dinosaur Data Book. Avon Books, New York, 320 pp.

(Page 216 includes a short section on dinosaur paleopathology. A series of 5 fused caudal vertebrae of the sauropod *Diplodocus* are figured and described as having ankylosing spondylitis; [probably DISH]. This fusion would have therefore reduced the effectiveness of the tail as a whip, and so "even non-fatal diseases could indirectly kill." [DHT] This has been rediagnosed as DISH [BMR]. Format: Popular).

Langston, W., Jr. 1961. News from Members. Soc. Vert. Paleo., News Bull., 63:7-9.

(On page 9, in reference to an injured lambeosaurine hadrosaur tail from the Late Cretaceous Judith River Fm. [now Dinosaur Park Fm.] (Campanian) of Dinosaur Provincial Park, Alberta, Canada, Langston states: "The end of the creature's tail had been lost during life and the injury was partly healed and repaired. The last vertebrae which are still some distance from the end of the normal tail are fused into a solid bar of bone," See Sternberg, 1961. [This specimen is now TMP80.23.3, Quarry 126]. [DHT]).

____ 1975. The Ceratopsian Dinosaurs and Associated Lower Vertebrates from the St. Mary River Formation (Maestrichtian) at Scabby Butte, Southern Alberta. Can. Jour. Earth Sci. 12:1576-1608.

(On page 1584, in noting unexplained depressions or pits in the crania of the ceratopsians *Styracosaurus, Centrosaurus,* and *Pachyrhinosaurus,* Langston poses the question that they might be "pathological (?fungal) corrosion and without genetic basis." [DHT]).

____ 1976. A Late Cretaceous Vertebrate Fauna from the St. Mary River Formation in Western Canada. pp. 114-133. In: ATHLON- Essays on Palaeontology in Honour of Loris Shano Russell. Edited by C.S. Churcher. Royal Ontario Museum Life Sciences Misc. Publ., 286 pp.

(Describes the Scabby Butte bonebed in southern Alberta, Canada. Late Cretaceous in age, it is dominated by the hadrosaur *Edmontosaurus* and ceratopsian *Pachyrhinosaurus.* The etiology of this deposit is uncertain, but like other "low diversity" or monospecific bonebeds in the Late Cretaceous of western North America, a mass mortality event seems likely. Illustrated. [DHT]).

Lapparent, A.F. de. 1957. Les Oeufs de Dinosauriens Fossiles de Roussett (Bouches-du-Rhone). [The Eggs of Fossil Dinosaurians of Roussett (Bouches-du-Rhone)]. Comptes Rendus, Acad. Sci., Paris, 245:546-549.

(NOT INDEXED. Pathological dinosaur eggs. Language: French. [DHT]).

____ and Lavocat, R. 1955. Dinosauriens. [Dinosaurians] In: Traite de Paleontologie. [Paleontology Treatise]. Edited by J. Piveteau, Masson, Paris, 5:785-962.

(NOT SEEN. NOT INDEXED. Language: French).

Larger, R. 1917. Theorie de la Contre-Evolution ou Degenerescence par l'Heredite Pathologique. Paris.

(NOT SEEN. NOT INDEXED. Considers the presence of ossified tendons in dinosaurs as evidence of racial degeneration. Language: French).

Larson, P.L. 1991. The Black Hills Institute *Tyrannosaurus* — A Preliminary Report. (Abstract). Jour. Vert. Paleontol. 11(3):41A.

(Late Cretaceous *Tyrannosaurus rex* ("Sue") with healed rib, fibula, humerus, skull and caudal vertebrae fractures and injuries. Unillustrated. [DHT]).

____ 1992. "Sue" Seizure Halts Science, Education. Rapid City Journal, Saturday, May 30, 1992:A4.

(In a "Letter to the Editor" newspaper column, Peter Larson responds and expresses concerns over the recent FBI (Federal Bureau of Investigation) and National Guard seizure of a nearly complete *Tyrannosaurus rex* skeleton (nicknamed "Sue") over some legal issues. The scientific importance of the specimen is related, including the evidence of multiple pathologies: intraspecific "face-biting" and a *Tyrannosaurus* tooth imbedded in one of Sue's infected cervical ribs; and a broken a healed leg, indicating that Sue was cared for by a mate or may have had "tremendous healing power." The seizure of the entire skeleton, manuscripts, photographs, drawings, notes and other research materials severely affects the planned massive interdisciplinary study by scientists worldwide of this rare and unique specimen. [DHT] Format: Semi-Popular).

____ 1994a. *Tyrannosaurus* Sex. pp. 147-157. In: 44th Ann. Geol. Assoc., Wyoming Geol. Assoc., Guidebook. Edited by G.E. Nelson. Casper, Wyoming.

(An interesting paper, where Larson speculates on sexual differences in the Late Cretaceous tyrannosaurid *Tyrannosaurus rex.* Sexually dimorphic pelvic characters are compared to same in extant crocodilians. Females are apparently larger (robust morphotype), with a shortened first chevron, more massive pelvis and robust postorbitals, lacrimal and quadratojugal than the more slender (gracile morphotype) males. There is a brief mention of the broken and healed leg fracture in the "Sue" specimen, and, while not described in the text, healed bite marks to the right posterior cranium and avulsion of the right humerus are figured. See Larson, 1994b, 1995; Fischman, 1993. [DHT]).

____ 1994b. *Tyrannosaurus* Sex. pp. 139-155. In: Dinofest. Edited by G.D. Rosenberg and D.L. Wolberg. The Paleontological Society, Spec. Publ. #7.

(Details as per Larson, 1994a; Fischman, 1993).

____ 1995. To Sex A *Rex*. Nat. Austr., 25(2):46-53.

(The article considers sexual dimorphism in the large Late Cretaceous *Tyrannosaurus rex.* Also includes mention of paleopathology of the *T. rex* specimen named "Sue." The title page painting by Michael Skrepnick shows Sue with lacerated soft tissues below the eye. An improperly healed rib with a "spongy swelling of extra bone" contained a fragment of another *T. rex* tooth. Two crushed caudal vertebrae had fused together. A healing fibula fracture, with a massive callus was also observed. Osteopathy unillustrated. See Larson, 1994; Fischman, 1993. Format: Popular. [DHT]).

____ 1997. The King's New Clothes: A Fresh Look at *Tyrannosaurus rex*. pp. 65-71. In: Dinofest International. Proceedings of a Symposium Held at Arizona State University. Edited by D.L. Wolberg, E. Stump and G.D. Rosenberg. 587 pp.

(Suggests that a *Tyrannosaurus* with a broken leg could not fend for itself and therefore must have been cared for by its mate. Fatal intraspecific fighting is implied from unhealed bites to the left side of the face. Osteopathy unillustrated. [DHT]).

____ 1998. Cranial Morphology, Mechanics, Kinesis, and Variation in *Tyrannosaurus rex*. (Abstract). p. 35. In: The Dinofest Symposium. Edited by D.L. Wolberg, K. Gittis, S. Miller, L. Carey and A. Raynor. The Academy of Natural Sciences, Philadelphia, Pennsylvania. April 17-19, 1998.

(Includes mention that a new *Tyrannosaurus* skull (BHI-3033) nicknamed "Stan" shows pathologies [unspecified]. A cast of this skull at the Academy of Natural Sciences in Philadelphia shows the classic supernumerary holes in numerous skull elements, suggestive of healed tooth puncture trauma inflicted by a conspecific [DHT, pers. observ., 1998]. Unillustrated. [DHT]).

____ 2001a. Pathologies in *Tyrannosaurus rex*: Snapshots of a Killer's Life. (Abstract). Jour. Vert. Paleo., 21(3):71A-72A.

(Pathologies in the skeletons of *Tyrannosaurus rex* provide important information about disease, metabolism, physiology, and behavior. *T. rex* suffered from a variety of afflictions including gout and bacterial infections. Major fractures, healed by rapid bone growth, point to a high metabolic rate for this Late Cretaceous theropod. Caudal "overload" injuries may be attributed to copulation accidents bolstering the theory of the robust morphotype being female. Healed cranial puncture wounds, broken ribs, fused cervical vertebrae injured humeri and a broken fibula show us that *T. rex* was actively involved in intraspecific and interspecific combat typical of an active predator. Major, healed, incapacitating injuries (i.e. to the neck and leg) may point to complex social behavior such as spousal care. [Author's abstract]).

____ 2001b. Paleopathologies in *Tyrannosaurus rex*. Dinopress, 5:26-37 (Japanese text), 6-9 (English translation insert).

(The best illustrated dinosaur paleopathology paper ever, lavishly illustrated with sharp focus, close-up color photographs of the *Tyrannosaurus* popularly known as "Sue," supplemented with another specimen: "Stan" (BHI 3033). The following pathologies are illustrated (S= Sue; ST= Stan): 3 fractured ribs, broken in a series (S); osteomyelitis of a dorsal rib with pseudoarthrosis development (S); embedded *T. rex* tooth in rib (S); healed puncture wound in a rib, caused by a bite from a conspecific (ST); broken furcula (S); calcified hematoma and fusion of gastral elements (S); gouty spurs and joint erosion in a manal element (S); osteophytic spurs at right scapula/coracoid juncture, attributed to arthritis (S); tendon avulsion affecting humerus (S); 5 pictures of pathologic (fracture with subsequent osteomyelitis) of left fibula (S); holes in surangulars (S and ST); sagittal

crest showing healed fracture, missing bone and healed puncture (ST); fusion of distal caudal vertebrae; 2 pictures (S); 2 pictures showing fusion of 2 neck vertebrae attributed to a fracture, followed by infection (ST) and 2 pictures of tooth-like interlocking bone spurs affecting proximal caudal vertebrae neural spines, attributed to mating (S). Due to the size and detail of this paper, we have not abstracted the text here, but list the relevant data in index two. While all may not agree with the interpretation of the lesions, this is a "must have" paper for anyone interested in dinosaur osteopathy. Format: Popular. Language: Japanese (with English translation insert). [DHT]).

Laws, R.R., including Hanna (nee Laws, R.R.)

Laws, R.R. 1993. A Specimen of *Allosaurus fragilis* from Big Horn County, Wyoming Exhibiting Several Pathologies. (Abstract). Jour. Vert. Paleo., 13(3):46A.

(A specimen of *Allosaurus fragilis* (MOR 693) from the Upper Jurassic Morrison Formation in Big Horn County, Wyoming was discovered in 1991 300 meters northeast of Howe Quarry. The individual is approximately 90 percent complete and exhibits several pathologies.

Although the skeleton is still in preparation, affected skeletal elements to date include a cervical vertebra, a manus phalanx, a pes metatarsal, and a rib. The presence of pathology in MOR 693 is recognized by the abnormal exterior of the aforementioned elements. However, in order to fully describe and interpret the features of a pathology, it is imperative that the histology of the afflicted area be examined. Therefore, both the exterior and the interior structure of each pathologic element will be described and discussed. [Author's abstract]. Osteopathy images available on lnternet; see Travsky, 1996).

____ 1995. Description and Analysis of the Multiple Pathological Bones of a Sub-Adult *Allosaurus* fragilis (MOR 693). Abstr. with Prog., Rocky Mtn. Sec., Geol. Soc. Amer., 47th Ann. Meetings, May 18-19, 1995, Bozeman, 27(4):43.

(The morphology of each of the 11 pathological elements of a sub-adult *Allosaurus fragilis* (MOR 693 from the Upper Jurassic Morrison Formation, Big Horn County, Wyoming, more than 95% complete) will be described and each disfigurement will be classified as resulting from trauma, infection, or congenital malformation. This information provides insight into elements which are not preserved, such as dinosaur behaviour and environmental influences.

The pathological skeletal elements include the third dorsal vertebra, right scapula, manus phalanx l-1, left ilium, metatarsal lll, metatarsal V, pes phalanx lll-1, two pes unguals, and two dorsal ribs. All elements were analyzed in macroscopic view, some were thin-sectioned, and some were studied as three-dimensional computer images derived from overlapping CAT scans. ln addition, since the frequency of pathology probably varied significantly from one individual to the next, a comparative study (in progress) will be completed utilizing this individual and a population of 44 allosaurs (*A. fragilis* material from the Cleveland-Lloyd Quarry, Utah) in order to fully understand the implications of one sub-adult allosaur possessing 11 pathological bones. [Osteopathy images available via the lnternet; see Travsky, 1996]. [Author's abstract]).

____ 1996. Paleopathological Analysis of a Subadult *Allosaurus fragilis* (MOR 693) from the Upper Jurassic Morrison Formation with Multiple Injuries and Infections. M.Sc. thesis, Montana State University, Bozeman, 61 pp.

(NOT SEEN. NOT lNDEXED. Dinosaur paleopathology; Upper Jurassic *Allosaurus*. See other entries under Laws in this bibliography and Travsky, 1996 for images on lnternet webpage).

____ 1997. Allosaur Trauma and Infection: Paleopathological Analysis as a Tool for Lifestyle Reconstruction. (Abstract). Jour. Vert. Paleo., 17(3):59A-60A.

(Abnormalities preserved in bones reflect lifestyle events because they formed when the animal was alive. Thus, pathologic bones can aid the reconstruction of lifestyles. Also, certain abnormalities may characterize taxa. lf so, the frequency of abnormalities and location in the body may be diagnostic of behaviour, environment, and physiology.

This study gives a detailed picture of the pathologic bones in one 87% grown, sub-adult, male, *Allosaurus fragilis* (MOR 693, "Big Al," from the Upper Jurassic Morrison Formation, Big Horn County, Wyoming). Affected bones include five dorsal ribs, cervical vertebra 6, dorsal vertebrae 3, 8, and 13, caudal vertebra 2, chevron 2, gastralia, scapula, manus phalanx l-1, pes phalanx lll-1, pes phalanx ll-3 (ungual), metatarsal lll, metatarsal V and ilium. The etiology of the bone affliction is diagnosed as resulting from trauma, infection, or aberrancy. Comparisons are made to pathologic theropod bones from the Cleveland-Lloyd dinosaur collection housed at Brigham Young University, University of Utah, and Museum of the Rockies.

These pathologic bones suggest that infection and injury was frequent in carnivorous dinosaurs. "Big Al" may have incurred some infection while standing on carcasses and some injury during competition with other males and pursuit of prey. Additionally, allosaurs possessed an immune response which allowed them to live with microbial infection in their bones, probably keeping it localized. [Author's abstract]).

Hanna (nee Laws), R.R. 2000. Dinosaurs Got Hurt Too. pp. 119-126. In: The Scientific American Book of Dinosaurs. Edited by G.S. Paul. St. Martin's Press, New York. vii + 424 pp.

(Essentially a review of previous author's works. We have only included the highlights of this paper. For another detailed review and discussion of small and large theropod paleopathology, see Molnar, 2001.

Allosaurus "Big Al" had numerous injuries (pp. 120-121):

- the basal tail region show fracture callus with much bone remodelling suggesting the wound had healed over "several years." This injury is related to a fall or blow from another animal.

- a serious injury affected the right foot, with pedal phalanges showing pyogenic infection. lt is suggested this animal was in pain and limped as a result of this pathology.

- the toes on the left pes show evidence of hyperextension [?avulsion], with damage to the 2nd ungual.

- second finger of right hand, broken and twisted, later on becoming infected; the injury possibly related to prey capture.

- 4 broken ribs related to a fall or blow from another animal.

- right scapula shows early stage infection or injury.

- hip and vertebrae also show injuries of unknown etiology.

Allosaurid with "cancerous tumorlike growth" affecting the arm (p. 121) [the true nature of this pathology is under dispute]; *Albertosaurus* and *Daspletosaurus* humeral fractures (p. 122); tendon avulsion affecting a *Tyrannosaurus* humerus (p. 122); possible face-biting behavior in *Tyrannosaurus* (p. 122). lnjuries in small theropods could be related to prey pursuit or capture (pp. 122-123).

ln ceratopsians, the most common injury are rib fractures. "Horn and frill disruptions" [presumably the latter meaning extra fontanelles] in *Triceratops*, *Torosaurus*, *Pentaceratops* and *Diceratops* "may be evidence" for intraspecific fighting. "Skull, neck and shoulder injuries" are known in *Triceratops*, *Einiosaurus* and *Pachyrhinosaurus* (p. 124). Hadrosaur tail injuries may be related to intraspecific trampling or copulation, but the author errs in stating for the latter that: ".... this would cause multiple breakage events, which are not seen in the fossil record." There are, in fact, several hadrosaur tails known that show multiple fracture trauma with evidence of healing, but these have not been described.

The author makes the following misleading comment (p. 124): "An *Apatosaurus* tail with a bite injury that matches up with *Allosaurus* teeth lends support to the idea that allosaurs were active predators...." We don't doubt that *Allosaurus* was an active predator, but the using the tail biting evidence is moot as there is no sign of healing on these vertebrae. ln my [DHT] experience, people often want to group toothmarked bone and paleopathology together, as if they are directly related. ln most cases they are not. Simple unhealed bite marks on prey bone indicate either predation and feeding on a living animal, or scavenging of a previously dead one. However, if the bite marks show any degree of healing (ie. Tanke and Currie, 1998 (2000)), then it would truly indicate a pathological condition.

Massive infection of a hypsilophodont tibia, referred here to *Leaellynasaura*, was recovered in Australia (see Gross et al., 1993). The bone was greatly deformed by the pathology. An ankylosaur *Tarchia* had a bony growth within its sinus cavity. This was caused by an injury or infection that was connected to the outside of the face via an opening in the skull (see Gallagher et al., 1998; Tumanova et al., 1998). *Stegosaurus* tail spikes showing signs of premortem fracture and/or infection were damaged during fights with rivals or predators (see McWhinney et al., 1998, 2001).

The author correctly states that osteoarthritis in dinosaurs is a rare phenomenon, affecting 2 specimens of *Iguanodon*.

The author concludes with this comment (p. 125): "Herbivores show signs of disease (i.e., injury, infection, etc.) less frequently than carnivores." This statement should be treated with caution. A careful, quantified reappraisal of all examples of dinosaurian paleopathology needs to be undertaken. Collecting, taphonomic and preservational biases need to be taken into account. Hanna's statement above would be untrue in Dinosaur Provincial Park, Alberta, Canada where examples of dinosaur paleopathology are found in abundance. There, hadrosaur paleopathologies greatly outnumber all other dinosaur paleopathologies combined.

Format: Semi-Popular. Osteopathy unillustrated. [DHT]).

____ 2002. Multiple Injury and Infection in a Sub-Adult *Allosaurus fragilis* with Comparisons to Allosaur Pathology in the Cleveland-Lloyd Collection. Jour. Vert. Paleo., 22(2): 76-90.

(A sub-adult *Allosaurus fragilis* [MOR 693] was discovered in 1991 in the Upper Jurassic Morrison Formation of Big Horn County, Wyoming. Examination of the specimen reveals pathological conditions on five dorsal ribs, gastralia, cervical vertebra, three dorsal vertebrae, caudal vertebra, chevron, scaupla, manus phalanx, ilium, two metatarsals, and two pes phalanges. Detailed description of these bones includes classification according to probable cause (i.e., traumatic; infectious; traumatic-infectious; developmental; idiopathic). In addition to the paleopathological analysis of MOR 693, descriptions and interpretations are given for a study in progress of pathological abnormalities in the Cleveland-Lloyd Dinosaur Quarry collection. This study provides a model for future paleopathological analyses, emphasizing that description of the location, extent, and texture of an abnormality is crucial, since interpretations are subject to change.

This analysis discusses physiological implications of the abnormalities in MOR 693 and suggests probable behaviors and environmental influences resulting in injury and infection. Lifestyle and behaviors that likely predisposed allosaurs to injury and infection include pursuit of prey, intra-specific competition for mates, and intra- and inter-specific rivalry for carcasses and territory. Ultimately, paleopathological analysis of a large sample of dinosaur bones may reveal that certain abnormalities characterize taxa, and are diagnostic of specific behaviors, enviromental influences, and physiology [Author's abstract, NOT INDEXED]).

____, LaRock, J.W. and Horner, J.R. 1999. Pathological *Brachylophosaurus* Bones from the Upper Cretaceous Judith River Formation, Northeastern Montana. (Abstract). Jour. Vert. Paleo., 19(3):49A.

(Paleopathological analysis was performed on material from a recently discovered bone bed in the terrestrial Upper Cretaceous Judith River Formation near Malta, Montana. The 1998 excavation yielded over 650 bones representing at least three dinosaurian and several non-dinosaurian taxa, 90% of which have been assigned to *Brachylophosaurus sp.* (Ornithopoda, Hadrosauridae). Out of approximately 450 bones examined, ten are pathological. Six of the bones are *Brachylophosaurus* and include: one pes phalanx; one metacarpal; two caudal vertebrae; and two dorsal vertebrae. Pathologies are also present on a fragment and three caudal vertebrae that are as yet taxonomically unassignable. Abnormalities are described and classified with respect to probable origin.

The bone-bearing unit is in close stratigraphic proximity to the underlying Claggett Shale, and may represent a coastal paleoenvironment. Detailed taphonomic and sedimentologic study of the deposit is underway, and excavation will continue during the 1999 field season. Continued documentation and pathological specimens from this site will help define the frequency and anatomical location of brachylophosaur abnormalities. [Author's abstract]).

____ in progress. Occurrence of Tyrannosaurid Arm Injuries: Implications for Use?

(Manuscript in progress).

____ and Varricchio, D.J. in progress. Frequency of Pathological Abnormalities in the Small Theropod *Troodon formosus*.

(Manuscript in progress).

Lehman, T.M. 1981. The Alamo Wash Local Fauna: A New Look at the Old Ojo Alamo Fauna. pp. 189-220. In: Advances in San Juan Basin Paleontology. Edited by S. Lucas, K. Rigby Jr. and B. Kues. University of New Mexico Press, Albuquerque.

(Some teeth described by Lehman as *Paronychodon* are actually aberrant teeth of small theropod dinosaurs of better known taxa. See Currie, Rigby and Sloan, 1990:117 and Baszio, 1997 for discussion. [DHT]).

____ 1990. The Ceratopsian Subfamily Chasmosaurinae: Sexual Dimorphism and Systematics. pp. 211-229. In: Dinosaur Systematics: Perspectives and Approaches. Edited by K. Carpenter and P.J. Currie, Cambridge Univ. Press.

(Late Cretaceous long-frilled ceratopsians (Chasmosaurinae) occasionally exhibit extra openings through the squamosals, either symmetrical or asymmetrical. Lehman's study of sexual dimorphism would suggest animals so affected were males, thus lending support to the intraspecific fighting hypotheses that have been quite popular in the past. [DHT]).

____ 1996. A Horned Dinosaur from the El Picacho Formation of West Texas, and a Review of Ceratopsian Dinosaurs from the American Southwest. Jour. Paleo., 70(3):494-508.

(Lehman describes a fragmentary skull of a new but as yet unnamed long-frilled chasmosaurine ceratopsian from the Late Cretaceous of Texas, USA. The braincase is slightly bilaterally asymmetric. Of the braincase, Lehman (p. 495) notes: ".... an unusual (possibly pathological) depression on the midline just below the opening for the olfactory peduncle." Etiology of these conditions are not discussed. Illustrated. [DHT]).

____ and Carpenter, K. 1990. A Partial Skeleton of the Tyrannosaurid Dinosaur *Aublysodon* from the Upper Cretaceous of New Mexico. Jour. Paleo., 64(6):1026-1032.

(A partial left dentary found with this specimen (OMNH 10131), shows the posterior-most tooth abnormally positioned. The tooth is strongly directed posteriorly. Etiology or significance of this anomaly is not discussed. [DHT]).

Leitch, L.G.A. 1988. Slicing Into The Past. Cab & Crystal, 1(5):8-9.

(Explores the research potential of CT-scan technology in the field of vertebrate paleontology. Format: Popular. [DHT]).

Lessem, D. 1988. *T. Rex* Exposed? Rotunda, 21(2):34-44.

(More an article on the artists who have reconstructed the large Late Cretaceous *Tyrannosaurus rex*. Includes paleo-artist Charles Knight renditions of one *Dryptosaurus* leaping on another and intraspecific biting in *Tyrannosaurus rex*. Intraspecific head-butting behaviour in *T. rex* is advocated by Robert Bakker and a detailed line drawing of one *Tyrannosaurus* head-butting a conspecific in the chest and knocking it off its feet is presented. For any of his future *T. rex* reconstructions, artist Mark Hallett notes that: "They were always breaking off teeth when they bit things. I'd make it more snaggle-toothed." Format: Popular. [DHT]).

____ 1989a. Digging for Dinosaurs in China. ibid, 21(4):14-23.

(Includes mention on the "fighting dinosaurs" discovery- a Late Cretaceous small theropod *Velociraptor* locked in mortal combat with a *Protoceratops*. Mass mortality of five juvenile ankylosaurs (*Pinacosaurus*) is noted and figured. The animals were found standing grouped together. They all may have been overwhelmed by a sudden sandstorm. Subsequent excavations revealed even more pinacosaurs; approximately 13 in total. Format: Popular. [DHT]).

____ 1989b. Secrets of the Gobi Desert. Discover, 10(6):40-46.

(See Lessem, 1989a for details. Format: Popular. [DHT]).

____ 1992. Kings of Creation: How A New Breed of Scientists is Revolutionizing Our Understanding of Dinosaurs. Simon & Schuster, New York:367 pp.

(Short discussion of possible arsenic poisoning as the cause of death in the dinosaurs recovered from the Dashanpu Quarry in Szechwan, China. Cross-sectioned dinosaur bones from this quarry revealed high levels of arsenic. Some researchers speculated that the local plants contained high levels of arsenic, and that the dinosaurs feeding on these were thus doomed. Chinese paleontologist Xiao Xi Wu disagrees with this interpretation however, and suggests that arsenic in the local groundwater filtered into the dinosaur bones during the fossilization process (p. 145-146). Puncture holes in the cheeks and frills of ceratopsians are accepted as being received during intraspecific battles according to Canadian and American paleontologists Philip Currie and Peter Dodson (p. 279). [DHT]. Format: Popular).

____ and Glut, D.F. 1993. The Dinosaur Society Dinosaur Encyclopedia. Random House, Inc. New York. xli + 533 pp.

(Long awaited and unfortunately, without a doubt, one of the worst dinosaur books ever written. Boring and full of incorrect information, numerous partial blank pages (and thus wasted space), skewed or cut-off figures, etc. The lead up to this book held great promise, but the result is quite disappointing.

There are some references to paleopathology. Page 47, the orientation of orbital horns of the Late Cretaceous ceratopsian *Arrhinoceratops* are possibly due to deformation-it is not stated whether this was pre- or postmortem. This comment is unusual, the orientation of the horns do not seem anything unusual or out of the ordinary. The distal 1/3 region of the neural spines of the Early Cretaceous theropod *Becklespinax* show healed fractures of the neural spines, although these are not mentioned in the text, p. 65. Supernumerary fontanelles in the Late Cretaceous ceratopsian *Diceratops* have previously been interpreted as caused by disease or injury, but may be normal for this genus according to Dr. Catherine Forster, p. 145 [see Forster, 1996b]. "Unique width" of the expanded dome of the Late Cretaceous pachycephalosaurid *Gravitholus* may be ".... a distortion

caused by disease or injury, or by pressure upon the fossil that occurred after the animal died," p. 204. The reference to pathology in this specimen is baffling. Maryanska (1990) first suggested it was pathological. There is no reference to osteopathy in the first description of the type specimen. Examination of the type housed in TMP collections revealed nothing unusual. Mass mortality of the Late Cretaceous ceratopsian *Pachyrhinosaurus* is noted on page 352. Choking to death on a "very large stone" is listed for the large Late Jurassic sauropod *Seismosaurus*, p. 429. Page 434, tailclub in *Shunosaurus*..... pathologic? Mass mortality for the Early Jurassic theropod *Syntarsus* is noted on page 457. Possible intraspecific fighting injuries (holes in frill, broken and healing orbital horn) in the Late Cretaceous ceratopsian *Triceratops* are noted, pp. 487-488. Format: Popular. [DHT]).

Lewin, R. 1982. Thread of Life. The Smithsonian Looks at Evolution. Smith-sonian Books, Washington, D.C.: W.W. Norton, New York, 256 pp.

(Page 156 of this book includes a photograph of a pathological ilium and basal tail region of the Upper Jurassic *Camptosaurus browni*. Pathology of this specimen was also considered as evidence of possible mating trauma by Gilmore in 1909 and 1912. [DHT]. Format: Semi-Popular).

____ 1994. Fact, Fiction and Fossil DNA. New Sci., 141(1910):38-41.

(Reviews the past and current studies on fossil DNA. There has been much recent criticism on the validity of fossil DNA- is it real or merely represents contamination? There is general consensus that DNA can survive for possibly several thousands of years, but dissenters say claims of DNA dating back millions of years is not possible. Clearly more work is needed to resolve this problem. [DHT]).

____ 1998. Patterns in Evolution - The New Molecular View. W.H. Freeman Publ., New York.

(NOT SEEN. NOT INDEXED. Includes dinosaur DNA studies. [DHT]).

Lidner, V. 1992. Interview- Robert Bakker. Omni, 14(6):64, 66, 90, 92-93.

(On pages 92-93 of this interview with radical vertebrate paleontologist Dr. Robert T. Bakker puts forward his hypothesis that disease killed off the dinosaurs and ultimately caused their extinction. Dinosaur migrations from continent to continent exposed endemic dinosaurian populations to new diseases that they were unable to adapt to or fight off. Bakker suggests that there may have been as many as 60 major extinctions during the total reign of the dinosaurs. [DHT]).

Lindblad, G.E. 1954. Field Notes, Steveville, Alberta. (Fieldnotes on file at Royal Tyrrell Museum of Paleontology library).

(Includes mention of the discovery and collection of an isolated pathologic adult hadrosaur tibia by field worker Gus Lindblad from what is now Dinosaur Provincial Park, Alberta, Canada (Dinosaur Park Formation, Campanian, Late Cretaceous. Examination of the specimen (CMN 41201) by one of us [DHT] discloses evidence of massive osteomyelitis with exuberant new bone formation which increases the bones mid-shaft diameter almost two-fold. What lead to this condition has not been determined. This specimen is figured in Anonymous, 2000a. [DHT]).

Lingham-Solair, T. and Broderick, T. 2000. An Enigmatic Early Mesozoic Dinosaur Trackway from Zimbabwe. Ichnos, 7(2):135-148.

(The ichnogenus *Atreipus*-like trackway is unusual in showing a marked negative (outward) rotation of the pes prints, among other features. It is postulated that this may represent a pathological condition or unusual behavior of a juvenile animal. There was no indication of limping. Illustrated. [DHT]).

Lockley, M.G. 1991. Tracking Dinosaurs— A New Look at an Ancient World. Cambridge University Press, London. xii + 238 pp.

(Includes a short review and description of some known occurrences of dinosaur footprints that indicate animals with injured or deformed feet and leaving resultant trackways of alternating long and short steps, or "limping trackways." See Abel, 1935; Ishigaki, 1986; Lockley, Hunt, Moratalla and Matsukawa, 1994. [DHT]).

____ 1999. The Eternal Trail - A Tracker Looks at Evolution. Perseus Books, Reading, Massachusetts. xvii + 334 pp.

(Includes comments on trackways showing evidence of limping dinosaurs, pp. 125-126. Some trackways show obvious signs of foot injuries or congenital abnormality. Trackways showing a limping dinosaur, but no obvious example of injuries to the foot, could indicate an animal injured somewhere else on its body, or had one leg slightly shorter than the other. Other possibilities that could affect normal walking locomotion are that the animal was looking over its shoulder or was carrying something. Of nine trackways showing "limping" dinosaurs, six show the animal was injured on the left side. The author notes that left-handed humans are injured more frequently than those that are right-handed. Could the same be true for dinosaurs? Were there dinosaurs who were "left-footed" or "right-footed," with lefties injuring their feet more frequently? The author agrees this is all "highly speculative," but worth considering pending future finds. Format: Semi-Popular. [DHT]).

____ and Hunt, A.P. 1995. Dinosaur Tracks and Other Fossil Footprints of the Western United States. Columbia Univ. Press, New York. xx + 338 pp.

(Includes a pair of small ornithopod (*Caririchnium*) trackways. One trackway shows alternating long and short steps; i.e., a limping animal. This specimen is illustrated; see pages 205-206. [DHT]).

____, ____, Moratalla, J. and Matsukawa, M. 1994. Limping Dinosaurs? Trackway Evidence for Abnormal Gaits. Ichnos, 3:193-202.

(At least nine different dinosaur trackways are known that reveal alternating long and short steps indicative of limping or some other unusual gait. The reasons for such abnormal dinosaur gaits are not clear in most cases, but they may be related to foot injuries, at least in one example. Most abnormal gait patterns have been observed in bipedal dinosaurs, but they have also been noted in the trackways of quadrupedal dinosaurs. Measurements of the trackway of a limping person revealed similar alternating long and short steps, and suggest that short steps precede the emplacement of an injured foot, and that long steps follow.

The ratio of short/long step length provides a measure of the degree of limping. In narrow trackways of limping bipeds, stride length is close to 2 X mean step length, and is quite regular regardless of significant differences in the length of consecutive steps. Such regularity in stride length is not always so apparent in the trackways of quadrupeds, where trackways are wider and several alternate measures of stride length can be selected (pes-pes, manus-manus, or mean of both). In the wide trackways of quadrupeds stride length is much less than 2 X mean step length. [Author's abstract]. By comparing the low number of trackways of limping dinosaurs to the large numbers of normal trackways from the same sites (5 localities worldwide), the authors conclude ".... no more than one in a hundred trackways are attributable to limping dinosaurs." Illustrated).

____, Matsukawa, M. and Hunt, A. P. 1993. Tracking Dinosaurs: New Interpretations of Dinosaurs Based on Footprints. Exhibit Guidebook. An International Dinosaur Exhibit by the University of Colorado at Denver Dinosaur Trackers Research Group. A Project of the College of Liberal Arts and Sciences as part of the Joint Colorado-Japan Project. 68 pp.

(Short description of limping dinosaur trackways having been found in Utah, New Mexico (ichnogenus *Caririchnium* = quadrupedal ornithopod), Spain and North Africa. The North African example is figured. See also Lockley, Hunt, Moratalla and Matsukawa, 1994. [DHT]).

____, ____ and Obata, I. 1991. Dinosaurs: New Interpretations of Dinosaurs Based on Footprints. Maruzen Library, Tokyo, 176 pp.

(NOT SEEN. NOT INDEXED. Mid-Jurassic theropod trackway showing a limping theropod. Alternating long and short steps are in evidence. See also Jenny and Josen, 1982; Ishigaki, 1986).

____ and Rice, A. 1990. Did "*Brontosaurus*" Ever Swim Out to Sea? Evidence from Brontosaur and Other Dinosaur Footprints. Ichnos, 1:81-90.

(Re-examine a sauropod manus-only trackway from the middle Jurassic of Morocco which shows alternating long and short step sequences; i.e. "limping." Illustrated. See also Lockley, Hunt, Moratalla and Matsukawa, 1994. [DHT]).

Long, J.A. 1998. Dinosaurs of Australia and New Zealand and Other Animals of the Mesozoic Era. UNSW Press, Sydney. 188 pp.

(On page 118, Long figures with brief comment on an Australian Early Cretaceous hypsilophodont partial skeleton exhibiting serious osteomyelitis of the tibia. This specimen was formally described by Gross, Rich and Vickers-Rich in 1993. Format: Popular. [DHT]).

Look, A. 1955. 1000 Million Years on the Colorado Plateau. Golden Bell Press, Denver, 300 pp.

(Pages 65-66 mention the discovery of tail of the Late Jurassic sauropod *Diplodocus* near Sinbad Valley, Colorado, USA. Two vertebrae were fused together near where the tail first dragged on the ground. The author

considers this specimen as "a fully developed case of arthritis." DlSH (diffuse idiopathic skeletal hyperostosis) seems a more likely condition; see Rothschild and Berman, 1991. [DHT]. Format: Popular).

Loope, D.B., Dingus, L. Swisher III, C.C. and Minjin, C. 1998. Life and Death in a Late Cretaceous Dune Field, Nemegt Basin, Mongolia. Geology, 26:27-30.

(Comments on mass mortality occurrences of dinosaurs. Were they smothered by dust and sand in wind-storms or buried by flash flooding events? The author's favor the latter hypothesis. See also Jerzykiewicz, 1989, 1998. [DHT]).

Lore, D. 1998. "Elvis" Dinosaur Enters the Building; COSI First to Display Skull of Crested Cryolophosaur. The Columbus Dispatch, Wednesday, April 15, 1998:4B.

(Several lengths or prosauropod rib were found in the throat region of this Antarctic Early Jurassic allosauroid *Cryolophosaurus* specimen, inviting speculation that it had choked to death on its' last meal. Format: Popular. [DHT]).

Lougheed, T. 1989. The Vector Theory. Arthritis News Magazine, 7(2):__. Also found on Internet at the Arthritis Society website at: http://www.arthritis.ca/programs

(Mentions work done by Dr. Bruce Rothschild and his quest for examples of true dinosaur arthritis. Such cases, it turns out, are extremely rare. Unillustrated. [DHT]).

Lowey, M. 1992. A Passion for the Past. Calgary Herald, Saturday, August 8, 1992:I4-I5.

(Newspaper article relating the 1992 field season discoveries made by the Royal Tyrrell Museum of Palaeontology (Drumheller) in Dinosaur Provincial Park, Alberta. A disarticulated hadrosaur skeleton (Quarry 206), discovered by the senior editor [DHT] was found to have two of the right dorsal ribs of widely differing positions bearing healed breaks of the proximal shaft region. Format: Popular. [The skeleton is that of an generically undetermined lambeosaurine hadrosaur (possibly the rare genus *Parasaurolophus*), and bears TMP accession number TMP92.53.21. [DHT]).

Lull, R.S. 1905. Restoration of the Horned Dinosaur *Diceratops*. Amer. Jour. Sci., Ser. 4, 20:420-422.

(Extra openings or fontanelles in the squamosal bones of the neck frill in the Late Cretaceous ceratopsian *Diceratops hatcheri* are considered as evidence of horn thrust injuries incurred during aggressive intraspecific fighting. Illustrated. [DHT]).

____ 1908. The Cranial Musculature and the Origin of the Frill in Ceratopsian Dinosaurs. ibid, 35:387-399.

(Intraspecific fighting causing osteopathy. Lull (pp. 391-392) states: "From the frequency with which one observes injuries, perforations and fractures, upon the ceratopsian skull, I cannot believe that the powerful armament of the horns was for mere passive defence. Many of the injuries are such that none other than a ceratopsian could have inflicted them, and this, together with the fine mechanical development of the great muscles, especially those in the wake of the supraorbital horns, shows that, in spite of apparent unwieldiness, *Triceratops* was an aggressive fighter when thoroughly aroused. In the type skull of *Diceratops hatcheri* Lull (1905) in the United States National Museum, the so-called foramina through the anterior part of the squamosal bones almost entirely obliterate the insertion of the complexus minor muscle of the left side, and partially obliterate that on the right. Enough, however, remains to indicate that the muscle depressions were precisely as in *Triceratops*. This strengthens the conviction which the writer has always had, that these perforations are entirely pathologic; moreover, the wounds must in large measure have disabled the animal and may ultimately have caused its death, though it lingered on long enough for the broken margins to heal, a matter of a few weeks.").

____ 1933. A Revision of the Ceratopsia or Horned Dinosaurs. Peabody Mus. Nat. Hist., Bull. 3(3):xii + 175 pp.

(This classic monograph of the Ceratopsia includes points relevant to this bibliography. Lull states that ceratopsians were "pugnacious animals" as evidenced by broken horns and frill punctures, p. 22. Two fused ["pathologic"] cervical vertebrae (#'s V and VI) in *Centrosaurus* are figured with little comment as to their etiology, pp. 40-41. An extra opening piercing the left squamosal of the type of *Arrhinoceratops* is considered ".... doubtless of a pathological nature...," p. 107 [see Plate 12A-B, p. 161 for photographs). Wiman, 1930 considered one of the specific characters of a new species of *Pentaceratops* [*P. fenestratus*] to be a squamosal opening (fenestra), but Lull (p. 111), comments: "The so-called fenestra is demonstrable through the left squamosal only [see fig. 40; p. 112] and seems to be pathologic as it is in so many ceratopsian skulls, more often, as seen here, on the left side. It may be either a puncture caused by a horn thrust or a bone lesion from the flesh side." The two *Pentaceratops* skulls show a posteriorly curved nasal horncore and forwardly curved orbital horncores, considered by Lull as ".... an anomaly that seems out of reason mechanically," it is suggested the curvature of the nasal horncore in both skulls is "abnormal," or possibly due to the effects of post-mortem crushing, p. 111. The right mandibular ramus in the type of *Triceratops serratus* [YPM 1823], is described as "somewhat pathologic," but no other details are provided, p. 121. Lull comments on the frill of type skull of *Diceratops*, pp. 127-128. Hatcher had considered four frill openings as one generic character, but Lull considers these as pathologies. He goes on to say: "The perforations through the crest number four, and are asymmetrical, the left squamosal containing a large subtriangular one at about its mid-length, and a lesser, irregular one in front, near the infratemporal fossa. The right squamosal has another irregular aperture in nearly the same place as the larger one on the left, but having less than one-fifth the area of the latter. There is yet another smaller perforation through the right side of the parietal, halfway between the squamosal and the rear margin. Below, the area in front of the largest aperture is tumid, thickened, and irregular, which heightens the impression that all of these perforations are pathologic and may be cystic openings comparable to those in the squamosal of the *Torosaurus latus* type mentioned above, and as such the result of disease, or injury or both. Surely they can have no taxonomic significance. One wonders how many of the peculiarities of this skull, except perhaps the absence of the nasal horn, may be due to this diseased condition which, in affecting the behaviour of the animal including carriage of the head, reacted upon the entire organism." A pathologic squamosal of *Torosaurus latus* YPM 1830 is illustrated, fig. 42, p. 131. Roy Moodie examined a photograph and plaster cast of the affected area and wrote (pp. 131-132): ""The photograph shows lesions which are identical with lesions found on the skull and skeletal elements of prehistoric Indians from the Channel Islands. There have been four cases of this disease studied from the Indian mounds. In one case there were evidences of 75 tumours on the skull alone. Comparisons with recent cases of the dread disease have led me to regard the condition as Multiple Myeloma" [not an acceptable consideration], "although there are some discrepancies in such a diagnosis. "The association of open lesions, depressed areas, called erosions', which are due to pressure atrophy from small tumours of subperiosteal origin and elongated channels, are so strikingly similar in the dinosaur bone that there would seem to be no doubt of the close relation between the condition in the dinosaur and prehistoric man. "The etiology of the disease is uncertain, but recent work in medical laboratories would lend favor to the suggestion that such cystic tumours have to do with a disturbance in the parathyroid. "The openings may be due to tumours arising in the medullary portion of the bone. Such pathological conditions first appear in the Triassic and are found in later reptiles and among Tertiary and Pleistocene mammal."

Finally, Plate 7A (p. 151) shows a skull of *Chasmosaurus* also exhibiting an extra opening through the left squamosal. Plate 15A shows a healed puncture wound above and in front of the right orbit of a *Torosaurus*. [DHT]).

____ and Wright, N.E. 1942. Hadrosaurian Dinosaurs of North America. Geol. Soc. Amer., Spec. Pap. 40:xii + 242 pp.

(Discusses the probable pathological dorsal neural spines in ROM 786 lambeosaurine *Parasaurolophus* (Quarry 12, Dinosaur Provincial Park, Alberta, Canada). They write (p. 211; see Plates 31A + B): "The [neural] spines of dorsals V, VI, VII, are remarkably modified, if not pathologic, showing a condition utterly unknown elsewhere. Spine of dorsal VI is unusually wide and straight; spine V is pointed and inclined backward so as almost to touch VI; spine VII is bent strongly forward and apparently in contact with VI; spine VIII is inclined strongly backward so that a triangular gap of more than 90 degrees separates it from VII. Moreover, the zygapophysial articulation between them seems to be destroyed, either pathologically or because of imperfect preservation. Above spine VI in particular, and to some extent spine VII, there is borne a "discoidal expansion or coosified separate bone about 100 mm. in diameter and 20 mm. thick. This pad of bone is rough and without distinct surface." Parks [original describer in 1922] first regarded this as the result of injury but later advanced the idea that the crest of the head was attached to this pad of bone by muscles or ligaments. The writers still hold to the idea of injury." This specimen also shows several healing rib fractures, visible just above the dorsal margin of the left scapula. See Parks, 1922.

Two hadrosaurs with broken ribs are figured without comments as to the injuries. The first (Plate 17B) is an *Edmontosaurus* with a mid-rib from

the right series showing a healed fracture at mid-length with prominent fracture callus development; ROM 867. The second (Plate 22B), a *Prosaurolophus* (ROM 787, Quarry 4, Dinosaur Provincial Park, Alberta, Canada) exhibits a series of six dorsal ribs broken in a near straight line about 3/4's the way distal to the rib head. All show the same state of healing, implying the fractures were received simultaneously. The distal portions show no significant angulation and the fracture calluses are mostly resorbed, indicating this animals was well on its way to healing this serious trauma. It is not known if the matching left ribs were similarly injured as the skeleton is restored as a panel mount and these ribs are hidden.

Also includes descriptions and discussions on skin impressions, musculature and tendons.

Illustrated, but none of the figures are detailed closeups of the injuries described here. [DHT]).

M

Ma, L. 1998. *Tyrannosaurus* agonistes. Discover, 19:50.

(Gout in *Tyrannosaurus* and another unspecified tyrannosaurid. See Rothschild, Tanke and Carpenter, 1997a,b. Format: Popular).

Macdonald, J.R. and Sibley, G. 1969. Paleopathological Ponderings or How to Tell a Sick Sabre-Tooth. Mus. Alliance Quarterly, Los Angeles Mus. Nat. Hist., 8(2):26-30.

(Mention is made of a dinosaur [hadrosaur] humerus from the Late Cretaceous of Alberta, Canada that suffered a bad fracture united by callus with a large abscess that may have caused the death of the animal. [This is AMNH 5207. A cast of this spectacular specimen is at the Royal Tyrrell Museum and bears catalogue number TMP98.11.1). This specimen is unillustrated. Semi-Popular. [DHT]).

MacLeod, E. 1994. Dinosaurs The Fastest The Fiercest The Most Amazing. Kids Can Press, Ltd., Toronto, 31 pp.

(Includes mention of some skulls and frills of the Late Cretaceous ceratopsian *Triceratops* having holes in them due to intraspecific fighting behaviour. Format: Popular (Childrens). [DHT]).

Machotka, S.V., II 1984. Neoplasia in Reptiles. pp. 519-580. In: Diseases of Amphibians and Reptiles. Edited by G.L. Hoff, F.L. Frye and E.R. Jacobson. Plenum Press, New York.

(Extensive literature review. Mention is made of an osteoma from the third dorsal vertebra of a large Late Cretaceous mosasaur and R.L. Moodie's suggestion of a neoplasm affecting the caudal vertebrae of Late Jurassic sauropod *Diplodocus*. Hatcher, 1901 suggested the latter was a fracture callus. Holland, 1906 considered it an example of osteomyelitis. Moodie, 1916 and Stolk, 1958 identified the condition as hemagiomas and Schlumberger and Lucke, 1948 as an example of benign overgrowths following fracture. Rothschild and Berman (1991) demonstrated that the "pathology" is simply an example of DISH or diffuse idiopathic skeletal hyperostosis. [DHT]).

Madsen, J.H. 1976a. *Allosaurus fragilis*: A Revised Osteology. Utah Geol. Mineral. Surv. Bull. 109, 163 pp. Second, unchanged edition was reprinted in 1993.

(In this excellent monographic treatment on the osteology of this Late Jurassic theropod, several pathologies are briefly described and illustrated (some in stereo pairs). Page 6 figures a pathologic proximal pedal phalanx with excessive bone growth; 2 fused mid-caudal vertebrae [an example of DISH?] and a healed mid-shaft fracture of the radius with callus formation. "Ribs with willow breaks" are also figured but these cannot be seriously considered as pathologic as there is no signs of healing indicating a perimortem or postmortem taphonomic artifact. Page 17 shows some *Allosaurus* teeth (stereopairs), one was obviously broken premortem with a subsequent wear facet extending far down the crown. Stereopairs of a pathologic pedal phalanx is presented on page 33. The distal articulating surface has a "moth-eaten" appearance- etiology unknown. A useful feature in these photographs is the inclusion of a healthy, normal bone for direct comparison. [DHT]).

____ 1976b. A Second New Theropod Dinosaur from the Late Jurassic of East Central Utah. Utah Geol., 3(1):51-60.

(UUVP 2742, a right ilium of the Late Jurassic theropod *Marshosaurus bicentesimus* from Utah, USA bears an anomalous area affecting the posterodorsal margin of the blade, grading into a ridge on the lateral surface. The pathology is apparently trauma-related, it is not figured. [DHT]).

____ 1991. Egg-Sitting (or) First Jurassic Dinosaur Egg from Emery County, Utah. pp. 55-56. In: Guidebook for Dinosaur Quarries and Tracksites Tour- Western Colorado and Eastern Utah. Edited by: W.R. Averett, Grand Junction Geol. Society.

(Pathological double layering of an unspecified dinosaur egg from the Late Jurassic of Utah is briefly discussed and illustrated with a photograph and two CAT scans. Suggested etiology of the twin layered shell is that the female was traumatized or stressed during egg production; resulting in the egg being retained and recirculated through the oviduct. Richmond and Morris, 1996 refer this egg to ?*Allosaurus*. [DHT]).

Manz, B. 1992. Imaging the Past: Revealing Fossil Skull & Dinosaur Egg Details. Advanced Imaging, 7(10):44, 46-47.

(UNIX image processing, hard copy).

Marsh, O.C. 1892a. Restorations of *Claosaurus* and *Ceratosaurus*. Amer. Jour. Sci., 44:343-349.

(Fused metatarsals of *Ceratosaurus* figured on plate 7 are pathologic. See Baur, 1890 (serious critique), Marsh, 1896).

____ 1892b. Discovery of Cretaceous Mammalia. Amer. Jour. Sci., 38:81-92.

(Teeth described here as belonging to the Late Cretaceous mammal *Dipriodon caperatus* are actually aberrant teeth of a small theropod [*sensu* "*Paronychodon*"], see Currie, Rigby and Sloan, 1990:117 for discussion. Illustrated. [DHT]).

____ 1896. The Dinosaurs of North America. 16th Ann. Rpt., U.S. Geol. Surv., 1894-95:133-415.

(Page 162 includes a figure of the pathologically fused left metatarsus of the Upper Jurassic theropod *Ceratosaurus nasicornus*. Marsh cited this specimen as being the first good evidence of a dinosaur/bird relationship. Plate 14 is a skeletal restoration of this form; the pathological metatarsals are incorporated too. See also Marsh, 1892a and Baur, 1890 for a serious critique and rebuttal of Marsh's use of the pathologically fused metatarsals as evidence for the dinosaur/bird connection. [DHT]).

Marshall, C., Brinkman, D., Lau, R. and Bowman, K. 1998. Fracture and Osteomyelitis in PII of the Second Pedal Digit of *Deinonychus antirrhopus* (Ostrom) an Early Cretaceous "Raptor" Dinosaur. (Abstract). Paleontological Assoc., 42nd Ann. Meeting, December 16-19, 1998. Univ. Portsmouth:16.

(We report here on a healing transverse, displaced, midshaft fracture of PII of the second pedal digit of Yale Peabody Museum 5205, the type specimen of *Deinonychus antirrhopus* (Ostrom). The affected phalanx bore the sickle-shaped talon for which the animal is named.

Radiographic examination of the fossil shows a caudal and ventral displacement of the distal fragment. The presence of osteomyelitis is supported by lytic areas at the fracture site with evidence of a sequestrum. Oblique views provide no evidence of longitudinal fracturing. Radiographs support the diagnosis of a fracture due to bending, which is compatible with damage during a slashing motion of the talon. However, pathologic fracture subsequent to primary osteomyelitis cannot be ruled out at this time.

Subsequent stability/immobility allowed partial healing to occur prior to the animal's death, as evidenced by lack of callus, remodelling and smoothing of dorsal and medial sides. That this animal survived for an unknown length of time with an injury to one of its purported major defence and food-gathering mechanisms may support Ostrom's analysis of gregarious/pack-hunting behaviour for *Deinonychus*. [Author's abstract]).

Marshall, M. 1995. Ancient DNA. MAPS Digest, 18(2):3-5.

(Popular description and discussion as to what is DNA, study of ancient DNA, fossil occurrences of DNA, dinosaur DNA, and future prospects. In this article the author mentions having conducted experiments to acquire dinosaur DNA and reports discovery of DNA from a hadrosaur tibia from the Judith River Fm. [now Dinosaur Park Fm.] (approx. 75 million years old). [DHT]).

Martill, D.M. 1991. Organically Preserved Dinosaur Skin: Taphonomic and Biological Implications. Mod. Geol., 16:61-68.

(Skin from a young individual of the [armored] ornithischian *Scelidosaurus sp.* is preserved as a kerogenous film in marine shales from the Upper Sinemurian [Lower Jurassic] of Charmouth, England. Both the internal and external surface of the skin are visible. There is considerable variation in scale size within a small area, and a number of bony scutes occur." [Author's abstract; in part]. Well illustrated. One of the skin scales shows a small circular lesion perforating the skin. Measuring 160 microns, the lesion is attributed to a possible skin parasite; see pp. 64, 65;

fig. 3a. [DHT]).

____ 2001. A Feather with Possible Ectoparasite Eggs from the Crato Formation (Lower Cretaceous, Aptian) of Brazil. N. Jb. Geol. Palaont. Abh., 219(3):241-259.

(An almost symmetrical, isolated feather from the Crato Formation is associated with numerous spherical, hollow structures approximately 75 microns [in] diameter which are interpreted as the eggs of an avian parasite, probably a mite. The feather shape resembles the caudal feathers of modern birds and *Archaeopteryx*, but it appears to have only simple barbules. This specimen may represent the oldest occurrence of ectoparasitism on feathered maniraptorans. [Author's abstract]. Illustrated. See also Martill and Davis, 1998a, b).

____, Barker, M.J. and Dacke, C.G. 1996. Dinosaur Nesting or Preying? Nature, 379:778.

(Suggest that if the Late Cretaceous theropod *Oviraptor* found "brooding" a nest of eggs (see Norell, Clark, Chiappe and Dashzeveg, 1995) is a female, that perhaps the medullary bone would show evidence of rapid resorption of calcium phosphate in response to egg production. However, see Chinsamy and Barrette, 1997 for a cautionary note. Unillustrated. [DHT]).

____ and Davis, P.G. 1998a. Did Dinosaurs Come Up to Scratch?. Nature, 396:528-529. Abstracted in: Martill, D.M. and Davis, P. 1998b. Ectoparasites on a Cretaceous Feather. The Palaeontological Association, 42nd Ann. Meeting, Univ. Portsmouth, Dec. 16-19, 1998:17.

(The authors describe and illustrate an isolated bird feather collected from the Lower Cretaceous Crato Formation of Brazil. Attached to the rachis and barbs of the feather are numerous, small spheroid structures which are interpreted as being the eggs of parasitic mites. Given that some dinosaurs are now known to have been feathered (or had feather-like structures), the possibility that these dinosaurs were similarly affected seems plausible. See also Martill, 2001. [DHT]).

____ and Unwin, D.M. 1997. Small Spheres in Fossil Bones: Blood Corpuscles or Diagenetic Products? Palaeontology, 40(3):619-624.

(Mineralized spherical structures within blood vessels of an archosaurian (possible pterosaurian) limb bone from the Lower Cretaceous of the Isle of Purbeck, Dorset, England, superficially resemble blood corpuscles, but are shown here to be pyrite framboids. Slightly weathered pyrite framboids in which the outer surface has oxidized, probably to goethite, may resemble nucleated cells when viewed in thin section. Previous records of so-called blood corpuscles within dinosaur bones may also be of a purely diagenetic origin and should be re-examined. [Author's abstract]. Illustrated).

____ and Naish, D. 2000. Walking with Dinosaurs — The Evidence. BBC, London. 176 pp.

(Includes some mentions of dinosaur paleopathology. A dromaeosaur (*Deinonychus*) pedal phalanx with a healing fracture indicates the enlarged sickle-like claw was used as a slashing weapon and this particular animal broke this bone while engaged in such activities (p. 113); see Marshall et al., 1998. Facial injuries in *Triceratops* and *Torosaurus*, consisting of broken horns and extra holes may be related to intraspecific fighting (p. 160). Osteopathy unillustrated. Format: Popular. [DHT]).

Maryanska, T. 1990. Pachycephalosauria. pp. 564-577. In: The Dinosauria. Edited by D.B. Weishampel, P. Dodson and H. Osmolska. Univ. California Press, Berkeley. xvi + 733 pp.

(States on page 575 that the dome of the type of *Gravitholus* "may be pathological" but does not substantiate this claim. Examination of the type did not disclose anything abnormal or unusual. This comment was subsequently cited by Lessem and Glut, 1993 (who were no doubt influenced by Maryanska's comments here). [DHT]).

____ and Osmolska, H. 1981. First Lambeosaurine Dinosaur from the Nemegt Formation, Upper Cretaceous, Mongolia. Acta Pal. Polonica, 26(3-4):243-255.

(Distal clubbing of the anterior caudal neural spines of the type specimen of the hadrosaur *Barsboldia sicinskii* (ZPAL MgD-1/110) are considered a specific character for this form. Clubbing or swelling of anterior caudal neural spines are well represented from the Late Cretaceous deposits of Alberta, Canada, and all of these are pathologic; the result of healing fractures some of which are exacerbated by infection. The type of *Barsboldia* should be re-examined to determine whether these neural spines are actually pathological or not. [DHT]).

Mateer, N.J. 1981. The Reptilian Megafauna from the Kirtland Shale (Late Cretaceous) of the San Juan Basin. pp. 49-75. In: Advances in San Juan Basin Paleontology. Edited by S. Lucas, K. Rigby and B. Kues, University of New Mexico Press.

(Mateer casts doubt on the supposed pathological nature of extra squamosal fontanelles in *Pentaceratops* and other ceratopsians. He suggests several other possibilities as to the cause of such features, including congenital origins or a specific character. See Parks, 1925; Wiman, 1930; Rowe, Colbert, and Nations, 1981; Tanke, submitted b, Tanke and Farke, ms for discussions on the extra squamosal fontanelle phenomenon in ceratopsians. [DHT]).

Matthew, W.D. and Brown, B. 1923. Preliminary Notices of Skeletons and Skulls of Deinodontidae from the Cretaceous of Alberta. Amer. Mus. Novit., 89:1-10.

(On page 3 the authors cast doubt on Moodie's 1918d interpretation of the thrown back nature of the head found in many dinosaur and mammal skeletons as evidence of death from poisoning or "lockjaw." Rather, the authors suggest the actual cause of this phenomenon is simply the shrinkage of the ligaments along the dorsal side of the neck and backbone after death. See Weigelt, 1927 [1989]; Davis, 1996. [DHT]).

Maxwell, D. 1999. Days of the Deinos. Nat. Hist., 108(10):60-65.

(Popular article, based on research by Maxwell and Ostrom, 1995. [DHT]).

Maxwell, W.D. and Ostrom, J.H. 1995. Taphonomy and Paleobiological Implications of *Tenontosaurus-Deinonychus* Associations. Jour. Vert. Paleo., 15(4):707-712.

(Postulate interspecific interaction (predation) on the medium to large-sized Lower Cretaceous ornithopod *Tenontosaurus* by the small theropod *Deinonychus*. Remains of both are often found directly associated, typically teeth of the latter with bones of the former. However, in one site, the intermingling of mostly disarticulated bones from both species suggested a fierce death struggle had occurred. Not only did the *Tenontosaurus* die, but at least 4 members of the *Deinonychus* pack also perished during these attacks. Multiple deaths in the latter are yet another example of some of the more unusual causative agents of mass mortality in some vertebrates. Illustrated. See also Paul, 1988. [DHT]).

May, K.C. and Gangloff, R.A. 1999. New Dinosaur Bone Bed from the Prince Creek Formation, Colville River, National Petroleum Reserve-Alaska. (Abstract). Jour. Vert. Paleo., 19(3):62A.

(Work completed in 1998 has defined a new dinosaur bone bed. The site is located on a bluff at the head of a gully along the west bank of the Colville River, 1.7 kilometres of Kikak Creek and 43 kilometres south of Ocean Point. Fragmentary bone has been collected at the mouth of the gully since 1988. Bone specimens collected *in situ* and as float indicate that at least four taxa are present. These include tyrannosaurids, dromaeosaurids, hadrosaurids and the ceratopsian *Pachyrhinosaurus*. This ceratopsian comprises 90% of the material identified to date. The *Pachyrhinosaurus* bone elements are of sub-adult proportions. This may be the earliest record of this taxon in North America.

The bone-bearing bed crops out 2 to 3 metres from the top of the bluff and extends along the bluff rim for 45 metres. Thickness of the bed ranges from 30 centimetres to 1 metre. Bone concentrations vary within this unit. In some parts of the bed, concentrations are greater than 20 bones/square metre (indicating a bonebed), in other parts, less than five. Skeletal elements are contained in highly indurated matrix with isolated occurrences of less indurated zones. All bones show some degree of pre-burial weathering and desiccation. Weathering features define two classes of bones, those that are highly weathered and those that exhibit only slight pre-burial weathering. Evidence of abrasion is rare. No evidence of trampling has been observed. All large bone elements exhibit permafrost induced fractures. Most bones show evidence of post-burial fractures due to loading and regional tectonic deformation. [Author's abstract]).

McAuliffe, K. 1993. Resurrecting the Dinosaur: The Scientist Behind Jurassic Park Moves Closer to Isolating Dinosaur DNA. Omni, July:16.

(Article on Dr. George O. Poinar and his work on fossil DNA. An unidentified fossil midge preserved in amber is illustrated. Format: Popular. [DHT]).

McDonald, K.A. 1994. The Iconoclastic Fossil Hunter. The Chronicle of Higher Education, November 16, 1994, 41(12):A1, A8-A9, A14, A17.

(Newspaper article reviews the work of vertebrate paleontologist Jack Horner. Includes discussion on the discovery and excavation of a

Maiasaura-dominated bonebed. This mass mortality event preserves the disarticulated remains of 10,000+ hadrosaurs. A volcanic eruption may be responsible for the formation and preservation of this unique deposit. Format: Popular. [DHT]).

McGinnis, H.J. 1982. Carnegie's Dinosaurs. The Board of Trustees, Carnegie Inst., Pittsburgh, Pennsylvania, 119 pp.

(Page 63 notes mid-caudal fusion of two vertebrae in the sauropods *Apatosaurus* and *Diplodocus*, spondylitis deformans is suggested. However, the condition coined "DlSH" seems more likely; see Rothschild and Berman, 1991. On page 103 the author mentions one specimen of *Tyrannosaurus* having injured vertebrae, and another having broken ribs and a punctured jaw. The jaw injury had partially healed, and the author suggests it was caused by aggressive intraspecific behaviour. lnjuries to the horns and frills of ceratopsians, including *Torosaurus* are mentioned on page 106. [DHT]).

McGowan, C. 1983. The Successful Dragons- A Natural History of Extinct Reptiles. Samuel Stevens, Toronto, vi + 263 pp.

(Pages 42-46 of this semi-popular book discuss the study and types of paleopathologies found in several Late Cretaceous dinosaurs from Alberta, Canada. The photographs accompanying the text are unfortunately of poor quality [Much better quality photographs of the same specimens can be found in McGowan, 1991]. Healed rib fractures in the ceratopsian *Chasmosaurus belli* and the hadrosaur *Prosaurolophus maximus* (ROM 787) are discussed and figured. Photographs of thin-sections of healthy and pathological dinosaur bone are included. A badly healed right fibula fracture in the tyrannosaur *Albertosaurus* [*Gorgosaurus*] from Dinosaur Provincial Park, Alberta, Canada is noted. [DHT]).

____ 1991. Dinosaurs, Spitfires, & Sea Dragons. Harvard Univ. Press, Cambridge. x + 365 pp.

(Pages 34-37 discuss much as was previously written and figured in McGowan (1983), although here McGowan embraces B. Rothschild's work on DlSH. On page 114 the author notes fusion of caudal vertebrae in sauropods being attributable to DlSH, a non-pathological condition. [DHT] Format: Semi-popular).

McIntosh, J.S. 1977. Dinosaur National Monument. Constellation Phoenix, 33 pp.

(lncludes a photograph of a fossil preparator pointing to some fused caudal vertebrae of the American Late Jurassic sauropod *Camarasaurus*. Accidental intraspecific trampling is the suggested etiology for this condition. DlSH should also be considered, but better photographs or examination of actual specimens is required for determination; see Rothschild and Berman, 1991. [DHT] Format: Popular).

____ 1990. Species Determination in Sauropod Dinosaurs with Tentative Suggestions for Their Classification. pp. 53-69. In: Dinosaur Systematics: Perspectives and Approaches. Edited by K. Carpenter and P.J. Currie. Cambridge Univ. Press.

(Four fused caudal vertebrae (numbers 17-20) of USNM 10865 *Diplodocus* figured on page 58. Their occurrence or etiology are not discussed. See Rothschild and Berman, 1991 for a detailed description and interpretation of this commonly encountered vertebral fusion phenomenon. [DHT]).

____, Miles, C.A., Cloward, K.C. and Parker, J.R. 1996. A Nearly Complete Skeleton of *Camarasaurus*. Bull. Gunma Mus. Nat. Hist., 1:1-87.

(lncludes comments on caudal pathology in this new Late Jurassic sauropod specimen. 13 vertebrae and 1 chevron were affected by three pathological conditions. Caudals 25 and 26 and adjoining chevron showed classic manifestations of DlSH (page 63; fig. 51E-l; page 68; fig. 59A-E). Caudals 39 and 40 (the latter figured on page 66; fig. 57A-B) show incomplete development of the neural arch base on one side (non-attachment to neural spine base) and this condition is considered by the author's to be an example of spina bifida occulta. Caudal 43 (page 66; fig. 57C-F) shows a neural arch base on one side only and with no neural groove. With the spinal cord unprotected this condition is diagnosed as spina bifida meningocele. The centrum also shows "osseous growth" possibly related to trauma. While not mentioned in the text, figure 57E is of interest in that caudal 43 centrum shows a deep transverse groove running side to side across the upper 1/3 of the centrum. This condition appears similar to some hadrosaur caudal vertebrae (though with variable groove orientations) in TMP collections. Those specimens appear to represent healed crush fractures (DHT, pers. obs.).Rothschild also recognized a pedal stress fracture (BMR, pers. obs.).

Caudals 32, 33 (page 67; fig. 58A-F), 43, 46, 47 and possibly 50-53 (fig. 58G-H) are diagnosed as having been affected by osteoarthritis [actually spondylitis deformans- BMR]. So affected specimens show "excessive bone growth around outer margins of the centrum on both the anterior and posterior surfaces;" p. 17. Caudals 46 and 47 are fused together as were caudals 49-53 with the latter in a slight kinked condition. Osteopathies of a physiological nature are related to advanced age and/or use of tail as a defensive weapon. Osteopathy well illustrated. [DHT]).

McLean, D.M. 1995. K-T Transition Greenhouse and Embryogenesis Dysfunction in the Dinosaurian Extinctions. Jour. Geol. Edu., 43(5):517-528.

(The author posits that a greenhouse effect of uncertain etiology (i.e. asteroid impact, Deccan Traps [lndia] volcanism), occurred at the end of the Cretaceous Period. "A greenhouse triggered dinosaurian extinctions via heat-induced embryogenesis dysfunction. Females experiencing warming suffered reduced blood flow to the uterine tract, damaging fertilized eggs and embryos and killing them in sufficient numbers to reduce population sizes to the point of extinction." [DHT]).

McNamara, K. 1992a. Dinosaur News- What Did Dinosaurs Eat? Dinonews 5:20-21.

(General discussion on how the isotopic Carbon 13 and Nitrogen 15 compositions of bone collagen are linked to the diet of living animals. Analysis of these components in Cretaceous dinosaur bone revealed the Late Cretaceous hadrosaur *Anatosaurus* from Wyoming, USA was a grazer, probably on ferns; however, similarly aged bones of a hadrosaur from Alberta, Canada indicated browsing on low shrubs. [DHT] Format: Popular).

____ 1992b. Dinosaur News- Dinosaur Eggstinktion and Extinction. Dinonews 5:21.

(General review of work being done on latest Cretaceous dinosaur eggs by Hans Hansen at the University of Copenhagen, Denmark. The dinosaur eggs studied came from southern France. Eggs closest to the K/T boundary had black shells. ln older deposits only 1% of eggs were black. The frequency of dark-colored eggs increases as one approaches the K/T boundary. The dark eggs contained concentrations of silver and crude oil- possibly related to the eggs rotting under plant compost as they failed to hatch. Selenium is detected in the eggs in increasing levels as one approaches the K/T boundary. Experiments with hens shows that increased selenium levels leads to reduced hatching. Hansen suggests selenium from massive volcanic activity (ie. Deccan Traps, lndia) at the end of the Cretaceous released selenium which was ingested by the dinosaurs. This in turn seriously affected their reproductive potential. [DHT] Format: Popular).

McWhinney, L.A., Carpenter, K. and Rothschild, B.M. 2001. Dinosaurian Humeral Periostitis: A Case of a Juxtacortical Lesion in the Fossil Record. pp. 364-377. In: Mesozoic Vertebrate Life: New Research Inspired by the Paleontology of Philip J. Currie. Edited by Darren Tanke and Kenneth Carpenter. Indiana University Press, Bloomington. xviii + 577 pp.

(Juxtacortical (surface) lesions originate from a variety of etiologies (causes) that can be either tumor or tumorlike in appearance. The resulting periostitis pattern is from the disease process and not the periosteum. A juxtacortical lesion is noted on an adult *Camarasaurus grandis* right humerus located along the distal anterior diaphysis and terminating at the metadiaphyseal junction. A resulting long-term or chronic periostitis would cause secondary inflammation of the muscles (myositis) and fascia (fascititis). The increased pressure in the affected area would then have the potential to compress the neurovascular system. The inflammatory process ultimately would cause decreased range of motion of the flexor and extensor muscles. Based on the location of the pathology, the primary muscles affected by the periostitis would be M. brachialis and M. brachioradialis, with secondary involvement of the M. biceps brachii. The distally sloping of the juxtacortical lesion and exostosis on the humerus follows the direction of the muscle bundles. The occurrence of this type of pathology on the humerus is caused by a stress injury or repetitive over*ex*ertion of the muscles resulting in an avulsion with fracture. The periosteal mass and spur represents the reparative process after a post-traumatic event. [Author's abstract]. Illustrated).

____, Rothschild, B.M. and Carpenter, K. 1998. Post-Traumatic Chronic Osteomyelitis in *Stegosaurus* Dermal Spikes. (Abstract). Jour. Vert. Paleo., 18(3):62A.

(Trauma-related injuries affecting the bony structure can be seen in the fossil record as an unique opportunity to view certain life and death

events. Evidence of trauma-induced bone fractures in individuals who survived show alterations in the bony structure seen as endosteal new bone formation (callus). The alterations seen in bone infections produce various degrees of bone resorption, bone formation and necrosis. No callus or other bone alterations due to infection occur post-mortem. Although infectious disease resulting from trauma is well documented in the fossil record, infection in dermal armor is rare. In a sample of 51 *Stegosaurus* dermal tail spikes, 4 (~8%) show trauma. Two of these spikes exhibit the effects of post-traumatic chronic osteomyelitis. The pathological spikes showed remodeled bone growth indicating that each *Stegosaurus* survived after a traumatic event resulted in breaking off part of the spike. The outer cortical surface exhibits deposits of extraneous bone and prominent areas of filigree bone. Drainage areas (sinus cavities) for the evacuation of pyogenic material are noted at or near the broken ends of the spikes. The disease exhibited in these two cases was a direct response to the traumatic open fractures. Open fractures have a higher rate of disturbance in the healing process due to the increased frequency of infection. The open fracture allowed direct access (implantation) for bacteria to enter the wound, resulting in post-traumatic chronic osteomyelitis. [Author's abstract]. First cited by Carpenter, 1996).

____, ____ and ____ 2001. Post-Traumatic Chronic Osteomyelitis in *Stegosaurus* Dermal Spikes. pp. 141-156. In: The Armored Dinosaurs. Edited by K. Carpenter and J.I. Kirkland. Univ. Indiana Press, Bloomington. xv + 526 pp.

(Abstract as per McWhinney et al., 1998 above).

Michard, J.-G. 1992. The Reign of the Dinosaurs. Discoveries, Harry N. Abrams, Inc., New York, 143 pp.

(On page 66 states that sites of dinosaur fractures could either be accidental or "battle scars." Caudal fusions are known in sauropods, and on page 72, several examples of these in *Diplodocus* are illustrated and again wrongly diagnosed as "probably brought on by arthritis" and later "....this sauropod was crippled by disease." This "disease" is actually a well known example of DISH; see Rothschild and Berman, 1991 for a description. [DHT] Format: Popular).

Mierzejewska, G. 1977. Note on Teratological Dinosaur (?) Eggs. Acta Medica Polona, 18(4):345-346.

(NOT SEEN. NOT INDEXED).

Millard, A.R. 1995. The Body Temperature of *Tyrannosaurus rex*. Science, 267:1666-1667.

(Challenges Barrick and Showers, 1994 methodology as flawed and concludes *T. rex* was ectothermic. With reply by Barrick, Showers, Brande, Neilson and Turner).

Miller II, M.F. and Wyckoff, R.W.G. 1968. Proteins in Dinosaur Bones. Proc. Nat. Acad. Sci. USA., 60:176-178.

(Presence of proteins in mostly unspecified dinosaur and mosasaur bone is demonstrated. Some specimens dated back to the Upper Jurassic sauropod *Diplodocus*. [DHT]).

Milstein, M. 2000. Behaving Like a Dinosaur. Found on Internet Nov. 17, 2000 at the Discovery Channel website at: http://www.discovery.com/exp/fossilzone/behaving.html

(Includes comments on intraspecific face-biting injuries in *Albertosaurus*, *Gorgosaurus* and *Daspletosaurus*; see Tanke and Currie, 1998 (2000). 10% of the tail spike of *Stegosaurus* show healed fractures or other injuries; see Carpenter, 1996; McWhinney, Rothschild and Carpenter, 1998. Ends of hadrosaur tails often show crushing injuries, with vertebrae that fuse together at unusual angles. This was probably a consequence of their herding behavior, with animals accidently stepping on each others tails according to Darren Tanke at the Royal Tyrrell Museum of Palaeontology. Unillustrated. Format: Popular. [DHT]).

Mohabey, D.M. 1984. Pathologic Dinosaurian Eggshell from Kheda District, Gujarat. Curr. Sci., 53:701-702.

(Multilayered (2 layers) "ovum-in-ovo"-type unspecified dinosaur eggshell of unspecified age from India. Illustrated. See also Jain, 1989. [DHT]).

____ 1990. Discovery of Dinosaur Nesting Site in Maharashtra. Gondwana Geol. Mag., 3:32-34.

(NOT SEEN. NOT INDEXED. Pathological Late Cretaceous dinosaur eggshell showing multilayering of the shell layers. See Mohabey, 1998).

____ 1991. Palaeontological Studies of the Lameta Formation with Special Reference to the Dinosaurian Eggs from Kheda and Panchmahal Districts of Gujarat, India. Ph.D. dissertation, Nagpur University, Nagpur, 124 pp.

(NOT SEEN. NOT INDEXED. Pathological Late Cretaceous dinosaur eggshell showing multilayering of the shell layers. See Mohabey, 1998).

____ 1998. Systematics of Indian Upper Cretaceous Dinosaur and Chelonian Eggshells. Jour. Vert. Paleo., 18(2):348-362.

(Includes description and figure of multilayered eggshell in the oogenus *Megaloolithus khempurensis* collected from the Lameta Formation of Khempur and Werasa in Kheda district, Gujurat, India. Pathologic dinosaur eggshell was uncommon across all localities examined. [DHT]).

Molnar, R.E. 1973. The Cranial Morphology and Mechanics of *Tyrannosaurus rex* (Reptilia: Saurischia). Ph. D. Dissertation, University of California, Los Angeles. 450 pp.

(Mention of tooth trauma and paleopathology in this Late Cretaceous taxon. See Molnar, 1991 for details).

____ 1977. Analogies in the Evolution of Combat and Display Structures in Ornithopods and Ungulates. Evol. Theory, 3:165-190.

(The presence of a wide variety of cranial horns, frills and crests as well as caniform teeth in various members of the Ornithopoda, and their derivatives, the Pachycephalosauria and the Ceratopsia, suggests analogy with various ungulates, especially artiodactyls. Suggestions that these cranial structures functioned in combat and display may be tested by comparing the actual structure with expectations or predictions derived from the hypothetical role of that structure. Such tests, while incapable of proving that the animals did in fact use these structures as suggested, could demonstrate that the structures either matched or did not match the expectations, and thus render more or less likely the suggested functions. Matching of such structures in psittacosaurs, ceratopsians, pachycephalosaurs and some hadrosaurs with expectations shows that it is likely that the structures functioned in intraspecific combat and display. The sequence of evolution of these structures matches that suggested by Geist for ungulates, commencing with the use of teeth, progressing to lateral display and the striking of blows with the head and finally using various modes of frontal display and combat. It is suggested that early adoption of an herbivorous diet and later adoption of the head in striking blows controlled the development of this sequence. [Authors' abstract]).

____ 1991. The Cranial Morphology of *Tyrannosaurus rex*. Paleontographica, A, 217:137-176.

(Possible pathological angular in MOR 008 (p. 155); ?tooth puncture pathology affects both LACM 23844 surangulars, and one surangular of MOR 008 (p. 156); postorbital rugosity might be altered by pathology among a number of other factors (p. 170); premortem premaxilla tooth crown damage in LACM 23844, with development of a new wear surface is figured on Plate 1, fig. 3; right surangular with injury in LACM 23844 is figured on Plate 15, fig. 1. [DHT]).

____ 1992. The Behaviour of Predatory Dinosaurs. pp. 210-219. In: The Ultimate Dinosaur- Past-Present-Future. Byron Preiss, Bantam, New York. xvi + 336 pp.

(Brief mention of intraspecific biting injuries in *Allosaurus* and *Tyrannosaurus*. [DHT]).

____ 1998 (not published until 2000). Mechanical Factors in the Design of the Skull of *Tyrannosaurus rex* (Osborn, 1905). GAIA, 15:193-218. In: Aspects of Theropod Paleobiology. Edited by B.P. Perez-Moreno, T. Holtz Jr., J.L. Sanz, and J. Moratalla. 403 pp.

(The author describes and illustrates a premaxillary tooth fracture with subsequent wear in *Tyrannosaurus*. [DHT]).

____ 2001. Theropod Paleopathology: A Literature Survey. pp. 337-363. In: Mesozoic Vertebrate Life: New Research Inspired by the Paleontology of Philip J. Currie. Edited by Darren Tanke and Kenneth Carpenter. Indiana University Press, Bloomington. xviii + 577 pp.

(NOT INDEXED. A survey of paleopathological features reported in the literature for theropod dinosaurs found that such features have occurred in at least 21 genera belonging to 10 families. Both large and small theropods exhibit pathologies, although pathologies are substantially less common (or less commonly preserved) among small theropods. Pathologies have been found in several parts of the skeleton, but appear absent (or very rare) from the major weight-bearing structures, such as the sacrum, femur and tibia. They appear most commonly in the postcranial axial skeleton (especially ribs and caudals), less commonly in the hind limbs and

least (with about equal frequency) in skull and jaws and the forelimb.

Pathologies present include congenital malformations and evidence for infections, but mostly represent injuries. Features in the latter category include both fractures and pits or punctures possibly resulting from bites. lnformation on frequency of fracture for various bones suggests that some elements (e.g., femora) were more strongly selected for resistance to breakage than others.

The study of congenital anomalies may be useful in illuminating the evolutionary history of developmental processes. Asymmetric and unusual fusions of cranial elements probably indicate gerontic individuals. There are two apparent instances of fluctuating asymmetry, mostly in the forelimb. lnfections seem to have been quite localized. [Author's abstract]. Unillustrated).

____ and Frey, E. 1987. The Paravertebral Elements of the Australian Ankylosaur *Minmi* (Reptilia: Ornithischia, Cretaceous). N. Jb. Geol. Palaont., Abh, 175(1):19-37.

(Comparison with the epaxial muscle-tendon systems of crocodilians with the paravertebral elements in the Australian ankylosaur *Minmi* paravertebra indicates that the paravertebral elements are sesamoid elements of the epaxial musculature, essentially similar in histology and function, but not anatomy, to ossified tendons. These structures may be associated with reduced dorsal armor and more cursorial habits than among other ankylosaurs. [Author's abstract]).

____ and Farlow, J.O. 1990. Carnosaur Paleobiology. pp. 210-224. In: The Dinosauria. Edited by: D.B. Weishampel, P. Dodson, and H. Osmolska, Univ. Calif. Press, Berkeley.

(Breakage of tyrannosaurid (Late Cretaceous) humeri, broken ribs in *Tyrannosaurus rex*, fractured humeri in *Albertosaurus libratus*, fractured humeri and radii in *Allosaurus fragilis* (Late Jurassic/Early Cretaceous), and injuries seemingly related to intraspecific biting found in *T. rex* and *A. fragilis* are noted. [DHT]).

Monaghan, J., Rich, T. and Rich, P. 1991. Polar Dinosaurs Down Under. Terra, 29(4):22-27.

(lncludes mention of evidence of a healed tibia fracture in an unspecified Lower Cretaceous hypsilophodontid collected from Dinosaur Cove, Australia. This pathology was later determined to actually be a severe case of osteomyelitis. See Gross, Rich and Vickers-Rich, 1993; Long, 1998. [DHT]).

Monastersky, R. 1990. Reopening Old Wounds- Physicians and Paleontologists Learn New Lessons from Ancient Ailments. Sci. News, 137(3):40-42.

(Semi-popular discussion of paleopathological researches being carried out by D.H. Tanke on Late Cretaceous hadrosaurs; B.M. Rothschild's work on osteoarthritis (and the notable rarity of this pathological condition in dinosaurs); L.D. Martin and Rothschild's study of avascular necrosis in marine mosasaurs and turtles (one infected mosasaur caudal vertebra showing an embedded shark tooth), and their study of an American Late Pleistocene sinkhole deposit for mammalian pathology. [DHT] Format: Popular).

____ 1991. *Seismosaurus* Proteins: Bone of Contention. Sci. News, May 4:277.

(Popular-format article on the apparent discovery of fossilized bone proteins in the skeletal remains of the 150 million year old sauropod *Seismosaurus;* with critiques of this discovery by unconvinced colleagues. Unillustrated. [DHT]).

____ 1995a. Squeezing From a Stone. Sci. News, 148:314.

(Fossilized blood residues in Late Cretaceous *Tyrannosaurus rex* bone tissue; being studied by M. Schweitzer et al. Unillustrated. Format: Popular. See Schweitzer et al., 1996. [DHT]).

____ 1995b. For the Sake of Sue- What Will Happen to the World's Best *T. rex*? Sci. News, 148:316-317.

(Late Cretaceous *Tyrannosaurus rex* skeleton and legal custody battle over ownership. lncludes mention of the presence of a healed leg fracture [a fibula], [tooth] gouges on the side of the skull, and an embedded tooth in a rib [doubtful]. A life rendition of the animal, ".... with her chronically infected facial wounds...." is given. Format: Popular. [DHT]).

____ 1996. DNA from Dinosaurs: Impossible Dream?. Sci. News, 149(19):294.

(Most recent work on the problem of evidence for dinosaur DNA casts a dark cloud on the whole matter. Work by H.N. Poinar and others indicates that except for examples preserved in amber, DNA preserved in other ways will break down in several thousand to 100,000 years at the most. Unillustrated. Format: Popular. [DHT]).

____ 1997. *T. rex* Bested by Argentinean Beast. Sci. News, 151:317.

(lncludes comments on gout in Late Cretaceous *Tyrannosaurus rex*; see Rothschild, Tanke and Carpenter, 1997, 1997a. Osteopathy unillustrated. Format: Popular. [DHT]).

____ 1999a. Getting Under a Dinosaur's Skin. Sci. News, 155(3):38.

(Short note on exquisite skin impressions recently described in a Late Cretaceous hadrosaur; see Anderson et al., 1998. Format: Popular. lllustrated. [DHT]).

____ 1999b. Cancer in the Jurassic Ward. ibid, 156(9):141.

(See Rothschild, Witzke and Hershkovitz, 1999. Unillustrated. Format: Popular).

Mongelli, A., Jr., Varricchio, D.J. and Borkowski, J.J. 1999. Wear Surfaces and Breakage Patterns of Tyrannosaurid (Theropoda: Coelurosauria) Teeth. (Abstract). Jour. Vert. Paleo., 19(3):64A.

lsolated tyrannosaurid teeth (n=386) from the Campanian Two Medicine and Judith River Formations of Montana were examined for wear and breakage. Damage to premaxillary and lateral teeth were compared. The teeth studied fell into three subjective wear classes: class 1 (little or no wear), class 2 (slight to moderate wear), and class 3 (heavy wear). The latter class also contained teeth displaying smooth, nearly flat wear facets; such teeth broke while in the animal's mouth and post-break usage flattened and smoothed them. Observed tooth damage was also compared to observations on tooth wear and breakage reported for extant carnivores. Tyrannosaurid premaxillary teeth most frequently exhibited heavy wear (class 3), while slight to moderate wear (class 2) was the most common type among lateral teeth. lnterestingly, 47% (n=24) of the premaxillary teeth examined displayed smooth, nearly flat wear facets (indicative of post-break usage), while only 8.4% (n=28) of the lateral teeth examined displayed this type of breakage. Several hypotheses may be advanced to explain the much greater frequency of this breakage amid premaxillary teeth, including taphonomic processes, differential rates of tooth replacement, greater stresses and/or usage than lateral teeth, and less resistance to torsional forces than lateral teeth. Among these, the latter two are the best supported. [Author's abstract]).

Moodie, R.L. 1910. An Armored Dinosaur from the Cretaceous of Wyoming. Kansas Univ. Sci. Bull., 4(14):257-273.

(*Stegopelta landerensis*, Wyoming, USA. While not discussed specifically in the text, the dorsal surface of some isolated scutes and fused sections of armor from this animal bear anomalous, large circular pits, suggesting possible ectoparasite origins. Rare occurrences of similar pitting are known from unspecified ankylosaur scutes from the Late Cretaceous of Dinosaur Provincial Park, Alberta and in TMP collections. Pitting of armored dinosaur scutes appears similar to that seen in extant and extinct turtle shells. [DHT]).

____ 1916. Two Caudal Vertebrae of a Sauropodous Dinosaur Exhibiting a Pathological Lesion. Amer. Jour. Sci., 4th Ser., 41:530-531.

(Brief description of two fused sauropod tail vertebrae recovered from the Como Beds (Morrison Formation, Upper Jurassic) of Wyoming, USA. Moodie was uncertain as to this specimens' etiology, suggesting chronic osteomyelitis, healed break with excess callus development, or a bone tumor (hemangioma). He was evidently greatly impressed by this specimen, as it frequently appears in his subsequent publications. See also Rothschild and Berman, 1991 who believe this specimen represents a case of diffuse idiopathic skeletal hyperostosis or DISH. The whereabouts of this important historical specimen is currently unknown. lllustrated. [DHT]).

____ 1917. Studies in Paleopathology. I. General Consideration of the Evidences of Pathological Conditions Found Among Fossil Animals. Annals of Medical History, 1(4):374-393.

(Excellent overview of various pathological conditions found in a variety of extinct vertebrates over long geological time. Moodie reports on an exostosis on the scapula of an *Allosaurus;* infection in a *Camptosaurus* ilium and a sauropod *Cetiosaurus leedsi* with a distal tail (centrum) fusion. Reprinted in: Diseases in Antiquity. Edited by D. Brothwell and A.T. Sandison, 1967, Charles C. Thomas, Springfield, pp. 31-46. [BMR/DHT]).

____ 1918a. Paleontological Evidence of the Antiquity of Disease. Sci. Monthly, 7:265-281.

(A period by period review of pathological conditions found in extinct invertebrates and vertebrates. The article is well illustrated with photographs of actual specimens, and histological thin sections of same, a trademark of Moodie's subsequent projects. Moodie relates the fractured and poorly healed condition of two unspecified sauropod caudal vertebrae (see Moodie, 1916).[BMR]).

____ 1918b. Studies in Paleopathology II. Pathological Evidences of Disease Among Ancient Races of Man and Extinct Animals. Surgery, Gynecol. Obstet., 27(5):498-510.

(NOT SEEN. NOT INDEXED).

____ 1918c. Pathological Lesions Among Extinct Animals: A Study of the Evidences of Disease Millions of Years Ago. Surg. Clin. Chicago, 2:319-331.

(Evidences of diseases among ancient man and fossil animals known as paleopathology. Disease unknown for the first three-quarters of the history of life on earth. Fracture and callus among fossil vertebrates. The nature of callus 20,000,000 years ago. Necrosis and hypertrophy, exostoses, and their causes among extinct animals. Bacteriology of the past. Bacteria among the oldest evidences of life 100,000,000 years ago. Bacterial invasion of bone. Bacterial decay, fungi, and their evidences. Deforming arthritides of fossil vertebrates similar to recent arthritic lesions. Osteoma from a swimming reptile 16,000,000 years old. Haemangioma in the tail of a dinosaur 18,000,000 years old. The pathology of cave mammals the first to be studied. Bone pathology of early human races. No evidence of syphilis among extinct animals. Extinct diseases indicated among some of the lesions. Paleopathology just beginning to be understood. Study of fossil lesions does not change present conception of the nature of disease. [Author's abstract]).

____ 1918d. Studies in Paleopathology. III. Opisthotonos and Allied Phenomena Among Fossil Vertebrates. Amer. Nat., 52:384-394.

(The condition of opisthotonos, where a variety of factors result in the head being pulled strongly backwards, rigid limbs, and death are described in a variety of fossil vertebrates and compared to the condition in man. In some fossil specimens described by Moodie, the pulled back nature of the skull is more probably due to tightening of the neck musculature during rigor mortis, or simply reflects dried muscles of a dessicated carcass (*sensu* Dean, 1919), although see Moodie, 1919a, b. See also Matthew and Brown, 1923 and Davis, 1996. [DHT]).

____ 1919a. Opisthotonos. Science, 50:275-276.

(Response to Dean, 1919).

____ 1919b. New Observations in Paleopathology. Ann. Med. Hist., 2:241-247.

(Includes comments on dinosaur paleopathology.

On page 241, Moodie first discusses spondylitis deformans in *Camarasaurus, Diplodocus* and *Tyrannosaurus*. The condition in sauropods is now recognized as DISH (diffuse idiopathic skeletal hyperostosis). While fusion of caudals in *Diplodocus* is acknowledged, a confusing statement of: "Coalesced cervicals are known in *Camarasaurus, Diplodocus* and *Tyrannosaurus*....." While *Tyrannosaurus* cervical-dorsal fusion is known in the famous AMNH specimen, we are unaware of cervical fusions in the two sauropod taxa.

Subperiosteal abscess in a Canadian dinosaur mentioned on p. 242. This is transverse fracture of a hadrosaur humerus which the collector, Barnum Brown, is quoted as saying was the "....sickest fossil bone I have ever seen." See Swinton, 1934 for additional details on this specimen.

Necrotic sinuses in *Stegosaurus* dermal plates are noted, but no additional details provided, p. 244.

On pages 244-245, Moodie again promotes his idea that the opisthotonic position (neck greatly curved posteriorly and head thrown over the back) often seen in theropod dinosaur skeletons is related to poisoning and is not a taphonomic artifact. However, few have accepted this view. Unillustrated. [DHT]).

____ 1920. Concerning the Fossilization of Blood Corpuscles. Amer. Nat., 54:460-464.

(General discussion on suggestions of fossil and subfossil blood in the past literature. Moodie describes and illustrates possible blood corpuscles found in the metatarsal of the Upper Jurassic sauropod *Apatosaurus*. Seitz, 1907 speculated on the presence of fossilized blood in an Early Cretaceous *Iguanodon* specimen. See Martill and Unwin, 1997. [DHT]).

____ 1923a. Paleopathology- An Introduction to the Study of Ancient Evidences of Disease. University of Illinois Press, Urbana. 557 pp.

(Original compendium of perspectives, many of which are now reinterpreted in light of current understanding of disease and currently available technology. References to dinosaur pathology are scattered throughout the text. Unfortunately, Moodie does not make use of any specimen numbers anywhere in his text.

Pages 61-75 are entitled "Historical Account of Studies of Ancient Diseases." In this section, mention is made of fused caudal vertebrae in *Diplodocus*, a *Triceratops* skull exhibiting a jaw fracture, anomalous hole piercing the right frontal and a snapped off tip of the right orbital horncore. Trauma to an *Allosaurus* scapula and necrosis of a *Camptosaurus* ilium are also noted.

Pages 122-124 are entitled "Fractures and Callus in the Dinosaurs." Describes a rib fracture in an Upper Jurassic sauropod *Apatosaurus*, the pathology being first noted by E. Riggs in 1903. A jaw fracture and horn fracture (with loss of the distal portion) in two *Triceratops* specimens are noted. A severe humerus fracture in a Late Cretaceous dinosaur is described but unillustrated. Erroneously described as being from a ceratopsian, Moodie then refers the reader to a hadrosaur paper to see the normal morphology of the element. This bone is in fact a hadrosaur and is AMNH 5207. A cast of this specimen is housed at TMP collections and bears catalogue number TMP98.11.1. Moodie (pp. 123-124) describes this unique find as follows: "But one of the horned dinosaurs of the Edmonton Cretaceous of Canada, discovered by Barnum Brown and preserved in the American Museum of Natural History, had suffered an oblique fracture of the humerus which healed in a very bad way, because of an intense infection. The infection produced one of the sickest looking fossil bones known. On the anterior surface of the bone the periosteum had doubtless been greatly elevated by an ingrowth of callus, which later ossified into a bridge of bone connecting the lower articular surface with the enormous deltoid crest, and covering an enormous abscess, capable of holding several liters of pus. This is the only known fossil example of a subperiosteal abscess. There is no definite indication that the infection ever completely healed and the dinosaur doubtless had a huge sore discharging pus from his arm for many months and up to the time of his death. Besides indicating an interesting new type of pathology for Cretaceous reptiles this lesion also furnished undoubted proofs of the presence at that epoch of infective bacteria."

Pages 161-164 are entitled "Arthritic Lesions of the Dinosaurs." Here Moodie examines fusions, especially those affecting caudal vertebrae of Upper Jurassic sauropods. Arthritic conditions or failed predation trauma are considered as etiologies for such fusions, although in modern light, DISH seems more likely; see Rothschild and Berman, 1991. Trauma to the extreme distal end the tail in a specimen of the European sauropod *Cetiosaurus* is also considered.

Pages 164-165 are entitled "Spondylitis Deformans in the Dinosaurs." Again vertebral fusions of sauropods, likely afflicted with DISH, are described.

Pages 165-169 discuss fossilized blood.

Pages 245-246 are entitled "Necroses and Hyperostoses in the Dinosaurs." Necrosis of a *Camptosaurus* ilium (see Gilmore, 1909, 1912 and Lewin, 1982), hook-like exostosis of a *Triceratops* scapula (see Gilmore, 1919a) and a necrotic *Stegosaurus* plate (latter unillustrated) are described.

Page 254 "Skeletal Anomalies Among Fossil Vertebrates" includes an *Anatosaurus* scapula with an "anomalous vascular foramen;" see Beecher, 1902.

Pages 326-327, entitled "The Opisthotonic Attitude Among Ancient Birds and Dinosaurs" discusses the severe "head pulled back" nature of some fossil skeletons such as seen in *Compsognathus* and *Struthiomimus*. Moodie, 1918d, 1919 had suggested this condition was brought about by disease or by poisoning, but this was not readily accepted by his colleagues (see Dean, 1919). It is generally accepted today that this condition is a taphonomic artifact only (see Davis, 1996).

As is characteristic of Moodie's many works, this tome is profusely illustrated with detailed line drawings and photographs of microscopic thin sections of pathological bone. Most of the pathological conditions outlined above are figured as follows:

Plate 9a. Partial *Triceratops* skull showing right orbital horncore snapped off about halfway along the length; this caused by a fight or accident.

Plate 10a. 2 fused *Diplodocus* caudal vertebrae.

Plate 23a. *Allosaurus* scapula.

c. *Cetiosaurus* distal caudal vertebrae.

d. *Apatosaurus* rib fracture- detail of callus.

Plate 26a. *Triceratops* dentary fracture.

Figure 14. Cross section of hemangioma.

Figure 15. A series of 5 fused *Diplodocus* caudal vertebrae.

Plate 29a. 2 fused *Apatosaurus* caudal vertebrae.
b. 2 fused *Apatosaurus* caudal vertebrae (different specimen).
c. *Anatosaurus* scapula with large foramen.
Plate 30. 2 thins sections of hemangioma lesion; the sections were taken from the specimen figured in Plate 29b.
Plate 31. Microscopic study (drawing) from ".... periphery of the large tumor of the tail of a dinosaur...." [presumably sauropod].
Plate 32a-d. 3 thin sections of examples of hemangioma [presumably sauropod] and thin-section of another piece of [unspecified] dinosaur bone.
Figure 23. *Camptosaurus* skeleton with osteopathy affecting right ilium outlined [see Plate 50a for a more detailed view].
Plate 50a. *Camptosaurus* ilium with necrotic sinus.
b-c. *Triceratops* scapula with massive hook-like exostosis.
Plate 67a. Opisthotonic body position of *Struthiomimus*.
Plate 68b. Opisthotonic body position of *Archaeopteryx*.
c. Opisthotonic body position of *Compsognathus*.
Pathological conditions in plants, invertebrates, other vertebrates, ancient to comparatively recent Man and other aspects of paleopathology are also described and illustrated in detail. [DHT]).

____ 1923b. The Antiquity of Disease. University of Chicago Science Series, 147 pp.
(NOT SEEN. NOT INDEXED. Moodie has a history of repeating his findings across many papers and therefore it is likely that observations (such as those in Moodie, 1923a) are probably to be found in this Moodie publication).

____ 1926a. Studies in Paleopathology XIII: The Elements of the Haversian System in Normal and Pathological Structures Among Fossil Vertebrates. Biologica Generalis, 2:62-95.
(NOT SEEN. NOT INDEXED).

____ 1926b. Excess Callus Following the Fracture of the Fore Foot in a Cretaceous Dinosaur. Ann. Med. Hist., 8(1):73-77.
(The excess callus following fracture of metacarpals III and IV in an apparently adult hadrosaur, *Thespesius* [now *Edmontosaurus*] *annectens*, from the Upper Cretaceous of Montana, is of a size and condition often found in young animals at the present day. Irritation due to unusual activity may have been the cause of the vicious, angular union and was a factor in the production of the mass of callus. [Author's resume]. Well illustrated. Fractures in the lightly constructed hadrosaurian manus (metacarpals), rarely represented in the fossil record, were subject to osteomyelitis, which is not surprising in view of the thin overlying tissues. [BMR]).

____ 1927. Studies in Paleopathology XX. Vertebral Lesions in the Sabre-Tooth, Pleistocene of California, Resembling the So-Called Myositis Ossificans Progressiva, Compared with Certain Ossifications in the Dinosaurs. Ann. Med. Hist., 9(1):91-102.
(Moodie illustrates 4 fused caudal vertebrae USNM Upper Jurassic sauropod *Diplodocus*, p. 92. He ascribes this feature to "spondylitis deformans" and attributes its occurrence to injury or old age, p. 97. The presence and histological structure of dinosaur tendons is described and illustrated. Ossified tendons in dinosaurs are not considered pathological. Comparisons of sauropod caudal fusions are compared with lumbar spinal fusion in the Pleistocene sabre-toothed cat *Smilodon californicus*, examples of which are well illustrated in this paper. See also Moodie, 1928. [DHT]).

____ 1928. The Histological Nature of Ossified Tendons Found in Dinosaurs. Amer. Mus. Novit., 311:1-15.
(The histology of the ossified tendons of two genera of dinosaurs [Late Cretaceous hadrosaur *Anatosaurus* and ankylosaur *Ankylosaurus*] is structurally unlike that of the skeletal bone of fossil reptiles, in the presence of fairly well-developed Haversian systems. In this respect the tendons approach the structure of mammalian long bones. There is an absence of osteoid
The concentric lamellae are few, rarely more than six. The lacunae are shaped like those seen in skeletal bones of dinosaurs, and the canaliculi are few, short, and unbranched. [Author's summary]. See also Moodie, 1927).

____ 1930a. The Dinosaurs of Wyoming. Wyoming Geol. Surv., Bull. 22:xiii + 119 pp.
(NOT SEEN. NOT INDEXED. This small book also covers a variety of paleontological topics, several of which relate to paleopathology. Chapter 10 (pp. 48-55) is entitled "Evidences of Injury and Disease Among the Dinosaurs." Chapter 11 (pp. 56-58) is entitled "Structure of the Bones of Dinosaurs." Thin sections of normal and pathological dinosaur bone are presented. Other figures and comments on dinosaurian paleopathology can be found throughout the book. [DHT]).

____ 1930b. Studies in Paleodontology- Dental Abscesses in a Dinosaur Millions of Years Old, and the Oldest Yet Known. Pacific Dental Gazette, 38:435-440.
(Two unassociated hadrosaur jaws from the Campanian Judith River Fm. [now Dinosaur Park Fm.] of Dinosaur Provincial Park, Alberta, Canada are described and figured. Both were collected by Canada's first dinosaur paleontologist Lawrence Lambe, who described and figured them in 1902 (making them the first Canadian paleopathological specimens to be described), but their significance was not fully recognized at that time. The first, a left dentary, presents a large, hollowed-out pocket or abscess affecting the middle region of the dental series. The middle region of the jaw has been so affected that it is now only half of its' original height, greatly weakening the entire structure. The stacked tooth series behind the lesion are oriented vertically to the long axis of the ramus, which is the normal condition. However, anterior to the lesion the tooth rows are angled anteriorly. Moodie considered traumatic origins with infection for this lesion, perhaps the result of accidently biting a hard food or non-food item. The second specimen, a complete right maxilla also expresses an abscess, although it is not as large as the first example, again Moodie suggests a traumatic origin with infection. Moodie had planned to include these specimens in a monograph on paleopathology of dinosaurs but he died prior to its' completion. It is indeed curious that L. Lambe happened to collect the only two known specimens of hadrosaur jaws with abscesses in the very first professional expedition to what is now Dinosaur Provincial Park. Since that time numerous intensive field expeditions have worked this entire region. Hadrosaur jaws are commonly found (D. Tanke, pers. field observation) and collected, hundreds more must reside in various North American and European museums, yet the senior editor is unaware of any other examples similarly affected. [DHT]).

Moratalla, J., Sanz, J.L., Dominguez, I.M. and Jimenez, S. 1988. Yacimentos Paleoicnologicoas de La Rioja; Huellas de Dinosaurios. Gobierno de la Rioja, Espana, 95 pp.
(NOT SEEN. NOT INDEXED. Lower Cretaceous trackway of a large bipedal ornithopod showing alternating short and long footstrides suggestive of an injured (ie. limping) animal. See also Lockley, Hunt, Moratalla and Matsukawa, 1994. Language: Spanish. [DHT]).

Morell, V. 1993a. G-Men Capture *T. rex*. Discover, 14(1):80-82.
(The *Tyrannosaurus* skull figured on pages 80-81 exhibits pathological lesions affecting the right orbit, jugal, and surangular regions. Etiology of these wounds might be related to intraspecific face-biting behaviour (see Tanke and Currie, 1995, 1998 (2000)). Format: Popular. [DHT]).

____ 1993b. Dino DNA: The Hunt and the Hype. Science, 261:160-162.
(Discussion of possible fossil blood residues in Late Cretaceous *Tyrannosaurus*. See Reid, 1993. [DHT]).

____ 1994. Warm-Blooded Dino Debate Blows Hot and Cold. Science, 265:188.
(See Barrick and Showers, 1994. Format: Popular).

Morris, W.J. 1976. Mesozoic and Tertiary Vertebrates of Baja California, 1968-1971. Nat. Geogr. Soc. Res. Rpts., 1968 Projects:305-316.
(Details as per Morris, 1981).

____ 1981. A New Species of Hadrosaurian Dinosaur from the Upper Cretaceous of Baja California- ?*Lambeosaurus laticaudus*. Jour. Paleo., 55(2):453-462.
(LACM 17711, a left tibia, shows a relatively unexpanded proximal end and there is a deep, circular lesion 6 cm deep affecting the proximal (also identified as distal) articulating surface of the element; see figures 2 and 3. Trauma (a fracture) or growth anomaly is suggested as a causative agent. Morris believes this species of hadrosaur spent most of its life in the water; thus this particular injured animal would be buoyed up and relatively unaffected by its injury. It is stated that in this bone there is ".... one groove cut into the lateral surface [of the tibia] that could possibly have been made by a large carnosaur." It is unstated whether there were signs of healing or not, or whether this postulated bite was responsible for the anomalies borne by this specimen. Three "dorsal vertebrae" [actually proximal caudal vertebrae] are shown in figure 4. The middle one of the series appears to have a fractured and healed neural spine tip, with the distal portion showing moderate angulation. Identical specimens

of this type are well known from hadrosaur proximal caudal vertebrae recovered from the Late Cretaceous of Dinosaur Provincial Park, Alberta, Canada (Tanke, field observation and Royal Tyrrell Museum collections). Osteopathy illustrated. [DHT]).

Muller, A.H. 1963. Uber Dinosaurier-Eier aus der Oberkreide (Dan.) Frank-reichs, unter Besonderer Berucksichtigung der Elektron-mikro-skopischen Strukturen. [On Dinosaur Eggs from the Upper Cretaceous (Dan.) of France, with Particular Consideration of the Electron-Microscopic Studies]. Monatsber. Deutsch Akad. Wiss. Berlin, 5(2):75-87.

(NOT SEEN. NOT INDEXED. Dinosaur egg pathology. Language: German).

Muyzer, G., Sandberg, P., Knapen, M.H.J., Vermeer, C., Collins, M. and Westbroek, P. 1992. Preservation of the Bone Protein Osteocalcin in Dinosaurs. Geology, 20:871-874.

(Two different immunological assays were used to identify the remains of bone matrix protein, osteocalcin (OC), in the bones of dinosaurs and other fossil vertebrates. Antibodies raised against OC from modern vertebrates showed strong immunological cross-reactivity with modern and relatively young fossil samples and significant reactions with some of the dinosaur bone extracts. The presence of OC was confirmed by the detection of a peptide-bound, uniquely vertebrate amino acid, (gamma-carboxyglumatic acid (GLa). Preservation of OC in fossil bones appears to be strongly dependent on the burial history and not simply on age. These results extend the range of protein preservation in the geologic record and provide a first step toward a molecular phylogeny of the dinosaurs. [Author's abstract]).

Myhrvold, N.P. and Currie, P.J. 1998. Supersonic Sauropods? Tail Dynamics in the Diplodocids. (Abstract). p. 41. In: The Dinofest Symposium. Edited by D.L. Wolberg, K. Gittis, S. Miller, L. Carey and A. Raynor. The Academy of Natural Sciences, Philadelphia, Pennsylvania. April 17-19, 1998.

(Computer models of the tail of *Apatosaurus louisae* show it could reach supersonic velocities, producing a noise analogous to the "crack" of a bullwhip. Similarity in tail structure suggests this was feasible for other diplodocids, and possibly unrelated forms like *Mamenchisaurus* and the dicraeosaurids. Lengthening of caudal vertebrae centra between positions 18 and 25 is consistent with adaptation to the stresses generated by such tail motion, as is ossification of vertebrae via diffuse idiopathic skeletal hyperostosis (DISH), which occurs in the same region in about half the specimens. The noise produced may have been used for defence, communication, intraspecific rivalry, or courtship, in which case the "cracking" may have been a sexually dimorphic feature. Comparisons with the club-bearing tails of the sauropods *Shunosaurus lii* and *Omeisaurus tianfuensis* show the diplodocid whiplash tail was not well adapted as a direct-impact weapon, bringing the tail-as-weapon hypothesis into doubt. [Author's abstract]).

N

Naeye, R. 1993. If I Only Had Eight Hearts. Discover, 14(1):50.

(In 1992 the American Museum of Natural History remounted their Late Jurassic sauropod *Barosaurus* in a spectacular and controversial fully bipedal pose, with a large adult rearing up to protect its young against a predatory *Allosaurus*. This pose prompted Columbia University cardiologist Daniel Choy to speculate whether *Barosaurus* had more than one heart, because the blood pressure required for this feat would have been seven times that of a human, and with only one heart would have been "... a prescription for a stroke...." Choy and colleague P. Altman suggest a series of seven additional "hearts" (single chambered outgrowths of the arteries) along the neck would be required to allow the animal to rear up. [DHT]).

____ 1996. *T. rex* Gets Tougher. Earth, 5(1):12.

(Intraspecific fighting with resultant injuries and speculations on possible cannibalistic behaviour in this dinosaur. [DHT]).

Naish, D. 2000. A Small, Unusual Theropod (Dinosauria) Femur from the Wealden Group (Lower Cretaceous) of the Isle of Wight, England. Neues Jb. Geol. Palaont. Mh., 2000(4):217-234.

(An isolated femur shows extensive pitting on the proximal end, indicating pathology or extreme young age of the individual. Naish concludes: ".... but in view of features that might indicate juvenility or pathology the possibility exists that it represents an unusual, juvenile or deformed tetanuran." Illustrated. [DHT]).

Nash, P. 1998. New Discoveries in Amber from the Cretaceous of New Jersey. (Abstract). pp. 41-42. In: The Dinofest Symposium. Edited by D.L. Wolberg, K. Gittis, S. Miller, L. Carey and A. Raynor. The Academy of Natural Sciences, Philadelphia, Pennsylvania. April 17-19, 1998.

(Includes mention of Turonian-aged midges in amber from central New Jersey, USA and their possible predaceous habits on dinosaurs. [DHT]).

Niiler, E. 2000. Most Ferocious Dinosaurs Would fit Nickname "Scarface." Christian Science Monitor, 92(187):15. (Also found on Internet on August 24, 2000 at: http://www.csmonitor.com/durable/2000/08/17/p15s1.htm

(Includes comments on intraspecific face-biting behavior in large theropods; see Tanke and Currie, 1998 (2000). Osteopathy unillustrated. Format: Popular. [DHT]).

Nopcsa (Nopsca), F. 1917. Notizen Uber Dinosaurier. 2. Die Riesenformen unter den Dinosauriern. [Notes on Dinosaurs. 2. The Giant Forms Among the Dinosaurs]. Centralbl. f. Min., Geol. u. Palaeont., Stuttgart, 1917:332-351.

(NOT SEEN. NOT INDEXED. Acromegaly in dinosaurs. Language: German).

____ 1930. Zur Systematik und Biologie der Sauropoden. [The Systematics and Biology of Sauropods]. Palaeobiologie, 3:40-52.

(NOT SEEN. NOT INDEXED. Discusses soft tissue preservation, muscle tissues. Language: German).

Norell, M.A., Clark, J.M., Chiappe, L.M. and Dashzeveg, D. 1995. A Nesting Dinosaur. Nature, 378:774-776.

(Spectacular fossil of the Late Cretaceous small theropod *Oviraptor* found sitting on a nest of eggs. It is briefly considered that the animal died while laying the eggs, but as no eggs were found inside the body cavity, this idea is discounted. While not mentioned in the text, figure 1 and the breathtaking color photograph on the front cover of this issue of Nature shows a fracture callus on the mid-shaft region of the left ulna).

____, Gaffney, E.S. and Dingus, L. 1995. Discovering Dinosaurs in the American Museum of Natural History. Alfred A. Knopf, Inc., New York. xx + 204 pp.

(Includes information relevant to the present bibliography. Pages 42-44 "Did dinosaurs fight?" discusses the Late Cretaceous *Velociraptor* found intertwined with its' prey; a *Protoceratops*. Healed intraspecific bite wounds in the large Late Cretaceous *Tyrannosaurus* are acknowledged. Of special interest though, is the braincase of a *Velociraptor* showing unhealed bites wounds to the dorsal surface. A fatal intraspecific fight is implicated. The victim showed no indications of scavenging, suggesting the fatal wounds were truly incurred in a fight only. This rare and unique specimen is figured on page 42. Page 71-73 discusses "Has any dinosaur DNA been found?" "Mass accumulations" [=mass mortality] is indicated for the Late Triassic *Plateosaurus engelhardti*, p. 98. The presence of "nine extra hearts" in the Late Jurassic sauropod *Barosaurus lentus* (postulated by Choy and Altman, 1992) is described as "A particularly foolish response...," p. 105. Mass mortality in the Late Cretaceous ceratopsian *Chasmosaurus* is recorded in "bone beds that contain numerous individuals," p. 174. This comment is partly in error. While a single *Chasmosaurus* bonebed is known from Texas, USA, no confirmed *Chasmosaurus* bonebeds are recorded from Alberta, Canada where remains of this form are most common. However, bonebeds of the ceratopsian *Centrosaurus*, *Styracosaurus* and *Pachyrhinosaurus* are well documented in that province. Format: Popular. [DHT]).

____ and Makovicky, P.J. 1997. Important Features of the Dromaeosaur Skeleton: Information from a New Specimen. Amer. Mus. Novitates, 3215:28 pp.

(A partial skeleton of an unspecified dromaeosaurid, collected from the Late Cretaceous of Tugrugeen Shireh, Mongolia showed a pathologic defect- a bifurcated gastral rib element. The condition is considered as an "individual abnormality." Illustrated; see page 7, fig. 5. [DHT]).

Norman, D.B. 1980. On the Ornithischian Dinosaur *Iguanodon bernissartensis* from the Lower Cretaceous of Bernissart (Belgium). Inst. Royal Sci. Nat. Belgique, Mem. Number 178, 103 pp.

(Page 44, states that it is ".... not uncommon to find two [distal] caudal vertebrae fused together; this is undoubtedly a pathological condition

resulting from injury to the tail during life of the dinosaur." Osteopathy unillustrated. [DHT]).

____ 1985. The Illustrated Encyclopedia of Dinosaurs. Crescent Books, London, 208 pp.

(Pages 70-71 note the presence of fused vertebrae in the Late Cretaceous *Tyrannosaurus* skeleton found in 1908. Norman incorrectly diagnoses this condition as "severe arthritic pain." DISH (diffuse idiopathic skeletal hyperostosis) would be another, more probable cause. On page 139 it is suggested that the pronounced fronto-nasal boss in the unusual Late Cretaceous ceratopsian *Pachyrhinosaurus* is the pathological remnant of a snapped off nasal horncore. Subsequent excavations of numerous skulls or isolated nasal bosses of *Pachyrhinosaurus* from a "monospecific" bonebed near Grande Prairie, Alberta, Canada show that this idea is incorrect and that the nasal boss is a normal feature developed at onset of full adult size and presumed sexual maturity; see Sampson et al, 1997. Norman incorrectly refers to osteoarthritis as a common disorder of prehistoric animals. Multiple myeloma affecting the squamosal of the latest Cretaceous ceratopsian *Torosaurus latus* is suggested on pages 143-144. Diagnosis, however is not established. [DHT]. Format: Popular/Technical).

____ 1994. Prehistoric Life - The Rise of the Vertebrates. Macmillan, New York. 246 pp.

(Drowning causes mass mortality of Late Cretaceous ceratopsian *Centrosaurus*; p. 173. Remains of this genus are found in large bonebed deposits in Alberta, Canada. Format: Popular. [DHT]).

____ and Milner, A. 1989. Dinosaurs. Stoddart Pub. Co., Ltd., Toronto, 64 pp.

(Several dinosaurian paleopathologies are figured on pages 48-49. The first is an *Iguanodon* ischium, the proximal shaft of which was broken and healed with callus formation. The second specimen consists of at least 4 articulated ?dorsal vertebrae of a hadrosaur. One of the vertebrae bears a "tumor growth" on the postero-ventral edge of the centrum. Locality information for each specimen is not given, the *Iguanodon* ischium is almost certainly from the Lower Cretaceous of England, and the hadrosaur specimen is probably from the Late Cretaceous of either Alberta, Canada, or the western United States. Format: Popular. [DHT]).

Nowicki, Z., Sarnecka-Keller, M., Pawlicki, R., Kubiak, H. and Korbel, A. 1972. Morphological and Chemical Analysis of the Structure of the Fossil Dinosaur Bone. Anat. Anz., 132:1023.

(NOT SEEN. NOT INDEXED).

O

Oelofsen, B.W. 1978. Atmospheric Carbon-Dioxide/Oxygen Imbalance in the Late Cretaceous, Hatching of Eggs, and Extinction of Biota. Pal. Afr., 21:45-51.

(Includes a short discussion on pathological thinning of dinosaurian eggshell. [DHT]).

Okino, D. 1997. Science Bits- Arthritic *T. rex*. The Boston Globe, May 26, 1997:C2.

(Four panel cartoon inspired by recent publication on gout in Late Cretaceous tyrannosaurids. See Rothschild, Tanke and Carpenter, 1997, 1997a. [DHT]).

Olert, C. 1997. Bones of Contention: Who Will Buy Priceless "Sue"? The Denver Post, Sunday, Sept. 28, 1997:__.

(Late Cretaceous *Tyrannosaurus* skeleton with a conspecifics tooth embedded in a rib, gouged skull, crushed left lower jaw and a broken leg [fibula]. The article speculates the skeleton will auction off for more than $1 million, it actually sold for $9 million U.S.! Format: Popular. [DHT]).

Olinger, D. 1987a. Pipestone Dino Dig Hosts Open House. Grande Prairie Herald-Tribune, August 21, 1987:__.

(Newspaper article noting the discovery of the first paleopathological specimen recovered from the Late Cretaceous (73 million ybp) Pipestone Creek *Pachyrhinosaurus* bonebed in northwestern Alberta, Canada. This specimen consists of 4 fused adult distal caudal vertebrae (TMP87.55.102; affected by DISH?). Format: Popular. [DHT]).

____1987b. Pipestone Bed Proves Rich Find- 1,000 Dinos May Have Died. Grande Prairie Herald-Tribune, Wed., Sept. 2, 1987, p. 3.

(Newspaper article relating the discovery of another paleopathology from the *Pachyrhinosaurus* bonebed, in this case an adult left scapula (TMP87.55.190) bearing a smooth rounded knob (exostosis) on its' external surface; etiology undetermined. The possibility that this bone assemblage represents a mass-mortality event is also considered. Format: Popular. [DHT]).

Olshevsky, G. 1988. Pachyrhinosaurs from Pipestone Creek, Alberta. In: Dinosaurs at the 48th Annual SVP Meeting. Archosaurian Articulations, 1(6):41-43.

(Brief review of presentation given by D. Tanke on the findings from the Late Cretaceous Wapiti Formation *Pachyrhinosaurus* bonebed, including discovery of several pathological frills (parietals) of this unusual ceratopsian. [Fractured in life, with loss of some portions]. Format: Popular. [DHT]).

____ 1989. More Sauropods from China. Archosaurian Articulations, 1(8):57-63.

(Comments on another specimen of the Upper Jurassic sauropod *Shunosaurus lii* exhibiting a club-like appendage on the tip of the tail. Several specimens are now known to possess this feature, suggesting this is a normal condition, and thus casts doubt on Tanimoto's 1988 suggestion that this was a pathological feature. Format: Popular. [DHT]).

____ 1994. [The Origin and Evolution of the Ceratopsians]. In: Gakken Mook, 6:78-99.

(Acknowledges the use of mono- or paucispecific ceratopsian (Late Cretaceous ceratopsian) bonebeds for paleopathology studies. Olshevsky states that supposed strong jaw muscles attached to the frill would cause it to collapse during a strong bite. Extra openings in the frills, broken frills and horns of unspecified ceratopsians is evidence for intraspecific fighting. In fact Olshevsky goes as far as to state the development of horns was solely (emphasis his) for adult intraspecific fighting. Language: Japanese; English translation available. Format: Popular. [DHT]).

Osborn, H.F. 1899. A Skeleton of *Diplodocus*. Mem. Amer. Mus. Nat. Hist., 1:191-214.

(NOT SEEN. NOT INDEXED. Mentions fusion of caudal vertebrae. [DHT]).

____1904. Manus, Sacrum, and Caudals of Sauropoda. Bull. Amer. Mus. Nat. Hist., 20:181-190.

(Fusion of caudals 17-18, 19-21, and their respective chevrons in AMNH 655 *Diplodocus longus* from the Upper Jurassic are briefly described, figured and acknowledged as a "resting point" area on the tail. This specimen was subsequently examined by other researchers of paleopathology, see Blumberg and Sokoloff, 1961; Rothschild and Berman, 1991. [DHT]).

____1916. Skeletal Adaptations of *Ornitholestes, Struthiomimus, Tyrannosaurus*. Bull. Amer. Mus. Nat. Hist., 35:733-771.

(Opisthotonus (the postmortem strong backward curving of the neck) is well illustrated in the AMNH *Struthiomimus* skeleton. Moodie, 1918d considered this as possible evidence for strychnine poisoning- an idea not embraced by his colleagues. [DHT]).

____1924. Three New Theropoda, *Protoceratops* Zone, Central Mongolia. Amer. Mus. Novit., 144:1-12.

(Includes a description of AMNH 6517 *Oviraptor philoceratops* from the Djadochta Beds (Late Cretaceous) of Mongolia. The skeleton of AMNH 6517 was found only four inches above a nest of dinosaur eggs, Osborn suggested it was overwhelmed by a sandstorm while trying to dig up the eggs, although the crushed nature of the *Oviraptor* skull has led to a general consensus among some vertebrate paleontologists that the *Oviraptor* may have had its head crushed underfoot by the vigilant mother. While this is a novel suggestion, crushing by post-depositional sediment compaction could also be considered. Discoveries of new *Oviraptor* material by the AMNH in the early to mid 1990's actually showed that this particular occurrence and another new find actually represents a dinosaur sitting "brooding" a nest of eggs. See Norell et al., 1995. [DHT]).

Osmolska, H. 1993. Were the Mongolian "Fighting Dinosaurs" Really Fighting? Revue de Paleobiologie, Vol. Spec., 7:161-162.

(Considers that the occurrence of Late Cretaceous *Velociraptor* and *Protoceratops* were not actually fighting, and that the *Velociraptor* was attacking a bogged down and helpless herbivore, or was scavenging its carcass when it too died from unknown causes. See also Barsbold, 1974 and Kielan-Jaworowska and Barsbold, 1972. Illustrated. [DHT]).

Ostrom, J.H. 1963. *Parasaurolophus cyrtocristatus*, a Crested Hadrosaurian Dinosaur from New Mexico. Fieldiana: Geol. 14:143-168.

(On page 162, Ostrom notes a pathological condition on the left fibula of this Late Cretaceous hadrosaur. The injury appears to be a healed

fracture. [DHT]).

____ 1969. Osteology of *Deinonychus antirrhopus*, an Unusual Theropod from the Lower Cretaceous of Montana. Bull. Peabody Mus. Nat. Hist., 30:165 pp.

(On page 144, Ostrom notes *Deinonychus* remains intermingled with that of possible prey *Tenontosaurus*. It is postulated that these occurrences represent interspecific predation situations resulting in the death of not only prey, but several of the attacking carnivores as well. This idea was further explored by Maxwell and Ostrom, 1995).

____ 1976. On a New Specimen of the Lower Cretaceous Dinosaur *Deinonychus antirrhopus*. Breviora, 439:1-21.

(Page 13 includes a short description of a broken and healed Digit II, 2 pedal phalanx of this small carnivorous dinosaur collected from Montana, USA. [A pathologic pedal phalanx (TMP81.26.145) demonstrating similar osteopathy is known in an unspecified Late Cretaceous dromaeosaurid from Dinosaur Provincial Park, Alberta, Canada]. Unillustrated. [DHT]).

____ 1994. *Deinonychus*, The Ultimate Killing Machine. pp. 127-137. In: Dinofest. Edited by G.D. Rosenberg and D.L. Wolberg. Paleontological Soc. Spec. Publ. No. 7.

(Mass mortality in Early Cretaceous small theropod *Deinonychus*, whereby hunting pack members are killed by the struggles of their prey. See Maxwell and Ostrom, 1995 for full study. Illustrated. [DHT]).

____ and Wellnhofer, P. 1986. The Munich Specimen of *Triceratops* with a Revision of the Genus. Zitteliana, 14:111-158.

(In this review of *Triceratops*, pathological conditions in several specimens are noted and briefly discussed. The authors conclude and accept previous interpretations of extra squamosal fontanelles as pathologic and related to injury, disease, or preservation. [DHT]).

Owen, R. Sir 1856. Monograph on the Fossil Reptilia of the Wealden and Purbeck Formations. Part III. Dinosauria (*Megalosaurus*). [Wealden]. ibid:1-26.

(While not described as such in the text, Plate 4, figure 1 shows a cervical rib of *Megalosaurus* that appears to have a well healed fracture of the ventral neck region. [DHT]).

P

P., S. 1924. The Study of Palaeopathology: Notices. Biometrika, 16(1/2):200-202.

(Review of Moodie, 1923a. Includes mention of serious fracture of hadrosaur humerus. On opisthotonus the writer comments: ".... Whilst a dinosaur found in the Alberta Chalk with a backward curve of its neck probably died in spasms from eating a poisonous plant, we must confess rather tempted us to laughter." [DHT]).

Paabo, S. 1993. Ancient DNA. Sci. Amer., November, 1993:86-92.

(Good, general discussion on various aspects of ancient DNA preservation and study. Difficulties of potential contamination and DNA breakdown over long periods of time is explored. Illustrated. [DHT]).

Paladino, F.V., Spotila, J.R. and Dodson, P. 1996. Which Physiological Blueprint Provides the Best Fit to Explain Dinosaurian Cardiovascular, Respiratory and Metabolic Paleobiology: Reptilian, Mammalian or Avian? (Abstract). pp. 88-89. In: Dinofest International, Program and Abstracts. Arizona State University, April 18-21, 1996. Edited by D.L. Wolberg and E. Stump.

(Healing rates of fractured dinosaur bones, if determinable, would provide much insight into the questions posed by the authors. See Tumarkin et al., 1999. [DHT]).

Parkinson, J. 1930. The Dinosaur in East Africa. Witherby, London, 192 pp.

(Brief mention of paleopathologist Roy Moodie's work on page 161. Format: Popular).

Park, E.-J. 2000. Tooth fossils of Cretaceous Dinosaurs from Korea and Canada. Department of Geology, Doctor of Science Thesis, Kyungpook National University, Korea. iv + 123 pp.

(Includes SEM photographs of *Paronychodon* tooth TMP 94.12.406 from Dinosaur Provincial Park, Alberta. These include closeups showing tooth enamel microstructure. See pp. 25, 52-53, 98-99. Some authors consider *Paronychodon* teeth pathologic, the author does not address this porbelm in this thesis. Illustrated. [DHT]).

Parks, W.A. 1921. The Head and Forelimb of a Specimen of *Centrosaurus apertus*. Trans. Roy. Soc. Can., (3), 15, sect. IV:53-64.

(Quarry 1, Dinosaur Park Formation (Campanian), Dinosaur Provincial Park, Alberta, Canada. Includes mention of a fractured and healed left lateral parietal. One of us [DHT] has seen this specimen and Parks' diagnosis appears correct. [DHT]).

____ 1922. *Parasaurolophus walkeri*- a New Genus and Species of Crested Trachodont Dinosaur. Univ. Toronto Stud., Geol. Ser., 13:1-32.

(The type specimen of this rare and unusual crested hadrosaur collected from the Campanian Dinosaur Park Formation of Alberta, Canada is described. Some traumatic pathology with evidence of healing was present on the torso skeleton. On the left side, dorsal ribs four, five, and six were broken above the dorsal edge of the scapula and healed with prominent callus development. Dorsal neural spines five, six, and seven also exhibit an anomalous condition. Here the neural spine of the fifth dorsal is inclined backwards, and tip of neural spine seven is inclined strongly forward and is joined to the tip of neural spine six by a rugose, rounded pad of bone. Parks briefly considered it pathological, but also considers it as a normal attachment point for a frill of skin attached to the back of the crest. The latter interpretation has been accepted by many dinosaur artists who have drawn or sculpted animals with the large skin flap. The close proximity of rib fractures and the absence of a similar bony pad in a *Parasaurolophus* skeleton from New Mexico, USA (Ostrom, 1963) would indicate a traumatic etiology for all these lesions. See also Lull and Wright, 1942:211. Illustrated. [DHT]).

____ 1925. *Arrhinoceratops brachyops*, a New Genus and Species of Ceratopsia from the Edmonton Formation of Alberta. ibid, 19:1-15.

(The type specimen of this Late Cretaceous ceratopsian bears an extra circular opening high up on the left squamosal. Such features are found regularly in other ceratopsian skulls (especially chasmosaurines), particularly the long-frilled forms of the subfamily Chasmosaurinae. The significance of the lesion is not clear, Parks thought it might be pathologic, later authors have accepted or disagreed with this interpretation, based on specimens of other ceratopsian genera. See Wiman, 1930; Mateer, 1981; Rowe, Colbert, and Nations, 1981; Tanke, submitted b, Tanke and Farke, ms for discussions of extra squamosal fontanelles in ceratopsians. [DHT]).

____ 1928. *Albertosaurus arctunguis*, a New Species of Therapodous Dinosaur from the Edmonton Formation of Alberta. ibid, 25:1-42.

(The author describes a large portion of a tyrannosaur skeleton, which was collected from the Late Cretaceous Horseshoe Canyon Formation near Drumheller, Alberta, Canada. In comparing this specimen to a *Gorgosaurus* described earlier by Lambe (1917), Parks suggests that left metatarsal IV in Lambe's specimen is in fact pathological. [DHT]).

____ 1935. New Species of Trachodont Dinosaurs from the Cretaceous Formations of Alberta- with Notes on Other Species. ibid, 37:1-45.

(Plate III of the uncrested hadrosaur *Edmontosaurus* (*Thespesius*) *edmontoni* collected near Drumheller, Alberta, Canada, shows a right mid dorsal rib of this individual broken at mid-length and healed with a prominent callus. [DHT]).

Parrish, J.M. 1997. Genetics. pp. 271-273. In: Encyclopedia of Dinosaurs. Edited by P.J. Currie and K. Padian. Academic Press, San Diego. xxx + 869 pp.

(Good overview of the status of DNA studies in dinosaurs and caveats involved therein. Unillustrated. [DHT]).

Paty, A.H. 2001. Taking Time for Timely Exhibits in Denver. Geotimes, 46(11):55, 63.

(Mention of "*Hadrosaurus*" (actually *Edmontosaurus*) showing injuries incurred by the bite of a predator. Osteopathy unillustrated. See Carpenter 1988a, 1998, 2000 for descriptions of this specimen. [DHT]).

Paul, G.S. 1988. Predatory Dinosaurs of the World. Simon and Schuster, New York. 464 pp.

(On page 369, Paul suggests the occurrences of intermingled skeletal remains of the Early Cretaceous medium-large sized ornithopod *Tenontosaurus* and small theropod *Deinonychus* is explained as all of the latter dying simultaneously while feeding on the carcass of the former. However, Maxwell and Ostrom, 1995 challenge this view and suggest the *Tenontosaurus* was able, in its' death struggles, to kill some of its' attackers before finally being overwhelmed. [DHT]).

____ 1991. The Many Myths, Some Old, Some New, of Dinosaurology. Mod. Geol., 16:66-99.

(States that ceratopsian horns were well designed to wound attacking predators; non-interlocking nasal horns of some species were "also good for seriously injuring opponents during intraspecific combat." Tail spines of the Late Jurassic stegosaur *Stegosaurus* were arranged to enhance their wounding ability, and ankylosaur tail clubs had sharp dorso-lateral rims [not always true, some show rounded edges - DHT] to enhance the effect of their impact. Pachycephalosaurs are traditionally restored as partaking in intraspecific head-butting. Paul states this would put dangerous lateral torques on the neck, and intra- and interspecific flank butting was more probable (See Tanke, 1988a, Carpenter, 1993, 1997; Ford, 1998 and Goodwin et al., 1998 for additional comments on the latter). [DHT]).

____ 1998 (not published until 2000). Limb Design, Function and Running Performance in Ostrich-Mimics and Tyrannosaurs. GAIA, 15:257-270. In: Aspects of Theropod Paleobiology. Edited by B.P. Perez-Moreno, T. Holtz Jr., J.L. Sanz, and J. Moratalla. 403 pp.

(Includes discussion on running tyrannosaurs, especially *Tyrannosaurus*, their running, falling, resultant injuries and consequences. See Farlow, Smith and Robinson, 1995. [DHT]).

Pawlicki, R. 1975. Studies of the Fossil Dinosaur Bone in the Scanning Electron Microscope. Zeit. Mikrosk.-Anat. Forsch., Leipzig, 89(2):393-398.

(The bone of dinosaurs have already been the object of investigations in the light and transmission electron microscopes. Moreover this bone has been subjected to biochemical analysis. Nevertheless, so far no scanning electron microscopic images of the fossil dinosaur bone have been presented. The present study fills this gap. The observations reported here may add to our idea of the spatial structure of this tissue. [Author's abstract]).

____ 1976. Preparation of Fossil Bone Specimens for Scanning Electron Microscopy. Stain Tech., 51:147-152.

(A method is described for preparing fossil bone specimens for scanning electron microscopy. To obtain bone surfaces suitable for study, material was embedded in Epon 812 and selected faces exposed by grinding were subjected to controlled etching with a 4:1 mixture of 5% HNO_3 and 1% OsO_4. Surfaces thus prepared were further processed by the so-called clearing replicas technique. As a result of this procedure the bone surfaces revealed a network of anastomosing vascular canals the inner surface of whose walls could be examined in the scanning electron microscope. By etching extremely thin ground sections of bone stuck to plastic tape the contents of vascular canals as well as osteocytes can be isolated. This method ensures the good preservation of spatial relations between bone elements essential for studies of fossil bones, which are sometimes very brittle. [Author's abstract]).

____ 1977a. Histochemical Reactions for Mucopolysaccharides in the Dinosaur Bone. Studies on Epon- and Methacrylate-Embedded Semithin Sections as Well as on Isolated Osteocytes and Ground Sections of Bone. Acta Histochem. Bd. 58:75-78.

(The dinosaur bone was examined with the aim to detect in it the presence of mucopolysaccharides. The methacrylate- and Epon-embedded semithin sections of the studied bone were found to contain substances giving positive reaction on application of histochemical procedures used for identification of mucopolysaccharides (mucosubstances). These substances were also shown to be localized in the perivascular space, within the vascular canal, and around the osteocytes. The distribution of mucopolysaccharides in the dinosaur bone turned out to be comparable with their distribution in the bones of contemporary animals. [Author's abstract]).

____ 1977b. Topochemical Localization of Lipids in Dinosaur Bone by Means of Sudan B Black. ibid, 59:40-46.

(A dinosaur bone [*Tarbozauru* [sic] *bataar*: Tyrannosauridae] was examined with the aim to demonstrate in it the presence of lipids and to determine their localization. Ground sections of the bone in question revealed the presence of substances yielding positive reactions on application of a histochemical method used for identification of lipids. Moreover, these substances were found to be localized in the vascular canal, precisely, in the perivascular space. Localization of lipids in a dinosaur bone appeared to be comparable with the distribution of these substances in human bone and contemporary animals. [Author's abstract]. The proper genus name spelling is *Tarbosaurus*).

____ 1978a. Morphological Differentiation of the Fossil Dinosaur Bone Cells- Light, Transmission Electron-, and Scanning Electron-Microscopic Studies. Acta Anat., 100:411-418.

(The investigation was carried out on the fossil dinosaur bone from before 80 million years. Samples for examination were prepared with specially elaborated methods. Thus the isolated osteocytes of the dinosaur bone, which had previously undergone natural fossilizing processes, were obtained. This permitted their morphological assessment. On the basis of the images obtained in the light, transmission electron, and scanning electron microscopes, two types of osteocytes were distinguished. Type l was characterized by an elongated shape, its length exceeding the width several times; the mean dimensions of this osteocyte amounted to 28.8/7.03 μιχρονσ. Type ll was shorter, its mean dimensions being equal to 20.28/6.88 μιχρονσ. Moreover, two types of osteocytes processes were differentiated: the first was represented by thick processes, so-called "axial processes," whose diameter ranged from 0.5 to 15 μιχρονσ, and which, as a rule, departed from the pole of the cell. They ran farther from the mother cell body to more distant osteocytes. The other type consisted of thin processes departing from various points of the cell body in no particular arrangement but always extrapolarly. They branched off in a close vicinity of the mother osteocyte. Their diameter ranged between 0.076 and 0.35 μιχρονσ. [Author's abstract]).

____ 1978b. Methods of Preparation of Fossil Bone Samples for Light and Transmission Electron Microscopy. Stain Tech., 53(2):95-102.

(The methods described make possible the preparation of bone samples for light and transmission electron microscopy. To obtain good images with ground sections of bone, both the grinding process and classical bone staining techniques were modified, the latter by staining already made ground sections. Ground sections of suitable thickness were etched with a 4:1 mixture of 5% HNO_3 and 2% OsO_4 at a lowered temperature, thereby obtaining isolated osteocytes with a complete network of processes. Using the same method with thicker ground sections, the contents of vascular canals were isolated. The contents retained spatial relations permitting complete reconstruction of the vascular system of the bone in question. The isolated osteocytes, the vascular canal contents, and the isolated remnants of the intercellular organic part of this bone, subsequently embedded in Epon 812 and in methacrylate, made possible sections suitable for detailed analysis of the image of the surfaces of these elements. Polished surfaces of the fossil bone were replicated by the so-called clearing replicas technique. This was followed by replication performed with the modified combined replicas technique adapted to fossil bone. The latter facilitated analysis of the ultrastructure of the surfaces of the vascular canals, isolated osteocytes and their processes, and analysis of the immediate proximity of these elements, since the technique preserves the mutual spatial relations intact. [Author's abstract]).

____ 1983. Metabolic Pathways of the Fossil Dinosaur Bones. Part I. Vascular Communication System. Folia Histochem. et Cytochem., 21(3):253-262.

(80 million year old dinosaur bones were studied, images of the spatial distribution of vascular canals were observed through the use of light, and scanning electron microscopes. Besides, the contents of these canals were isolated; the contents fully corresponded to the vascular network in the dinosaur bones under study, this permitted the morphological assessment of the vascular system. In the dinosaur bone, independently of its type, i.e. whether it was primitive eg. plexiform, or Haversian, two blood inflow tracts were distinguished: the main, primary tract running from the marrow cavity, and the secondary tract departing from the periosteum. Examinations made with the use of an X-ray microanalyzer corroborated the essential importance of the tract running from the marrow cavity, revealing the presence of the same material (iron) in the wall of the marrow cavity and in the vascular canals closely connected with this part of the cavity The bone was found to contain the axial vascular canals whose course was parallel to the long axis of the bone, and the anastomasing canals perpendicular to them and thereby the long axis of the bone. The system of interlinked canals of the two types bounded the bone mass into a prism. The osseous space restricted by these canals was defined as the functional bone area, undoubtedly functionally subject to the control of the surrounding vessels. The spatial system of the functional bone areas was more orderly and these areas were markedly smaller in the primitive, plexiform bone than in the Haversian bone. This may testify to better vascularization of a bone of this type and thus to its greater viability and more intense metabolism. A comparison of the dinosaur bones with those of recent animals showed them to have the identical vascular system, including the blood in-and outflow tracts. [Author's abstract]. Language: English (with Polish and Russian abstracts)).

____ 1984a. Metabolic Pathways of the Fossil Dinosaur Bones. Part II. Vascular Canal in the Communication System. ibid, 22(1):33-42.

(The vascular canal of 80 million year old dinosaur bone was the object of the study. The microscopic and ultrastructural images of the canal revealed three zones therein: proper, perivascular, and vascular. The zone proper was formed by the mineralized wall of the canal, the perivascular zone was a space between the proper and vascular zone, and the vascular zone was made up of the canal contents identified with blood vessels. The perivascular zone contained collagen fibres; moreover, histochemical examinations revealed in it mucopolysaccharides and lipids. ln the wall of the vascular canal (zone proper) the outlets of the bone canaliculi departing from the osteocyte lacunae were detected. The endings of these canaliculi were of two kinds: they were either of the same diameter as the rest of the canaliculus (more numerous) or assumed a widening funnel form as the canaliculi reached the vascular canal (less numerous). By analogy with modern bone appropriate functions may be ascribed to particular zones distinguished in the vascular canal and in the varied endings of the bone canaliculi in the system of conveyance of nutrient and conservative elements as well as metabolites. [Author's abstract]. Language: English (with Polish and Russian abstracts)).

____ 1984b. Metabolic Pathways of the Fossil Dinosaur Bones. Part III. Intermediary and Other Osteocytes in the System of Metabolic Pathways of Dinosaur Bone. ibid, 22(2):91-98.

(The fossil dinosaur bone material, 80 million years old was studied. Samples for analysis were prepared with specially elaborated methods. lmages obtained in the light, transmission electron, and scanning electron microscopes revealed the spatial distribution of osteocytes lying near and far from the vascular canal. Osteocytes of particular kind were found to be present in the immediate vicinity of the canal The characteristic morphological structure and localization of these osteocytes between the vascular canal and the osteocytes lying farther from the canal, as well as mediation of this cell in the system of connections between those elements, served as a basis for the separation of this cells as the intermediary osteocyte. Among the osteocytes situated farther from the vascular canal, three kinds were distinguished: mono-, bi-, and multipolar, according to the kinds of processes and their distribution in relation to the mother cell body. By analogy with modern bone, in dinosaur bone specific functions may be ascribed to the distinguished types of osteocytes and their differentiated processes in the conduction of nutrient and building elements and metabolites from the vascular canal to the intermediary osteocytes and, with their participation, to other osteocytes lying farther from the canal This should naturally be analyzed as the two-way tract. [Author's abstract]. Language: English (with Polish and Russian abstracts)).

____ 1984c. Metabolic Pathways of the Fossil Dinosaur Bones. Part IV. Modes of Linkage Between Osteocytes and a Variety of Nexuses of Osteocytes Processes. ibid, 22(2):99-104.

(Light, transmission electron, and scanning electron microscopic images of 80 million year old dinosaur bone showed the spatial distribution of osteocytes with the system of processes as well as by thin and short ones. The axial processes, retaining the same diameter along their entire course, usually connected the polar parts of the osteocytes which frequently lay considerable distance apart. Such connections were of two kinds. ln one case the link was attained by catoplasmic continuity. ln the other, the processes belonging to one osteocyte came in contact with a definite spot of plamalemma of another osteocyte by means of a terminal, club-shaped widening, the so-called contact body. This spot looked like a hollow or a conical protuberance. ln this type of contact there were always tiny apertures between the contacting elements. Moreover, three types of contact, especially between thin processes, were distinguished, i.e. "end to end," "side to side," and "end to side." lt seems that direct connections achieved through cytoplasmic continuity are utilized in rapid exchange, which may be indicated by the thickness of processes and the lack of a membranous barrier. The remaining, indirect links (with participation of membranes) though varied in the type of contact seem to fulfill identical functions. [Author's abstract]. Language: English (with Polish and Russian abstracts)).

____ 1985. Metabolic Pathways of the Fossil Dinosaur Bones. Part. V. Morphological Differences of Osteocyte Lacunae and Bone Canaliculi and Their Significance in the System of Extracellular Communication. ibid, 23(3):165-174.

(The study was carried out on dinosaur bones nearly 80 million years old. The light and transmission electron microscopic images permitted two kinds of bone lacunae and two types of paralacunar canalicular endings to be distinguished. The lacunae of the first kind were characterized by their elongated shape, their length exceeding their width several times, their dimensions being 31.2/9.4 microns. The lacunae of the other kind were not so long, their mean measurements amounting to 21.32/9.7 μιχρονσ. Among the paralacunar canalicular endings those of small diameter were more numerous. The canaliculi of wider, funnel-shaped endings amounted to two or three, they were usually localized in the polar part of the lacuna, and were defined as the axial canaliculi. These were canaliculi of a large diameter. The canalicular wall was constructed of collagen fibres. The same fibres were found in the lacunar wall.

Also, a relationship between the structure of the lacunar wall and the localization of an osteocyte in the lacuna was analyzed in the light and electron microscopes. ln regard to the structure of the bone lacuna and the localization of an osteocyte in it, zones A and B were distinguished.

Zone A had a characteristic loose and disorderly system of collagen fibres building the lacunar wall. The fibres in this area were by nature open to view. Besides, this region of the lacunar wall revealed specific terraced hollows.

Zone B was distinguished by a compact system of parallelly arranged collagen fibres, which formed characteristic ridges in the lacunar wall.

The localization of the osteocyte in the lacuna was irregular, the pericellular space around it being of variable width. This space was shown to contain mucopolysaccharides.

The images obtained from dinosaur bone were compared to those already known for modern bone. These comparisons permitted it to be ascertained that zone A corresponds to a spot in the lacuna in which the osteocyte exhibits a decreased activity. Zone B is the area of the actual direction of the osteocyte's activity aiming at the shaping of the wall of its lacuna. lt can be supposed that the widened endings of the paralacunar canaliculi perform more important functions in conveyance, this being evident from comparisons of analogous areas in modern bone. [Author's abstract]. Language: English (with Polish abstract)).

____, Korbel, A. and Kubiak, H. 1966. Cells, Collagen Fibrils and Vessels in Dinosaur Bone. Nature, 211 (5049):655-657.

(Presence of osteocytes and collagen fibrils in an unspecified Late Cretaceous dinosaur phalanx from the Gobi Desert of Mongolia is demonstrated. Well illustrated. [DHT]).

____ and Bolechala, P. 1987. X-Ray Microanalysis of Fossil Dinosaur Bone: Age Differences in the Calcium and Phosphorus Content of *Gallimimus bullatus* Bones. Folia Histochem. et Cytochem., 25(3-4-):241-244.

(Bones of dinosaurs *Gallimimus bullatus* [Saurischia: Ornithomimidae], belonging to selected age groups were studied using an X-ray microanalyser. Content of calcium and phosphorus, their distribution in the investigated areas and Ca/P-ratio were determined. The obtained results revealed that the Ca/P ratio highest in the bones of young and middle-aged animals and decreased with age. [Author's abstract]. Language: English (with Polish abstract)).

____ and ____ 1991. X-Ray Microanalysis of Fossil Dinosaur Bone: Age Differences in Lead, Iron, and Magnesium Content. Folia Histochem. et Cytobiol., 29(2):81-84.

(Bones of dinosaurs, *Gallimimus bullatus* [Saurischia: Ornithomimidae], belonging to selected age groups, were studied using an X-ray microanalyser. The content of lead, iron, and magnesium, as well as the distribution of those elements in the investigated bone areas were determined. The results showed, that bones of old animals contained the highest level of lead and iron, whereas in young dinosaurs the respective values were lowest. The obtained data were compared with the results of X-ray microanalysis of the contemporary bone. [Author's abstract]. Language: English (with Polish abstract)).

Pellegrino, C.R. 1985. Dinosaur Capsule. Omni, 7(4):38-40, 114-115.

(Considers the role of blood-sucking biting midges (Diptera: Ceratopogonidae) as vectors of disease on contemporary dinosaurs, with possible bearings on extinctions of the latter. The possibility of DNA studies from blood residues extracted from amber entombed biting flies is discussed. See also Grogan and Szadziewski, 1988 and Borkent, 1995. [DHT]).

Peng, Jianghua, Russell, A.P. and Brinkman, D.B. 2001. Vertebrate Micro-site Assemblages (Exclusive of Mammals) from the Foremost and Oldman Formations of the Judith River Group (Campanian) of Southeastern Alberta: An Illustrated Guide. Prov. Mus. Alberta, Nat. Hist., Occ. Pap. No. 25. ii + 54 pp.

(Includes teeth of the enigmatic small theropod *Paronychodon lacustris* (Plate 8, figs. 20-23). Some authors have considered these as pathological teeth of better known taxa. This suggestion is not addressed in the paper. [DHT]).

Penner, M.M. 1983. Contribution a L'Etude de la Microstructure des Coquilles D'Oeufs de Dinosaures du Cretace Superieur dans la Bassin d'Aix-En-Province: Application Biostratigraphique. These de Doctorat 3eme cycle. Univ. Marie Curie, Paris 6. 234 pp.

(NOT SEEN. NOT INDEXED. Pathological dinosaur eggs. Language: French).

____ 1985. The Problem of Dinosaur Extinction. Contribution of the Study of Terminal Cretaceous Eggshells from Southeast France. Geobios, 18(5):665-669.

(A biostratigraphic sequence based upon dinosaur eggshells during the lower and upper Rognacian (Upper Cretaceous) in the Aix-en-Provence sedimentary basin (Bouches-du-Rhone, France) has been studied from a morphometric and microstructural viewpoint. Stratigraphic control of eggshell fragment sampling made it possible to follow their evolution throughout the Rognacian. Our results differ from those of certain authors who have worked in this region in that no tendency toward abnormal eggshell thinness appears at the end of the Cretaceous which could be linked to the problem of dinosaur extinction. Furthermore, we observed no significant increase in the number of bi-or multistratified eggshells ("ovum-in-ovo") in the deposits. The microstructural study shows the presence mainly of normal eggshells belonging to at least three morphotypes. [Author's abstract]. "Thinning" of eggshell is probably due to the fact that several egg taxa are represented or through diagenetic factors; see also Dauphin, 1990).

Perkins, S. 2000. Did Ancient Wildfire End in Barbecue? Sci. News, 158(20):317.

(See Wegweiser, 2000).

____ 2001. Turn Your Head and Roar - Can Diagnosing Disease in Fossils Shed Light on Modern Maladies? Sci. News, 160:376-378.

(General discussion on latest research on dinosaur and other fossil vertebrate paleopathology. Includes differing views on the interpretations of *Tyrannosaurus rex* pathologies as studied by Peter Larson and Elizabeth Rega. Some *T. rex* osteopathy illustrated. Format: Popular. [DHT]).

Petersen, K., Isakson, I. and Madsen, J.H. 1972. Preliminary Studies of Paleopathologies in the Cleveland-Lloyd Dinosaur Collection. Utah Acad. Sci. Proc., 49:490-499.

(Approximately 2% of the bones in the Cleveland-Lloyd Dinosaur Collection exhibit some form of pathology. Consistent with the common occurrence of *Allosaurus*, the majority of pathological elements belong to individuals of this genus. Other genera represented by diseased bones are *Stegosaurus*, *Camptosaurus*, and *Camarasaurus*. Pathological conditions include degeneration or necrosis, traumatic amputation and resultant osteomyelitis, common fractures, neoplasms [no neoplasms in this collection-BMR], ankylosis resembling degenerative arthritis, and regenerated (?) caudal vertebrae. Although some bones show an apparent pathology, the aberration can often be attributed to a postmortem cause such as scavenger activity or deformation occurring after lithification. [Author's abstract]. Illustrated. The senior editor [DHT] has examined the Cleveland-Lloyd collection and can attest to the observation that many of the "pathologies" in this collection are in fact nothing more than pre- or postburial fracturing of otherwise nonpathological dinosaur bones. See index for specific examples of osteopathy noted in this paper. [DHT]).

Poinar, G.O., Jr., Zavortink, T.J., Pike, T. and Johnston, P.A. 2000. *Paleocul-icis minitus* (Diptera: Culicidae) n. gen., n. sp., from Cretaceous Canadian Amber, with a Summary of Described Fossil Mosquitoes. Acta Geol. Hispanica, 35(1-2):119-128.

(A new genus and species of fossil mosquito (Diptera: Culicidae) is described from Canadian Cretaceous amber, thus providing the first undeniable record of this group in the Cretaceous Period. *Paleoculicis minitus* n. gen., n. sp. Can be separated from extant culicids by features of the head, thorax, and abdomen. *Paleoculicis* has closer affinities to the Culicinae than to the Anophelinae and Toxorhynchitinae. If *P. minitus* fed on blood, a range of vertebrates (including dinosaurs) were potential hosts some 79 million years ago. A review of previous descriptions of fossil mosquitoes is presented. Many cannot be confidently assigned to the Culicidae, while others are extant species in copal. Only a minority of them can be regarded as true Culicidae, all of which are reported from Tertiary deposits. [Author's abstract]. Illustrated).

Poling, J. 1996. The Dinosauria Homepage. Internet URL address: www.dinosauria.com/gallery/darren/htm~/fibula/jpg

(Healed mid-shaft fracture of right fibula with good alignment in TMP91.36.500, a Late Cretaceous tyrannosaurid (*Gorgosaurus libratus*) collected from the Campanian Dinosaur Park Formation of Dinosaur Provincial Park, Alberta, Canada is illustrated. [DHT]).

Popeo, D. 1996. Dinosaur Nest Found in Central Asia. Found during Internet search, on November 30, 1996 at: http://virtual.union.edu/~concordy/dinosaur.htm

(Brooding Late Cretaceous small theropod *Oviraptor*. The AMNH specimen had a healed fracture of an ulna. Unillustrated. [DHT]).

Powell, J.E. 1989. Hallazgo de Heuvos Asignables a Dinosaurios Titanosauridos (Saurischia, Sauropoda) de la Provincia de Rio Negro, Argentina.

(NOT SEEN. NOT INDEXED. Sauropod eggshell pathology. Language: Spanish).

Pringle, H. 1989. Giant Steps. Saturday Night, 104(8):16-19.

(Includes mass mortality event related to drowning of a portion of the herd of the Late Cretaceous ceratopsian *Centrosaurus*. [DHT]).

Psihoyos, L. 1994. Hunting Dinosaurs. Random House, New York. xvii + 267 pp.

(Includes hypothetical Lower Cretaceous *Deinonychus* with previously fractured tail illustrated on p. 112- it would be interesting to know how such an injury to this presumed delicate balancing organ would have affected the animals mobility and hunting activities. On pages 234-235 is a rendering of a small group of *Tyrannosaurus*, one based on the multipathologic Black Hills Institute [now Chicago Field Museum] specimen "Sue" who was seized by the FBI and National Guard in 1992 in a controversial legal custody battle. Another example of how paleontology and politics do not mix well. [DHT]).

R

Raath, M.A. 1969. A New Coelurosaurian Dinosaur from the Forest Sandstone of Rhodesia. Arnoldia, 4(28), 25 pp.

(NOT SEEN. NOT INDEXED. The material in utilized in this study is derived from a mass mortality bonebed).

____1972. Fossil Vertebrate Studies in Rhodesia: A New Dinosaur (Reptilia: Saurischia) from Near the Trias-Jurassic Boundary. Arnoldia, 5(30):1-37.

(The author describes an incomplete skeleton of the early Jurassic barapasaurid sauropod *Vulcanodon*, recovered from Rhodesia. On page 11, the author describes the tail as "... seems to have been arthritic..." The 3rd and 4th caudals and chevron are fused together. These vertebrae are also noticeably larger than the preceding or following vertebrae. [DHT]).

____1977. The Anatomy of the Triassic Theropod *Syntarsus rhodesiensis* (Saurischia: Podokesauridae) and a Consideration of Its Biology. Ph.D. thesis, Rhodes University, Zimbabwe.

(NOT SEEN. NOT INDEXED. The locality contains numerous skeletons of this species and is considered to represent a mass mortality event).

____ 1990. Morphological Variation in Small Theropods and Its Meaning in Systematics: Evidence form *Syntarsus rhodesiensis*. pp. 91-105. In: Dinosaur Systematics: Approaches and Systematics. Edited by K. Carpenter and P.J. Currie. University of Cambridge Press, Cambridge.

(NOT LISTED IN PATHOLOGY INDEX. Fossil material used in this study originates from a mass mortality event).

Radetsky, P.

(Planned article on dinosaur paleopathology, pers. comm. to DHT, 2000. Format: Popular).

Radford, T. 1997. Bad-Tempered *Tyrannosaurus* a Martyr to Gout. The Guardian, May, 22, 1997:8.

(Discusses the discovery of gout in Late Cretaceous *Tyrannosaurus* and another unspecified tyrannosaurid from Dinosaur Provincial Park, Alberta. See main paper by Rothschild, Tanke and Carpenter, 1997. Includes mention of a BMNH specimen of a "huge *Iguanodon*" that "obviously had

some sort of arthritis" which "must have been very painful." McNeill Alexander comments on the unlikely occurrence of manal gout in the *Tyrannosaurus* (also popularly known as "Sue"), because the animal had "silly little hands, of no apparent use. They couldn't get near its mouth." How this aspect of tyrannosaur anatomy would preclude the animal from getting gout is unstated. Alexander also speculates on the potential for "overripe" meat (ie. rotted) as an important factor in the potential development of gout. Format: Popular. See also Rothschild, Tanke and Carpenter, 1997a. [DHT]).

Radley, J.D. 1996. Type, Figured and Cited Specimens in the Museum of Isle of Wight Geology (Isle of Wight, England). Geol. Cur., 6(5):187-193.

(Lower Cretaceous *Iguanodon* with abnormal bone histology; see Clarke and Barker, 1995. Two chironomid midge specimens (one figured) from the Lower Cretaceous Wessex Formation, Brightstone Bay, lsle of Wight are listed (see also Volume 11(2) of Geology Today, front cover and page 42). [DHT]).

Ratkevitch, R.P. 1976. Dinosaurs of the Southwest. University of New Mexico Press, Albuquerque. 115 pp.

(Suggested that the mass mortality event at preserved at the Late Triassic *Coelophysis* locality at Ghost Ranch, New Mexico, USA was the result of drinking highly alkaline and poisonous water, or the animals becoming stuck in sticky mud. See Schwartz and Gillette, 1994 for a revised and scientific discussion. [DHT]).

Rauhut, O. and Zinke, J. 1995. A Description of the Barremian Dinosaur Fauna from Una with a Comparison of that to Las Hoyas. - II. Inter. Sympos. of Lithographic Limestone, Extended Abstract:123-126, Cuenca.

(NOT SEEN. NOT INDEXED. Describe *Paronychodon*-like teeth; see Zinke, 1998. [DHT]).

Raymond, P.E. 1958. Prehistoric Life. Harvard Univ. Press, Cambridge, x + 324 pp.

(On the topic of dinosaur extinction, Raymond (p. 151) writes: "Dr. R. L. Moodie's studies suggest also that old races are more susceptible to disease than young ones, and some have thought that epidemics of disease swept away the dinosaurs." Format: Semi-Popular/Technical. [DHT]).

Rega, E.A. and Brochu, C.A. 2001. Paleopathology of a Mature *Tyrannosaurus rex* Skeleton. (Abstract). Jour. Vert. Paleo., 21(3):92A.

(A variety of abnormalities are present throughout the skeleton of FMNH PR2081, a mature *Tyrannosaurus rex* specimen popularly known as "Sue." These include healed osteomyelitis (infection) of the left fibula, healed fractures of the right and left ribs, possible well-healed osteomyelitis of the proximal right humerus, exuberant vertebral osteophyte formation, and multiple bilaterally-present erosive lesions primarily confined to the post-dentary mandibular elements. No evidence of pre or peri-mortem bite marks is present. Pathology of the left fibula most likely did not prevent locomotion. The jaw lesions are bilaterally present although not bilaterally symmetrical and may be neoplastic or fungal in origin, although the pattern and location of the lesions remains problematic for a conclusive attributation. Lesions of this nature are common in large tyrannosaurid specimens, and so a number of other possibilities should be entertained. While the number of these pathologies present in a single individual may superficially seem to imply that Sue was not healthy during life, the maturity of the specimen and the clear evidence of healing indicate that Sue was a robust individual who successfully survived many insults. The injured ribs suggest two traumatic events to the trunk, one of which also impacted the right pectoral complex. Functionally, the evidence of pseudoarthrosis (non-union) in two of a series of adjacent healed fractures in the right thoracic ribs suggests the potential of not-inconsiderable movement in the rib cage during healing and may imply thoracic breathing. No skeletal evidence of cause or manner of death is apparent. [Author's abstract]). While the abstract accurately relates most of the pathologies noted, several clarifications are necessary. Bite marks were present and the post-dentary mandibular 'erosive' lesions were actually holes in which marginal healing produced a thin bony sheet which partially filled the holes. This pathology is identical to that seen with healing trephination, wherein bone heals around a hole cut into a living human's skull. This is quite different from what is seen with fungal disease. Fungal disease appears as an expansile mass (BMR).

Reid, M. 1990. The Last Great Dinosaurs. Discovery Books, Red Deer College Press, 184 pp.

(Possible intraspecific horn thrust puncture wound to the frill of the Late Cretaceous ceratopsian *Arrhinoceratops* (p. 144); "Many specimens [*Triceratops*] have bones damaged in combats with rivals or predators." (p. 146). [DHT]. Format: Popular).

Reid, R.E.H. 1984. The Histology of Dinosaurian Bone, and Its Possible Bearing on Dinosaurian Physiology. In: The Structure, Development and Evolution of Reptiles. Edited by M.W.J. Ferguson. Symp. Zool. Soc. London, 52:629-663.

(Page 651 includes a short discussion on the histology of pathologic dinosaur bones and tendons. [DHT]).

____ 1990a. Zonal "Growth Rings" in Dinosaurs. Mod. Geol., 15:19-48.

(Page 39 includes a description and discussion of a dinosaur bone tumor. It is figured on page 37, fig. 38. The specimen had previously been considered by Swinton (1934) and Campbell (1966). Generic identification of the specimen had posed problems to past authors. Reid (p. 39) states that the bone is histologically similar to *Orthomerus*, a Late Cretaceous hadrosaur from Romania in which the writer had found two other similar tumors. [DHT]).

____ 1990b. Arctic Dinosaurs: Residents or Migrants? Mod. Geol., 15:95-99.

(Comments on Arctic dinosaurs as being migratory and non-resident. During the cool season or "winter," animals that stayed behind would be affected by hypothermia and die, forming the mass mortality bonebeds already observed in Alaska. [DHT]).

____ 1993. Dinosaur Blood Cells Rediscovered. Nature, 366:24.

(Comments on the recent discovery of possible fossilized blood cells found in the Late Cretaceous carnivorous *Tyrannosaurus* and potential research possibilities. Alternative explanations as to the occurrence of fossilized "blood corpuscles" is explored. An historical account of previous finds of dinosaur blood (Early Cretaceous *Iguanodon* and Late Jurassic ?*Apatosaurus*) is also presented. See Martill and Unwin, 1997. [DHT]).

Rein, T. 1990. Paleopathology. Paleodiscovery 5/90:__.

(Short article on the paleopathology of extinct animals, namely tail injuries in hadrosaurs; avascular necrosis in mosasaurs and marine turtles; and the discovery of tuberculosis and brucellosis in North American Pleistocene mammals. Format: Popular. Reprinted in Austin [Texas, USA] Paleontological Society Newsletter, December, 1992. [DHT]).

Rempel, B. 1990. Secrets from the Stone- Fossils Yield New Information About A Little-Known Dinosaur. Alberta Report, 17(3):37.

(Includes a mention of paleopathological studies being carried out by D. Tanke on the Late Cretaceous ceratopsian *Pachyrhinosaurus* from Alberta, Canada. [DHT] Format: Popular).

Rensberger, J.M. 1987. Cracks in Fossil Enamels Resulting from Premortem vs. Postmortem Events. Scanning Micro., 1(2):631-645.

(Vertebrate enamel preserves a record of fracture-producing strain. Fracturing during the life of the individual is potentially a source of selection for stronger enamel in the course of evolution. To determine if it is possible to recognize such fractures in fossil enamel, cracks in a variety of fossil materials, including enamel-covered holostean scales, crocodilian teeth, theropod and hadrosaurid dinosaur teeth, and mammalian teeth were examined. Cracks that occurred during the life of the individual could be recognized by abrasive wear on edges exposed at the surface of the enamel in areas worn by oral or locomotor abrasion. Certain distinctive crack patterns were identified as results of specific stress states occurring during life. Transverse cracks on the anterior parts of *Lepisosteus* [Garfish] scales were probably caused by external loading. Hertzian cracks and shallow, arcuate, lateral cracks on the occlusal edges of tooth enamel appear to be caused by stress concentrating impacts. Horizontal cracks arranged asymmetrically on the sides of conical teeth were reproduced in models subjected to bending stresses. Oblique cracks near the tips of fossil conical fossil teeth were produced in models by oblique loads near the tip. Vertical cracks around cylindrical or conical tooth surfaces caused by several different sources of stress, including lateral "wind" loads and vertical "snow" loads. Of the postmortem causes of fracturing of fossil enamel, drying cracks seem to be the most important. Experimental drying produced from 25% to 50% of the cracks in dry teeth. [Author's abstract]).

Reynolds, L. (Editor) 1988. Mass Death of Baby Dinosaurs in Inner Mongolia. Dinogramme (Friends of the Tyrrell Museum of Paleontology Foundation Newsletter), 2(3&4):2-3.

(5 juveniles of the Late Cretaceous armored *Pinacosaurus* found "huddled together" in sand dune sediments in China. More pinacosaurs

were expected from this site in future excavations. [This indeed occurred]. Format: Popular. [DHT]).

Rich, P.V. and Rich, T.H. 1990. News from Members. Soc. Vert. Paleo., News Bull., 149:8-9.

(Mention of a healed massive fracture of the tibia of a herbivorous hypsilophodontid from the Lower Cretaceous of Dinosaur Cove, Victoria, Australia. This was later rediagnosed as not being traumatic in origin, but instead represents a massive osteomyelitic infection (T. Rich, pers. comm. to DHT, 1991). See Gross, Rich and Vickers-Rich, 1993; Long, 1998. [DHT]).

Richmond, D.R. and Morris, T.H. 1996. The Dinosaur Death-Trap of the Cleveland-Lloyd Quarry, Emery County, Utah. pp. 533-545. In: The Continental Jurassic. Edited by M. Morales. Museum of Northern Arizona Bulletin Number 60.

(The Cleveland-Lloyd Quarry has long been recognized by paleontologists as containing an unusually high number of predatory remains, accounting for about 70% of the bones collected so far. Minimum numbers of carnivores represented in the site, and of all species is 51 (44 *Allosaurus*) and the same for herbivores is 22. The mode of formation of this unique deposit has been the subject of debate for some time, with widely varying conclusions reached. The author's do a detailed study of the site geology, sedimentology and especially the matrix in which the bones were entombed. It was found that the bones were preserved in what was once a sticky, smectitic mud. Now it seems likely that animals preserved in the site had became mired in this mud and perished there. The higher percentage of juvenile and subadult *Allosaurus* is suggestive that they traveled in hunting packs and became mired as a group resulting in a mass mortality event. A pathological dinosaur egg with multilayering of eggshell was found in this site (Madsen, 1991 and Hirsch, Stadtman, Miller and Madsen, 1989). Multilayering of eggshell occurs in individuals under stress and that have retained their eggs. Here, it is suggested that the egg is from an ?*Allosaurus* and that the stress was the animal being mired in the mud. [DHT]).

Riggs, E.S. 1903. Structure and Relationships of Opisthocoelian Dinosaurs. Part 1. *Apatosaurus* Marsh. Field Colum. Mus., Geol. Ser., 2(4):165-196.

(Right dorsal ribs 5 and 6 of Upper Jurassic sauropod *Apatosaurus* (ex *Brontosaurus*) show an enlargement of the shaft, indicating imperfectly healed bone fractures. [DHT]).

Ritter, M. 1999. Dinosaur Egg Hunt Yields Big Surprise. Las Vegas Review-Journal, Sunday, April 25, 1999:23A-24A.

(Mass mortality of Late Cretaceous titanosaur eggs and embryos due to flooding events, Auca Mahuida, Argentina. Illustrated. Format: Popular. [DHT]).

Rodrigeuz-De La Rosa, R.E. and Aranda-Manteca, F.J. 2000. Were There Venomous Theropods? (Abstract). Jour. Vert. Paleo., 20(3):64A.

(In the last years a considerable amount of information about the biology of theropod dinosaurs has come to light. Some of these issues mainly regard their physiology, anatomy, avian relationships, etc. The existence of venomous theropods, however, has been to the moment matter of speculation and movie by-products (as in the case of a dilophosaur star). A single theropod tooth crown (FCM 06/053) recovered from the Late Campanian outcrops of the El Gallo Formation in the state of Baja California, Mexico, shows a structure related to the conductance of oral toxins. The crown is blade-like in shape and labio-lingually compressed. It is of small size (0.95 cm in anteroposterior base length, 0.56 cm in lateral width, and ca. 2 cm in height). The tooth crown lacks the tip. However, it seems sharply pointed and distally recurved. Both carinae preserve just the denticle bases. Anterior denticles are minute compared to posterior ones. The general features of this tooth could be found in most theropod taxa; however, the posterior denticles are located within a longitudinal groove that runs over the distal 2/3rds of the posterior carina. This structure, not recognizable at the moment in known theropod taxa, is analogous to those found in other reptilian groups with adaptations for envenomation, such as elaphid snakes, helodermatid lizards, and other extinct Mesozoic amniotes such as *Uatchitodon kroehleri*, *Euchambersia mirabilis*, and some Late Cretaceous varanoid lizards. This evidence is interpreted as the existence of a lineage of small theropods bearing teeth adapted to the conductuance of oral toxins, probably related to aid in feeding strategies. This is the first record of its kind, not only in the El Gallo Formation, but within the context of the study of dinosaurs, and particularly under the scope of theropod biology. [Author's abstract]. See also Hecht, 2000).

Rogers, R.R. 1988. Taphonomy of a Hadrosaur Bonebed, Two Medicine Formation, Northwestern Montana. (Abstract). Jour. Vert. Paleo., 8(3):24A.

(The Late Cretaceous (Campanian) Two Medicine Formation of northwestern Montana contains one of the most diverse dinosaur faunas in North America. In the summer field season of 1985, an extensive bonebed of an as yet undescribed species of hadrosaurian dinosaur was discovered within the upper lithofacies of the formation north of Cut Bank, Montana. Taphonomic and geologic data pertaining to the bonebed was collected the following three summers.

Numerous calcretes, smectite-rich paleosol horizons, abundant labile mineral grains and rock fragments within channel sands, and faunal characteristics all suggest a warm, seasonal paleoclimate frequently punctuated by dry episodes. Mass mortality of the hadrosaurs probably occurred in response to a severe drought. The carcasses remained exposed upon a floodplain, eventually becoming disarticulated. A subsequent flood event interred the skeletal remains in a local depression. Bioturbation of the event following burial accounts for the lack of preferred orientation and the unstable arrangement of many bones within the deposit. [Authors' abstract]. Mass mortality, *Maiasaura*).

____1989. Taphonomy of Three Monospecific Dinosaur Bonebeds in the Late Cretaceous Two Medicine Formation, Northwestern Montana: Evidence for Dinosaur Mass Mortality Related to Episodic Drought. Masters Thesis, Univ. Montana, 102 pp.

(See Rogers, 1990).

____1990. Taphonomy of Three Dinosaur Bone Beds in the Upper Cretaceous Two Medicine Formation of Northwestern Montana: Evidence for Drought-Related Mortality. Palaios, 5:394-413.

(Drought-related mass mortality of hadrosaur *Prosaurolophus* and *Styracosaurus* (the latter now referable to *Einiosaurus*). Includes figures of two ceratopsian dinosaur jugals with "probable tooth marks," formed by two semi-parallel, curved and smooth-bottomed grooves on the anterior internal surface. These are more probably vascular in origin (*sensu* Saul and Saul, 1984, 1992). Near identical occurrences of grooving are known in ceratopsian jugals from the Late Cretaceous of Alberta, Canada (pers. obs., DHT). See also Rogers, 1989. [DHT]).

____ 1997. Two Medicine Formation. pp. 760-765. In: Encyclopedia of Dinosaurs. Edited by P.J. Currie and K. Padian. Academic Press, San Diego. xxx + 869 pp.

(Campanian Two Medicine Formation, Montana, USA. Includes comments on *Troodon* nests, hadrosaur nesting horizons, concentrated *Hypacrosaurus* neonate occurrences, hadrosaurine hadrosaur *Prosaurolophus* and centrosaurine ceratopsian *Einiosaurus* bonebeds. Eight low diversity bonebeds (hadrosaur or ceratopsian) are already known from this formation. Mass mortality can be implicated in many of these events. The formation is recognized for its low diversity bonebeds, only one multigeneric bonebed has been recognized so far. Illustrated [DHT]).

____ and Sampson, S.D. 1989. A Drought-Related Mass Death of Ceratopsian Dinosaurs (Reptilia: Ornithischia) from the Two Medicine Formation (Campanian) of Montana: Behavioral Implications. (Abstract). Jour. Vert. Paleo., 9(3):36A.

(Taphonomic and geologic data indicate that two extensive low-diversity *Styracosaurus* [now referable to *Einiosaurus*] bone beds discovered in the Upper Cretaceous Two Medicine Formation of Montana are drought-related fossil assemblages. The two quarries, Canyon Bone Bed and Dino Ridge Quarry, occur in low-energy depositional settings and consist primarily of skeletal lag elements; thus, both bone beds are presumably autochthonous. The styracosaurs are buried in shallow, vegetated oxbow lakes. Carcasses disarticulated subaqueously; disarticulation was expedited by trampling and occasional flood currents. Bones were fragmented and scattered by bioturbation, and were eventually trampled into the soft bottom sediments of the lakes. Both bone beds were scavenged prior to burial.

The nature of the mass deaths, together with aspects of cranial anatomy, suggest certain behavioral implications. These styracosaurs were gregarious animals, living at least part of the year in big groups. They were water-dependent, and apparently capable of dominating water sources during periods of drought. A massive rostrally recurved nasal horn, present only in adults, was not employed as an anti-predator defense, but rather as an intraspecific display device. We propose that these styracosaurs were highly social animals dependent upon group dynamics for their nurturing and protection. [Authors' abstract]. The "*Styracosaurus*" material mentioned here is referable to *Einiosaurus*).

Romer, A.S. 1924. Review of: Moodie, R.L. 1923. Paleopathology. An Introduction to the Study of Ancient Evidences of Disease. Jour. Geol., 32:262-263.

(Overall a positive review of Moodie's 1923a book, although Romer urges caution in identifying a lesion to a specific pathology. For example, an exostosis affecting the inside of a *Triceratops* scapula was ascribed by Moodie to have "caused considerable irritation of the pleura;" Romer suspects it was actually embedded in the subscapularis muscle. [DHT]).

Rothschild, B.M. 1985a. Diffuse Idiopathic Skeletal Hyperostosis: Misconceptions and Reality. Clin. Rheum. Prac., 4:207-211.

(An important contribution, as diffuse idiopathic skeletal hyperostosis (DISH) is known in a wide variety of extinct vertebrates such as dinosaurs and mammals. The gross appearance of this phenomenon is described. Possible etiologies are discussed. DISH is often misdiagnosed. DISH resulting in fusion of vertebral centra is often misidentified as arthritis or osteoarthritis. Illustrated. [DHT]).

____ 1985b. Paleopathology of Ankylosing Spondylitis and Diffuse Idiopathic Skeletal Hyperostosis. (Abstract). Arthritis Rheumatol., 28:95.

(Serendipitous observation of ceratopsian cervical spine fusion in the British Museum stimulated a variety of site visits to determine the uniqueness of the observation. Similar cervical pathology was documented, not only in both major species of the propositus but, also in other members of the Ceratopsia family of dinosaurs. As this group was characterized by rostral overgrowth and massive skulls, it is proposed that cervical fusion played a protective role, facilitating support of the heavy skull. This cervical fusion not only involved the centrum but also affected the posterior elements of the first three or four cervical vertebrae. Further evidence for a protective role of cervical fusion is noted in the pre-Miocene mole, *Mesoscalops*, which apparently used its head as a "battering ram" in digging. Such fusion can easily be distinguished from the isolated fusion of caudal vertebrae noted in *Diplodocus* and *Apatosaurus*. Absence of apophyseal joint fusion and the nature of the fusion in the latter two species of sauropod dinosaurs is more in keeping with the diagnosis of diffuse idiopathic skeletal hyperostosis (DISH). The site of the occurrence of "DISH" in sauropods is at a highly stressed spinal region. While it may represent a response to trauma, the absence of apophyseal joint damage suggests a protective role, distributing the stress over a wider region of spine. Classical changes of DISH were also noted in two Miocene *Mysticetes*, *Pelocetus* and *Thinocetus*. The extent of spinal calcification in the latter actually led to the species designation, *arthritus*. [Author's abstract]).

____ 1986. Paleopathology of the Axial Skeleton in Dinosaurs and Early Mammals. (Abstract). Paleopath. Newsl., 25:4.

(NOT INDEXED. Discussion of DISH (diffuse idiopathic skeletal hyperostosis)).

____ 1987a. Diffuse Idiopathic Skeletal Hyperostosis as Reflected in the Paleontologic Record: Dinosaurs and Early Mammals. Seminars in Arthritis and Rheumatism, 17(2):119-125.

(Syndromes of spine and spinal ligament calcification have been a source of controversy. Does the calcification represent a pathologic response or is it protective in nature? The controversy surrounding diffuse idiopathic skeletal hyperostosis (DISH) has a forum in both clinical medicine and in paleontology. Elements of the paleontologic record were examined for phenomena that are the paleontologic equivalents of DISH in humans. Interestingly, a Mystocetal whale (*Thinocetus*), dated at 12 million years, was given the species name *arthritus* because of the mistaken idea that such bridging represented arthritis. Diffuse Idiopathic Skeletal Hyperostosis has been documented in Pleistocene *Mastodon*, *Teleoceras*, *Gigantocamelus*, *Michenia*, *Antilocapra*, *Equus*, *Bison bison*, and Miocene *Thinocetus arthritus* and *Pelocetus*. Ossification of spinal ligaments, present in 15-25% of older mammals, both in the Pleistocene and the Holocene, was ubiquitous among ceratopsians, hadrosaurs, iguanodonts, pachycephalosaurs, carnosaurs, and ornithischia. Such widespread evidence of DISH in the paleontologic record strengthens the concept that ligamentous calcification may not represent a disease after all, and may even have been useful to dinosaurs. [Author's abstract]. Specifically examined are examples of DISH in Upper Jurassic sauropods *Apatosaurus*, *Camarasaurus*, *Diplodocus* and large theropod *Allosaurus*. Examples of these are figured).

____ 1987b. Paleopathology of the Spine of Cretaceous Reptiles. In: Art, History and Antiquity of Rheumatic Disease. pp. 97-99. Edited by T. Appelboom, Elsevier, Brussels.

(Exostosis on USNM *Allosaurus* scapula, as well as review of dinosaur paleopathology studies in 1986. [DHT]).

____ 1988a. Radiologic and "Clinical" Evaluation of Osteoarthritis in Dinosaurs. (Abstract). Jour. Vert. Paleo., 8(3):25A.

(Semantically confused application of the diagnosis osteoarthritis, to what is actually unrelated spondylosis deformans, prompted a concerted search for the articular pathology in dinosaurs. Not to be confused with vertebral spurs (also called osteophytes), the main signs of osteoarthritis on visual examination are joint surface eburnation and remodeling with osteophyte formation at the cartilage periphery. A systematic multi-institutional visual survey of 10,000 dinosaurs revealed only two with such surface alterations. As subchondral sclerosis and cyst formation, which also characterize osteoarthritis, are only recognizable radiologically, x-ray analysis of weight-bearing bones of 121 dinosaurs was also performed to assure absence of subtle signs of that disease. Techniques were established for x-ray fossil analysis. In addition to 59 sauropods, the weight-bearing metaphyses of 121 theropods, Ceratopsia, ornithopods, stegosaurs, ankylosaurs and pachycephalosaurs were analyzed. Although the two *Iguanodon bernissartensis* proximal metatarsals, with remodeling and spur formation (osteoarthritis), could not be removed from their mounts for x-ray analysis, the survey of 121 dinosaurs revealed no radiologic evidence of osteoarthritis, even in the largest of the sauropods. Osteoarthritis is rare in dinosaurs. It is curious that the only involved area in dinosaurs, as in fossil marsupials, was the ankle joint. While the large cartilage cap (predicted on the basis of articular surface architecture) may have protected the bone, mechanical design and joint stability may be more important. [Author's abstract]).

____ 1988b. Stress Fracture in a Ceratopsian Phalanx. Jour. Paleo., 62(2):302-303.

(A prominent anterior bulge on a ceratopsian dinosaur phalanx was examined for evidence of infection or stress (fatigue) fracture. The presence of a knife-slice type radiolucency, associated with periosteal reaction, was pathognomonic (diagnostic) for a stress fracture. Stress fractures have previously recognized only in humans, racing greyhounds, and horses. [Author's abstract]. Also figured in Rothschild, 1997).

____ 1988c. Diffuse Idiopathic Skeletal Hyperostosis. Comprehensive Therapy, 14:65-69.

(Includes mention of the occurrence of DISH in the Upper Jurassic sauropods *Apatosaurus* and *Diplodocus*. Dinosaurian DISH unillustrated. [DHT]).

____ 1989a. Paleopathology and Its Contributions to Vertebrate Paleontology: Technical Perspectives. (Abstract). Jour. Vert. Paleo., 9(3):36A-37A.

(As paleopathology has evolved from observational speculation to analysis of testable hypotheses, so too has recognition of its contribution to vertebrate paleontology. In the presence of significant structural and density variation (between matrix and osseous structures), X-rays provide an additional perspective of osseous response to stress and disease. As film techniques are time and cost effective, fluoroscopy has proven a valuable alternative. Radiologic techniques also allow non-invasive "sectioning" of specimens, illustrating significant internal detail. The object can be "split" on a plane and the two portions rotated to "open" the image. This three-dimensional approach now can be applied to other forms of sequential data to facilitate their three-dimensional representation graphically or with solid representation. Antigen and microstructure may be well preserved in fossils. Molecular preservation with retention of helical structure and sensitivity to collagenase has been demonstrated in 10,000 year old collagen. Antigen has been extracted from 100 million year old bone and documented, *in situ*, in 11,000-year-old bone. Minute amounts of DNA can be amplified and analyzed. Recovery of DNA from a 40,000-year-old mammoth and from 25 million-year-old insects provides opportunity for cloning and independent assessment of relationships. Implications of available technology focuses direction for development of collaborative approaches. [Author's abstract]).

____ 1989b. Skeletal Paleopathology of Rheumatic Diseases: The Subprimate Connection. In: Arthritis and Allied Conditions: A Textbook of Rheumatology. Edited by D.J. McCarty. Lea and Febiger, Philadelphia:1-4.

(Although osteoarthritis was noted in Quaternary vertebrates, its occurrence in Tertiary vertebrates has proven difficult to document. By contrast, spondylosis deformans (vertebral end plate osteophytosis) has been previously noted and actually is commonly present in dinosaurs. Osteoarthritis was identified in the ankle (Figure 1-1) in 2 of 39 *Iguanodon*

in the famous herd on exhibit in Brussels. [BMR]).

____ 1990. Radiologic Assessment of Osteoarthritis in Dinosaurs. Ann. Carnegie Mus., 59:295-301.

(Osteoarthritis has been erroneously considered common in dinosaurs because of semantic confusion. Gross remodeling of diarthrodial (articulating, synovial-lined) bone, characteristic of osteoarthritis is extremely rare in dinosaur specimens examined in this study. Radiologic techniques were used to assess subtle signs of osteoarthritis that could not be recognized on gross specimen examination. X-ray analysis of 664 weight-bearing metaphyses of 121 individual dinosaurs, representing 18 genera, confirmed the rarity of osteoarthritis in dinosaurs and suggests weight alone does not have a direct role in development of osteoarthritis. [Author's abstract]).

____ 1993. Skeletal Paleopathology of Rheumatic Diseases: The Sub-*Homo* Connection. pp. 3-7. In: Arthritis and Allied Conditions: A Textbook of Rheumatology. Edited by D.J. McCarty and W.J. Koopman. Lea and Febiger, Philadelphia.

(Osteoarthritis was actually quite rare in dinosaurs. Previous misconception, that osteoarthritis was common in prehistoric animals related to a semantic error. Although the term osteoarthritis has been applied to describe osteophytes (spurs) affecting vertebral centra, the more correct term for that phenomenon is probably spondylosis deformans. Osteophytes on movable cartilage-lined joints are more properly considered evidence of osteoarthritis. As spinal osteophytes are asymptomatic, except when they impinge on spinal nerve roots, they further differ from osteoarthritis by lack of clinical significance.

Osteoarthritis has been observed in pterosaurs (Bennett, 1989). However, pterosaurs are not actually dinosaurs but flying reptiles. The osteoarthritis was present in one genus, *Ornithocheirus*, localized to the carpal-metacarpal joint. It was recognized by the grooves formed by loss of cartilage with bone rubbing on bone. One interpretation relates to the importance of this joint in pterosaur flight. This was an evolutionary, but biomechanically inferior attempt to develop a function flight-permitting wrist. Absence of evidence of osteoarthritis in another genera of pterosaur, *Pteranodon*, may reflect less flight activity in that group. Osteoarthritis in *Iguanodon* is illustrated. [BMR]).

____ 1994. Paleopathology and the Sexual Habits of Dinosaurs, as Derived from Study of Their Fossil Remains. pp. 275-283. In: Dino Fest. Edited by G.D. Rosenberg and D.L. Wolberg. The Paleontological Society Special Publication No. 7. vi + 503 pp.

(The limited examples of osteoarthritis (in *Iguanodon*), bone fractures (*Centrosaurus* and *Pachyrhinosaurus* ribs; hadrosaur proximal caudal neural spines; tyrannosaur humeri) and DISH is sauropods (*Apatosaurus, Camarasaurus and Diplodocus*) are discussed. *Camptosaurus* caudal ligament ossification and *Apatosaurus* caudal vertebrae bridging by DISH are illustrated. [BMR]).

____ 1995. Application of Medical Techniques to Paleontology. (Abstract). Jour. Vert. Paleo., 15(3):50A.

(The complimentary role radiologic techniques can play in paleontology extends far beyond characterization of pathologies. While its use for hypothesis testing in such circumstances is often invaluable, radiologic techniques have significant implications in general paleontology. In addition to generating images of unprepared materials and internal structures of prepared specimens, it can guide in preparation efforts and even "straighten out" "warped" / crushed specimens. This component of the workshop will examine routine X-ray, computerized tomographic, and magnetic resonance techniques. It will address technical issues, critical when working with X-ray technologists or radiologists. It will also address mechanisms for establishment of cost / effective relationships, both with respect to time commitment and ways to minimize expense.

The second component of the workshop examines specimens with pathologic or diagenetic changes. The participants will formulate hypotheses about the nature of the underlying phenomenon and recommend techniques to test the hypothesis. The results of such analyses will then be presented, to assess their contribution to the process. [Author's abstract]).

____ 1997. Dinosaurian Paleopathology. pp. 426-448. In: The Complete Dinosaur. Edited by J.O. Farlow and M.K. Brett-Surman. University of Indiana Press, xiv + 752 pp.

(Overview of the field with extensive literature review. The following topics are discussed:

Recognition of Bone Paleopathology: Problems and Procedures. History, current technology available for use in studies (MRI, CT Scan, X-ray); pseudopathology.

Exostoses. *Triceratops* dentary, scapula [illustrated]; *Allosaurus* scapula [illustrated].

Divots. This refers to round or oval shaped depressions, occurring on hadrosaur pedal phalanges, usually occurring alone (rarely 2 or 3) and nearly always on the proximal articulating surface. Rothschild errs when he says this phenomenon is only known in lambeosaurine hadrosaurs, p. 431. Divots may represent developmental cartilage defects [several examples illustrated]. Other divot-like depressions are known in a *Tyrannosaurus* humerus and might represent avulsion injuries [illustrated].

Fractures. The most common paleopathology found in dinosaurs. Many examples are noted:

Sauropod rib fractures; basal tail fracture [neural spines], *Camptosaurus*; ischium fracture, *Iguanodon*; various unspecified theropod limb and foot fractures; *Allosaurus* radius fracture; *Syntarsus* metatarsal fractures; *Deinonychus* pedal phalanx fracture; fractured ribs and fibula fracture in *Gorgosaurus*; humeral fractures in tyrannosaurids [illustrated]; tibia fracture in Syntarsus; various hadrosaur and ceratopsian fractures; proximal caudal neural spine fractures in hadrosaurs [illustrated]; frill fractures in ceratopsians related to intraspecific agonistic encounters.

Stress Fractures. Cause of stress fractures and example in an unspecified ceratopsian phalanx illustrated.

Dental Pathology. Rare in dinosaurs generally. Dental abscess in hadrosaur jaw, broken teeth in theropods (not uncommon); premortem loss of teeth / anterior toothrow in *"Labrosaurus"* [illustrated]; malocclusion in *Tyrannosaurus* maxilla [illustrated] and "injured right premaxilla" in nodosaur *Edmontonia*.

Infectious Disease. Osteomyelitis is rare in dinosaurs. Some are known: osteomyelitis following hadrosaur hand fracture; *Camptosaurus* ilium with abscess; abscessed *Dilophosaurus* humerus, *Allosaurus* phalanx and *Troodon* parietal. Infectious periostitis in a ceratopsian scapula and an isolated *Triceratops* coronoid are noted.

Osteoarthritis. Virtually unknown in dinosaurs. Fusions or osteophyte development are indicative of spondylitis deformans, which is NOT to be confused with arthritis. Osteophyte development in a dorsal vertebra of the nodosaur *Edmontonia* and true arthritis, affecting the metatarsals of *Iguanodon* are illustrated.

Inflammatory Arthritis. Gout is known from a *Tyrannosaurus* manual element and a pedal phalanx of an unspecified tyrannosaur from Alberta, Canada.

Diffuse Idiopathic Skeletal Hyperostosis. This condition, or DISH for short is often confused with arthritis or osteoarthritis. DISH is not a pathological condition, but simply an ossification of lateral ligaments due to stress. DISH is best documented in Upper Jurassic sauropods such as *Camarasaurus, Diplodocus* [illustrated], and *Apatosaurus*.

Vertebral Fusion. Cervical vertebrae fusion in ceratopsians [illustrated] is normal and related to carrying the great weight of the head. Fusion of a neck and back vertebra in AMNH *Tyrannosaurus* is noted, but the cause is unknown. Tail tip fusions of vertebrae in various hadrosaurs and *Allosaurus* are related to trauma [trampling].

Tumors. At time of publication of this article, dinosaur tumors were unknown. All previous attempts of defining dinosaur tumors were in fact misdiagnoses. Several tumors are now known; see index two at the end of this bibliography for references.

Dinosaur Eggs. Multilayering of eggshell in sauropod *Hypselosaurus* and other unidentified dinosaur eggs.

Illustrated. Good bibliography. [DHT]).

____ and Berman, D. 1991. Fusion of Caudal Vertebrae in Late Jurassic Sauropods. Jour. Vert. Paleo., 11(1):29-36.

(Fusion of caudal vertebrae in the sauropod *Apatosaurus, Diplodocus*, and *Camarasaurus* is explained as the result of ossification of ligaments spanning consecutive centra. The ossification does not involve the intervertebral space or the annulus fibrosus of the disc and therefore represents true bridging. This is verified by not only the gross external appearance, but also by the use of CAT scans and longitudinal section of a fused pair of *Diplodocus* caudal vertebrae. Fusion of caudal vertebrae in *Camarasaurus* is reported here for the first time. Apparently analogous to such tendon ossification is the phenomenon noted in perhaps 50% of sauropods, whereby two to four contiguous caudal vertebrae are fused by new bone. Localization of fusion to a segment of tail between the 15th and 25th caudal vertebrae, and not affecting the zygoapophyseal (facet) and costo-vertebral joints supported this contention. Radiological visualization of a clear space between the ossification and the vertebral body confirmed the diagnosis as diffuse idiopathic skeletal hyperostosis (DISH). CT scan

of multiple specimens and longitudinal section of American Museum of Natural History specimen # 655 (*Diplodocus*) revealed intact disk spaces and the anticipated separation of the ossification from the vertebral body by a thin gap. The position of fusion (two-fifths of the distance from the sacrum to the most distant caudal vertebrae) represents the optimal position for "buttressing" a cantilever structure. It is concluded that the fusion is the result of the physiological phenomenon called diffuse idiopathic skeletal hyperostosis (DISH) and therefore is not a pathological response or due to a physical injury. Various proposed hypotheses to explain the function of the fused caudals, such as defence and postural support, are considered untenable. Fusion of the caudal vertebrae probably aided in keeping the tail elevated and undoubtedly served a functional role, though the specific nature of that function is presently unknown. Survey of North American specimens indicates that fusion of caudal vertebrae occurs in 50% of the individuals of *Apatosaurus* and *Diplodocus* in which the requisite portion of the tail is preserved, whereas this figure for *Camarasaurus* is about 25%. For this reason it is suggested that fusion of caudal vertebrae may be a sexually dimorphic feature. [BMR]).

____ and Martin, L.D. 1993. Paleopathology- Disease in the Fossil Record. CRC Press, Boca Raton, Florida. 386 pp.

(Paleopathology started as a curiosity, from its origins dealing with bone injuries and fusions. Alterations in isolated bones led to speculations, at times quite wild. Pattern recognition often allows the cause of clinical conditions (diseases) to be recognized. More commonly, a hypothesis reflects merely a guess as to the etiology. However, perspectives are often not what they seem.

Technology and understanding of disease processes has advanced sufficiently to allow hypotheses to be critically examined. The underlying assumptions are that:

1. Disease manifestations are relatively stable through time.
2. Tissue is preserved in a state amenable to analysis.
3. Pathology can be distinguished from diagenesis (pseudopathology).
4. If a testable hypothesis cannot be generated, consider:
   a. Interdisciplinary "brain-storming" sessions.
   b. Relegating the issue to the "future research" file.
5. Analysis of pathology as a skeletal phenomenon provides more insight than examination of isolated bones.
6. Analysis of pathology as a population phenomenon provides more insight than examination of isolated skeletons.
7. Collaborative approaches are essential.

What makes a hypothesis testable? If a phenomenon is recognizable in a biologically) intact individual [e.g., clinical (patient) material], then its significance in the skeleton is testable. Although clinicians rarely have the opportunity to examine bare bones, the X-ray affords a glimpse. If the *in vivo* radiologic appearance mirrors that of defleshed bones, the diagnosis is likely to also be mirrored. Differential diagnosis or other possible diagnoses would likewise be mirrored. However, examination should not be limited to that of isolated bones. The distribution of pathology in the skeleton is as informative as the actual nature of the individual lesion. Comparison of bones with those from individuals with clearly documented disease is an essential step in that process.

Collaborative approaches are essential. Thus accessibility can be established to the equipment required for analysis (preferably non- or minimally destructive) and to the expertise, essential for its interpretation. That process is quite similar to study of a foreign language. Each field has its own vocabulary. Although specific terms may be shared, at times they are quite disparate in meaning. Vocabulary must be clarified. Perhaps the past isolated approach of the anthropologist or paleontologist (interpreting disease on the basis of written descriptions) or the physician, chemist or "technologist" has been limited by a shared vocabulary with quite disparate meaning.

It is also useful to recognize what is controversial in diagnosis of pathology. Diagnoses often represent arbitrary categories, rather than definitive entities. The contemporary human population is quite diverse and many diseases are present. Select ancient human populations appear to have been afflicted in a more selective manner. Often only one or two major "bone-afflicting" disorders were present, allowing a clearer perspective of those diseases. Study of paleopathology in paleontologic materials allows further clarification.

Preliminary classification of arthritis and bone disease in humans is based on the nature of bony (e.g., preservation of size and configuration, presence of erosion, reactive bone formation or remodeling), as well as soft tissue alterations. Diagnosis of the specific type of arthritis involves characterization of a series of disease parameters. While bony alterations represent only a subset of those parameters, defleshed bones are frequently all that is available to the paleontologist.

The specific distribution and pattern of disease represent diagnostic criteria, with which diseases can be distinguished. The ability to identify and distinguish specific disease features is the most important aspect of diagnosis. When surveying a skeleton for disease, it is imperative that one recognize all changes which are not part of the normal condition of bone, and that each change is distinguished from another type, with all of their variations.

Although here are perhaps 200 varieties of arthritis which affect humans, most are not known to produce any bony alterations and are therefore not amenable to evaluation in skeletons (with currently applied technology). Diagnosis of diseases of bone, without benefit of soft tissue, requires the development of new criteria. By utilizing all obtainable information, characteristics that could distinguish one disorder from another and provide for their correlation with medical (e.g., rheumatologic diagnoses have been developed and tested. Given the population frequency, sex ratio, radiologic appearance, pattern of involvement, nature of the lesions, and association with other disease features, the manifestation of disease in a skeletal population is often attributable to specific clinical diagnosis.

We suggest that paleopathology should be predicated upon the premise that osseous alterations are reproducible. Reproductibility of diseases across species lines has been established for spondyloarthropathy (Gorilla, Chimp, Monkey), not only for gross or radiologic appearance of individual bones, but also for skeletal distribution. While the field is referred to as paleopathology, it must be emphasized that pathology is actually relatively rare. Study of paleopathology confirms the basically healthy nature of fossil organisms. Study of paleopathology now provides information on posture, gait, habits, and habitat. The contents of the book are therefore as follows:

Part I: Philosophical approach:
- Ch. 1. Philosophy
- Ch. 2. Bone reaction
- Ch. 3. Documentation of fossil preservation.
- Ch. 4. Diagenesis

Part II: Diseases w/ significant skeletal impact-holistic analysis.
- Ch. 5. Fracture
- Ch. 6. Avascular necrosis
- Ch. 7. Bone and Joint Infection
- Ch. 8. Arthritis of Mechanical Derivation
- Ch. 9. Rheumatoid arthritis
- Ch. 10. Spondyloarthropathy
- Ch. 11. Diffuse idiopathic skeletal hyperostosis
- Ch. 12. Gout
- Ch. 13. Calcium pyrophosphate deposition disease
- Ch. 14. Metabolic/endocrine disorders
- Ch. 15. Hematologic disorders
- Ch. 16. Bone Dysplasia and Neoplasia

Part III: Diagnostic approach.
- Ch. 17. Histological and Biochemical Techniques
- Ch. 18. Radiologic techniques.

Part IV: Evidence in the Veterinary/Paleontologic Record
- Ch. 19. Pathologic Approach to Phylogeny.
- Ch. 20. Phylogenetic Approach to Pathology.
- Ch. 21. Implications of disease in paleontology for determination of lifestyle, habitat and climate (Information not otherwise obtainable).

Part V: Literature Base
- Ch. 22. Literature Cited

[BMR].

Dinosaur pathology examined: exostosis affecting left scapula *Allosaurus*; *Anatosaurus* [*Edmontosaurus*] phalanges (actually metacarpals) with infected displaced fracture; stress fracture affecting ceratopsian phalanx; rarity of trauma-related fractures in ceratopsians such as *Centrosaurus* and *Pachyrhinosaurus*; ilium and basal tail injuries in *Camptosaurus browni* [cited by some authors as possible evidence of mating trauma]; healed fracture of tibia and metatarsus in *Syntarsus*; dental abscesses in hadrosaurs; DISH in a variety of dinosaurs; rarity of true osteoarthritis in dinosaurs (2 *Iguanodon* the only confirmed examples), etc. [DHT]).

_____ and Martin LD. 2001. Disease in the Skeletal Record. e-Medicine (in press).

(The most up to date information on data-based skeletal analysis with delineation of fossil examples and epidemiology [BMR]).

____ and Tanke, D.H. 1992. Paleopathology: Insights to Lifestyle and Health in the Geological Record. Geoscience Canada, 19(2):73-82.

(Study of ancient disease (paleopathology) is a powerful tool for understanding lifestyle and population dynamics, as well as the history of disease in antiquity. The major premise of paleopathology is that diagnoses of conditions of living animals can be extrapolated to fossils. Recognition of persistence of structural integrity, and even of cellular components, allows use of new radiologic, immunologic, DNA and holistic analysis techniques to effectively test diagnostic impressions. Collaboration by specialists in structural relationships (e.g., paleontologists) and students of disease (e.g., health care providers) provides significant insights to behavior of animals, long since extinct. [Authors' summary]. The article serves as an intensive review of the current state of paleopathological research of some fossil and recent vertebrates, alert the reader to the various methods of examination available for the study of paleopathology and summarizes the efforts of the "Drumheller [Darren Tanke]-Youngstown [Bruce Rothschild]-Kansas [Larry Martin] connection." Topics discussed: lntroduction, Osteoarthritis, lnfections, Dental abnormalities, Fusions, Ossified tendons, Tumors, Avascular necrosis and decompression syndrome, Fractures, lnjuries through intra- and interspecies interactions, Conclusions and implications. This is a good general and overall introduction to the field of paleopathology for the new student. Dinosaur pathology illustrated: rare arthritis in *Iguanodon*; fracture of tip of ceratopsian [cf. *Anchiceratops*] orbital horncore with pseudoarthrosis (false joint) development and mild periostitis; DlSH in caudal vertebrae of Upper Jurassic sauropod *Diplodocus*. Other illustrations of osteopathy in the extinct/extant record are presented. lncludes large bibliography. [BMR/DHT]).

____ and ____ 1996. Thunder in the Cretaceous: Interspecies Conflict as Evidence for Ceratopsian Migration. (Abstract). p. 96. In: Dinofest International Symposium. Program and Abstracts. April 18-21, 1996. Arizona State University, Tempe. Edited by D.L. Wolberg and E. Stump.

(TMP89.55.1234 Late Cretaceous (73 million years old) ceratopsian *Pachyrhinosaurus* n. sp. skull with a spectacular, large, circular lesion affecting the right side of the face. The lesion extends deep into the cranium, another 1-2 cm and it would have penetrated completely through the other side of the face. Etiology of this prominent lesion is discussed. ls it infectious, or an inter- intraspecific horn-thrust injury? Part of the orbit is also missing; suggestive of blindness on one side. Unillustrated. See Rothschild and Tanke, 1997 for full description. [DHT]).

____ and ____ 1997. Thunder in the Cretaceous: Interspecies Conflict as Evidence for Ceratopsian Migration?. pp. 77-81. In: Dinofest International: Proceedings of a Symposium Held at Arizona State University. Edited by D.L. Wolberg, E. Stump and G.D. Rosenberg. Academy of Natural Sciences, Philadelphia, Pennsylvania.

(*Pachyrhinosaurus* n. sp. TMP89.55.1234 also shows an atrophied ventral edge of the left squamosal and 2 "punched-out" lesions on the internal surface of this element. See Rothschild and Tanke, 1996 for additional details).

____ and ____ 1998a. Defective Dinosaur Bones: The Hole Truth. (Abstract). pp. 49-50. In: The Dinofest Symposium. Edited by D.L. Wolberg, K. Gittis, S. Miller, L. Carey and A. Raynor. The Academy of Natural Sciences, Philadelphia, Pennsylvania. April 17-19, 1998.

(Collaborative efforts are the foundation of paleopathology. We have noted defects in the surface of dinosaur bones have so far fallen into five categories: developmental, injury, infection, gout and tumor. Non-infectious erosive arthritis has not been recognized. Developmental abnormalities have been noted in the form of exostoses in carnosaurs and osteochondral defects (ie. Phalangeal articular surface divots) in hadrosaurs. As fractures have been a subject of major contributions, other injury-related bone defects were studied: tendon avulsion injuries in carnosaurs. Given predator/prey relationships, infectious lesions (ie. osteomyelitis and joint infections) are not completely separable from injuries.

Gout is a form of hyperacute arthritis in which the metabolic by-product, uric acid, is deposited in tissues. This forms identifiable holes in bones. The spheroid appearance of holes and new bone formation at the surface, producing an overhanging edge appearance, allowed recognition of gout in tyrannosaurids. It is curious this disorder has only been found in carnosaurs, contrasted with the larger available collections of herbivore skeletons for comparison. This may be analogous to high levels of uric acid in raptors, in contrast to that in other birds. Gouty arthritis, itself, has rarely been noted in crocodilians, lizards and turtles, but is reported in 1-5% of some birds. Contributing factors to occurrence of gout in humans are dehydration, renal failure, and ingestion of foods with high purine content. One dietary component is red meat, perhaps the foundation of the carnosaur diet.

Tumor or neoplasia has been a controversial subject in paleontology. While benign external surface bone growths have been reported in Cretaceous mosasaurs, reports of actual tumors have not been confirmable. While Moodie suggested a vascular tumor (hemangioma) as the explanation for caudal fusion in a *Diplodocus*, sauropod fusion actually represents an unrelated phenomenon called diffuse idiopathic skeletal hyperostosis or DlSH.

Hemangiomas are benign tumors of blood vessel derivation. They are common in humans, with a predilection for vertebral shape/contour. Coarse vertical (cephalad-caudad) striations (thick trabecular struts) are separated by relatively clear zones. This appearance has now been noted in bone collected by Gene and Virginia Talbot from Bull Hollow, Cedar Mountain, Emery County, Utah (Morrison Formation, Upper Jurassic). The fragmentary nature of this 10 pound fragment (some pieces at TMP—TMP94.191.1) precluded identification of species or even definite bone element identification, although the general surface morphology suggested a vertebral centra. Macroscopic examination of cut surface revealed a sharply defined, abnormal area completely enclosed by normal bone. The abnormal bone consisted of uni-directionally thickened bone trabeculae, separated by wide zones of matrix. The macroscopic and radiologic appearance of this Jurassic bone pathology and its change observation are classic for hemangioma.

Four varieties of surface defects have been noted to date in dinosaurs: developmental, interdependent injury and infection, gout and tumor. While developmental disorders provide insights to skeletal development and injuries/infections to inter- and intraspecies interactions, metabolic disorders (e.g. gout) provide insight to physiology. Tumors are an undefined area. As hemangioma are internal bone neoplasias, without external sign, they will only be found in fragmentary specimens or on X-ray. A role for systematic paleoradiology is suggested. [Author's abstract]).

____ and ____ 1998b. Mesozoic Neoplasia, From Moodie To The Lapidary Experience. (Abstract). Jour. Vert. Paleo., 18(3):73A.

(Advances in application of medical technology to paleontology has transformed speculations into testable hypothesis. This process has witnesses alternative explanations for pathological specimens which largely figured in Moodie's work. While Moodie suggested the neoplasia, hemangioma, as the explanation for caudal vertebral fusion in *Diplodocus*, computerized tomography allowed recognition of diffuse idiopathic skeletal hyperostosis as the actual pathology.

Moodie's speculation as to the existence of hemangioma in the Mesozoic has now been validated. Gene and Virginia Talbot discovered TMP94.191.1 [single slice at TMP, rest in possession of finders] on Cedar Mountain, Utah (Morrison Formation, Upper Jurassic). Fragmentary nature of the fragment precluded identification of species or even definite bone element identification, and the bone was processed for lapidary use. Macroscopic examination of the cut surface of section TMP94.191.1 revealed a sharply defined, abnormal area completely enclosed by normal bone. The abnormal bone consisted of uni-directionally thickened bone trabeculae, separated by wide zones of matrix. The macroscopic and radiologic appearance of this Jurassic bone pathology are classic for hemangioma. As hemangioma are internal bone neoplasias, that do not alter external bony architecture, they will only be found in fragmentary specimens or on x-ray. Fluoroscopic examination of the Carnegie Museum collections supports a role for systematic paleoradiology. [Author's abstract]. Published as: Rothschild, Tanke, Hershkovitz and Schultz, 1998).

____, ____ and Carpenter, K. 1997a. Tyrannosaurs Suffered from Gout. Nature, 387:357.

(Lesions of gout affecting metacarpals of a Late Cretaceous *Tyrannosaurus* from South Dakota, USA and a pedal phalanx (with associated bone infection) of an unspecified tyrannosaurid from the Campanian Late Cretaceous of Dinosaur Provincial Park, Alberta, Canada are described and illustrated. This is the first confirmed occurrence of gout in dinosaurs and in the fossil record generally. lllustrated. [DHT]).

____, ____ and ____ 1997b. Spheroid Erosions in Tyrannosaurids: Mesozoic Gout. (Abstract). Jour. Vert. Paleo., 17(3):72A.

(Serendipitous observation of metatarsal spheroid joint erosions with overhanging edge in casts of "Sue" (incarcerated *Tyrannosaurus*) led to evaluation of tyrannosaurids for evidence of erosive disease. TMP92.36.328, attributable to *Gorgosaurus*, *Daspletosaurus*, or *Albertosaurus*, is a phalanx with a 0.4 X 0.9 cm defect composed of two adjacent space occupying masses with smooth internal borders. New bone overgrew this area, producing an overhanging edge. Erosive disease was not observed in eighty-two other phalanges from that collection, suggesting "population" frequency of greater than or equal to 1.2%.

The uniformly excavated nature of the *Tyrannosaurus rex* erosions and those in a non-speciated tyrannosaurid resulted in a characteristic (for gout) spheroid lesion appearance. Overhanging lesion edges are characteristic for gout, only rarely having been reported in other diseases. Gout is a metabolic disorder in which urate crystals accumulate in joints as space-occupying masses.

Gouty arthritis has been noted rarely in crocodilians, lizards, turtles and in 1-5% of some birds. Contributing factors to occurrence of gout in humans are dehydration, renal failure, and ingestion of foods with high purine content. One such dietary component is red meat, no stranger to this denizen of the Cretaceous. [Author's abstract]).

____, ____, Hershkovitz, I. and Schultz, M. 1998. Mesozoic Neoplasias: Origins of Haemangioma in the Jurassic Age. The Lancet, 351(9119):1862.

(This important specimen was first briefly noted and figured in Anonymous, 1993b. In the present paper, the specimen catalogue number is erroneously given as RTM [Royal Tyrrell Museum] 1921A. Actual number of the slice studied is TMP94.191.1. The catalogue number for the original specimen is MSR [Museum of the San Rafaels, Castle Dale, Utah, USA] 1921A. For popular newspaper article see Talbot, 1998. Also abstracted by Rothschild and Tanke, 1998b. For another dinosaur bone cancer paper, see Rothschild, Witzke and Hershkovitz, 1999. [DHT]).

____, ____ and Ford, T. 2001. Theropod Stress Fractures and Tendon Avulsions as a Clue to Activity. pp. 331-336. In: Mesozoic Vertebrate Life: New Research Inspired by the Paleontology of Philip J. Currie. Edited by Darren Tanke and Kenneth Carpenter. Indiana University Press, Bloomington. xviii + 577 pp.

(A unique window into theropod behavior is afforded by the study of activity-related pathologies. Stress fractures and tendon avulsions provide evidence of activities overstressing regional mechanical strength of bone. Disjunction of pedal stress fracture localization with gait suggest alternative behavior-defined lesions. Identification of similar lesions in the manus and presence of upper extremity tendon avulsions support predation-related injuries. Such injuries are also likely the cause of pedal stress fractures. The scavenger-predation debate thus has new evidence supporting a very active, probably predatory lifestyle for theropods. [Author's abstract]. Unillustrated).

____, Witzke, B.J. and Hershkovitz, I. 1999. Metastatic Cancer in the Jurassic. Lancet, 354(9176):398.

(CM 72656, unspecified dinosaur bone from the Upper Jurassic Formation of western Colorado, USA. This is the second confirmed occurrence of a cancerous lesion in a dinosaur. For the first report, see Rothschild, Tanke Hershkovitz and Schultz, 1998. Illustrated. [DHT]).

Rowe, T., Colbert, E.H. and Nations, J. Dale 1981. The Occurrence of *Penta-ceratops* with a Description of Its Frill. pp. 29-48. In: Advances in San Juan Basin Paleontology. Edited by S.G. Lucas, J. Keith Rigby, Jr., and B.S. Kues. University of New Mexico Press.

(Includes brief discussion of the extra openings in the squamosal bone of the Late Cretaceous ceratopsian *Pentaceratops* from New Mexico, USA. Lull (1933) considered such features as pathological in nature, representing healed horn thrust injuries from other ceratopsians. See also Wiman, 1930; Mateer, 1981; Tanke and Farke, ms. [DHT]).

____ and Gauthier, J. 1990. Ceratosauria. pp. 151-168. In: The Dinosauria. Edited by D.B. Weishampel, P. Dodson and H. Osmolska. Univ. Calif. Press, Berkeley. xvi + 733 pp.

(Includes comments on the fusion of metatarsals in the type of Upper Jurassic *Ceratosaurus*. Fusion of metatarsals II, III and IV occur most of their length, ".... although the more distal fusion might be pathologic." This specimen is illustrated. [DHT]).

Rowe, W.F. 1990. Bobbing for Dinosaurs: A Forensic Scientist Looks at the Genesis Flood. Creation/Evolution, 28:16-20.

(Forensics. Format: Semi-Popular. [DHT]).

Rubin, L. 1998. Cartoon of *Tyrannosaurus* and Feeding Mosquito.

(Nationally syndicated cartoon dated April, 22, 1998 showing an exasperated and trembling *Tyrannosaurus* with a mosquito which is feeding on its back. With its' short arms, it is completely unable to dislodge the bothersome pest. The cartoon caption states: "*T. rex*, the ultimate killing machine, yet powerless against prehistoric mosquitoes." [DHT]).

Russell, D.A. 1969. A New Specimen of *Stenonychosaurus* from the Old-man Formation (Cretaceous) of Alberta. Can. Jour. Earth Sci., 6:595-612.

(Includes mention of a "strikingly asymmetrical" braincase in CMN 12340, now referred to *Troodon*. Etiology of this condition is not explored. [DHT]).

____1970. Tyrannosaurs from the Late Cretaceous of Western Canada. Nat. Mus. Nat. Sci., Publ. in Paleo., 1:1-34.

(Page 11 comments on pathological metatarsal noted by Parks (1928). Page 18 mentions one of two humeri in *Daspletosaurus torosus* having pathologic distal ends, and in five specimens of *Albertosaurus* [*Gorgosaurus*] *libratus*, two humeri were pathologic. Russell suggests humeral injuries were the result of the small forelimbs being accidently crushed by the owners body. See Vance, 1989 and Molnar and Farlow, 1990 for additional hypotheses as to this pathological conditions etiology. Plates III and IV include dorsal and ventral views of a humerus exhibiting healed fractures. [DHT]).

____ 1989. An Odyssey in Time: The Dinosaurs of North America. Univ. Toronto Press, in association with the National Mus. Nat. Sci., Canada, 239 pp.

(Horns and bony shields of ceratopsians bearing puncture wounds through frill (p. 145). *Chasmosaurus* skulls showing partly healed horn thrust wounds showing intraspecific combat (p. 156). *Triceratops* bones from an aged animal showing evidence of disease (type unstated) (p. 183). [DHT]. Format: Popular).

____ and Zheng, Zhong. 1993. A Large Mamenchisaurid from the Junggar Basin, Xinjiang, People's Republic of China. Can. Jour. Earth Sci., 30:2082-2095.

(An incomplete skull and articulated neck of the enormous Jurassic sauropod *Mamenchisaurus* is described and illustrated. Page 2083 mentions that the teeth in the lower jaw "were fully erupted but unworn, suggesting the animal may have been starved." [DHT]).

Russell, L.S. 1935. Fauna of the Upper Milk River Beds, Southeastern Alberta. Roy. Soc. Canada, Trans., (Ser. 3, Sec. 4) 29:115-127.

(Late Cretaceous "*Paronychodon*"-type teeth from Alberta, Canada described and figured by Russell (p. 123 and Plate 2, fig. 8) are actually aberrant teeth of better known small theropod taxa. See Currie, Rigby and Sloan, 1990:117 for discussion. [DHT]).

Ryan, M.J. 1992. The Taphonomy of a *Centrosaurus* (Reptilia: Ornithischia) Bonebed (Campanian), Dinosaur Provincial Park, Alberta, Canada. Masters thesis, Univ. Calgary, Calgary, Alberta, Canada. xxvi + 526 pp.

(Masters thesis on Campanian Dinosaur Park Formation (Late Cretaceous) *Centrosaurus* bonebed (Bonebed 43, Quarry 143) in Dinosaur Provincial Park, Alberta, Canada. Includes mention of the few pathological specimens recovered from this site. Mass mortality is implicated in the formation of this deposit, mass drowning is suspected. Thesis on file at Royal Tyrrell Museum of Paleontology library. Osteopathy unillustrated. [DHT]).

____ 1993. The Taphonomy of a *Centrosaurus* (Reptilia: Ornithischia) Bone Bed (Campanian), Dinosaur Provincial Park, Alberta, Canada. (Abstract). Can. Assoc. Herpet., 7(1):16.

(Drowning mass mortality event affecting Late Cretaceous ceratopsian *Centrosaurus apertus*. See Ryan et al., 2001. Unillustrated. [DHT]).

____ and Russell, A.P. 1994. Taphonomy of a *Centrosaurus* (Ornithischia: Ceratopsidae) Bone Bed from the Dinosaur Park Formation (Upper Campanian), Alberta, Canada. (Abstract). Jour. Vert. Paleo., 14(3):44A.

(Drowning mass mortality event, possibly involving thousands of ceratopsians is preserved in Bonebed 43 (Quarry 143) and allied bonebeds within Dinosaur Provincial Park. See also Currie, 1981, Currie and Dodson, 1984; Ryan, 1992; Ryan et al., 2001. [DHT]).

____, ____, Eberth, D.A. and Currie, P.J. 2001. The Taphonomy of a *Centrosaurus* (Ornithischia:Certopsidae [sic]) Bone Bed from the Dinosaur Park Formation (Upper Campanian), Alberta, Canada, with Comments on Cranial Ontogeny. Palaios, 16:482-506.

(Complete, illustrated description of this classic dinosaur mass-mortality locality. [DHT]).

____, ____, Eberth, D.A. and Brinkman, D.B. 1999. A New Centrosaurine Ceratopsid from the Oldman Formation of Alberta, Canada. (Abstract). Jour. Vert. Paleo., 19(3):72A.

(Includes mention of *Centrosaurus* and *Styracosaurus* bonebeds in the Dinosaur Park Formation, Dinosaur Provincial Park, Alberta, Canada. Bonebed 138, in the older Oldman Formation also within Dinosaur Park, is yielding material of a new centrosaurine. All these bonebeds represent mass mortality occurrences. [DHT]).

S

Sahni, A. 1972. The Vertebrate Fauna of the Judith River Formation, Montana. Bull. Amer. Mus. Nat. Hist., 147:323-412.

(Some Late Cretaceous teeth described in this paper are actually aberrant small theropod teeth ["*Paronychodon*"] of better known taxa. See Currie, Rigby and Sloan, 1990:117 and Baszio, 1997 for discussion. Illustrated. [DHT]).

Sampson, S.D. 1993. Cranial Ornamentations in Ceratopsid Dinosaurs: Systematic, Behavioral, and Evolutionary Implications. Ph. D. Thesis, Univ. Toronto. Toronto, Canada. xix + 299 pp.

(NOT INDEXED. Includes pathology.).

____ 1995. Two New Horned Dinosaurs from the Upper Cretaceous Two Medicine Formation of Montana: with a Phylogenetic Analysis of the Centrosaurinae (Ornithischia: Ceratopsidae). Jour. Vert. Paleo., 15(4):743-760.

(Material referable to *Einiosaurus procurvicornis* was collected from two monospecific bonebeds which represent mass mortality events. Resorption pitting resulting in partial to total loss of the orbital horncores (or bosses) in centrosaurines is related to advanced age. Such pits had been ascribed to a variety of conditions including fungal corrosion of living tissue (Langston, 1975; see also Sampson, Ryan and Tanke 1997 for further discussion on possible age-related pitting]. [DHT]).

____ 1997. Bizzare Structures and Dinosaur Evolution. pp. 39-45. In: Dinofest. Edited by D.L. Wolberg, E. Stump and G.D. Rosenberg. The Academy of Natural Sciences, Philadelphia.

(Includes comments on drought-related mass mortality documented in several ceratopsian bonebeds excavated in Montana, USA, p. 43. See entries under Rogers or Rogers and Sampson for details. [DHT]).

____ Of Horns, Herds and Hierarchies: Speculations on the Socioecology of Ceratopsid Dinosaurs.

(Manuscript).

____, Ryan, M.J., and Tanke, D.H. 1997. Craniofacial Ontogeny in Centrosaurine Dinosaurs (Ornithischia: Ceratopsidae): Taxonomic and Behavioral Implications. Zool. Jour. Linn. Soc., 121:293-337.

(The *Centrosaurus, Pachyrhinosaurus, Einiosaurus* and *Styracosaurus* material used in this study were derived from monospecific or "low diversity" bonebed typically ascribed to mass mortality events. Includes comments (pp. 308-310) on postorbital horncore pitting, i.e. "resorption pits." These pits could be related to periodic resorption followed by regrowth; age-related resorption; periodic loss due to a seasonal antler-style of replacement; or pathology related to disease or trauma. Traumatic pathology seems unlikely, histologic examination may elucidate this problem. See Tanke and Farke, ms. [DHT]).

Sander, P.M. 1992. The Norian *Plateosaurus* Bonebeds of Central Europe and Their Taphonomy. Palaeogeogr., Palaeoclimato., Palaeoecol., 93:255-299.

(Mentions (pp. 263, 285) of broken and healed gastral ribs in two specimens of this Late Triassic prosauropod. The *Plateosaurus* remains are found in large bonebeds and indicate mass mortality occurrences of herding animals. The author (pp. 290-291) considers and refutes CO_2 suffocation, predation, or disease as possible factors causing the mass die off. The strongly pulled back nature of the neck in the plateosaurs is also examined (pp. 291-292), with a quick review of other described examples. Moodie (1918d) erroneously considered this phenomenon as evidence for strychnine poisoning. [DHT]).

Sanz, J.L., Moratalla, J.J., Diaz-Molina, M., Lopez-Martinez, N., Kalin, O. and Vianey-Liaud, M. 1995. Dinosaur Nests at the Sea Shore. Nature, 376:731-732.

(See Sanz and Moratalla, 1997 for specific details. Illustrated. [DHT]).

____ and ____ 1997. Bastus Nesting Site. pp. 42-43. In: Encyclopedia of Dinosaurs. Edited by P.J. Currie and K. Padian. Academic Press, San Diego. xxx + 869 pp.

(Eggshell fragments of an estimated 300,000+ Upper Cretaceous unspecified dinosaur eggs, Bastus, Spain. Illustrated. 24 nests (each containing 1-7 [usually 2-3] eggs) were arranged in three clusters. Mass mortality. See Sanz et al., 1995. [DHT]).

Sattler, H.R. 1981. Dinosaurs of North America. Lothrop, Lee & Shepard Books, New York, vii + 151 pp.

(Intraspecific fighting in the Late Cretaceous ceratopsian *Triceratops* caused cranial injuries. Format: Popular).

Saul, F.P. and Saul, J.M. 1992. Vascular Impressions and Pseudopathology Revisited. Paleopath. Newsletter, 80:7-8.

(Vascular groove impressions in bone of the temporal region in *Homo* are reexamined; these are formed by the anterior branch of the superficial temporal artery. Apparently they have been repeatedly confused or misdiagnosed as healed bone cut trauma. Similar features are seen on dinosaur cranial material and are occasionally considered as evidence of unhealed or healed carnivore tooth trauma (pers. obs., DHT). See Rogers (1990: fig. 10) for description and illustration of "probable toothmarks" that are probably vascular in origin. [DHT]).

____ and ____ 1993. Cutmarks or Vascular Impressions? Clues from Paleo-pathology and Anatomy. (Abstract). Pap. Paleopath. presented at the 20th Ann. Meet. Paleopath. Soc., Toronto:23.

(A speaker at the February 1992 meeting of the American Academy of Forensic Sciences asked the audience for opinions regarding the origin of grooves in the lateral portions of the frontal bone of a projected skull from a recent case. The forensic pathologist suspected that they represented "cutmarks." For us, it was another case of "deja vu all over again." These, and similar vascular grooves elsewhere in the skeleton, have frequently been misinterpreted by investigators studying ancient skeletal remains as being due to trauma or to medical procedures ("cauterization"). Grooves in this specific location are probably the impressions that are sometimes produced by the pulsation of the frontal branch of the superficial temporal artery (the "checkpoint" for the temporal pulse). In support of this contention, we provide photographs of this vessel in place in one of our dissecting room specimens, and a scanning electron microscopic analysis of another groove that reveals fine grooves (= vessels) branching off from the main groove, as well as smooth muscle-like impressions. We also review the anatomy and paleopathology literature and present our own information on variation in presence and form. [Author's abstract] see Rogers, 1990.).

Schelle, W.E. 1954. Prehistoric Animals. World Publ. Co., Cleveland, 125 pp.

(Many skulls of ceratopsians show evidences of battles between male animals (p. 114). Format: Popular. [DHT]).

Schlumberger, H.G. and Lucke, B. 1948. Tumors in Fishes, Amphibians, and Reptiles. Cancer Res., 8(12):657-754.

(The study of tumors occurring spontaneously in animals and the experimental study of neoplasia are complementary. Such studies in the past have dealt largely with tumors in the higher vertebrates, mammals and birds; much less attention has been paid to the lower vertebrates, fishes, amphibians and reptiles. But neoplastic processes are ubiquitous among vertebrates, and comparison has shown that tumors in cold-blooded animals are essentially identical in regard to their structure and behavior with the corresponding tumors in warm-blooded animals. Since no comprehensive account of spontaneous tumors of the former group exist, it was thought advisable to assemble the available literature as a guide to source material and as an aid to future investigations. This has been done in the present paper. [Authors' introduction; in part]. The author's consider the fusions of mid-caudal vertebrae as seen in the Late Jurassic sauropod *Diplodocus* as benign overgrowths following bone fracture. See Rothschild and Berman, 1991).

Schmitt, J.G., Horner, J.R., Laws, R.R. and Jackson, F. 1998. Debris-Flow Deposition of a Hadrosaur-Bearing Bone Bed, Upper Cretaceous Two Medicine Formation, Northwest Montana. (Abstract). Jour. Vert. Paleo., 18(3):76A.

(Specimens derived from this *Maiasaura*-dominated bonebed may represent reworked material from a prior mass mortality event. [DHT]).

Schneider, D. 1996. Dining Out On Dinosaurs. Can. Geogr., 116(6):19.

(Note on A. Borkent's work on Late Cretaceous biting midges recovered from amber collected in Alberta and Manitoba, Canada. Anatomical features on two or three species indicates possible feeding habits on the blood of dinosaurs. See Borkent, c.1993, 1995. Format: Popular. Unillustrated. [DHT]).

Schowalter, T. 1995a. Dinosaur Diner- Feeding Site Discovered in Park near Brooks. The Calgary Herald, Saturday, March 25, 1995:B1.

(Popular article on tooth-marked dinosaur bone found near Drumheller, Alberta. [Serrated teeth of Late Cretaceous tyrannosaurid [cf. *Albertosaurus*] left long parallel striation rows as the tooth was dragged lengthways along the bone of a prey animal. Any inconsistencies of the serration pattern can thus be reflected in the toothmarked and fossilized remains of the prey. A hadrosaur rib is figured in the article. Long equally-spaced striations (ie. made by normal serrations) can be seen, but some serration rows are replaced by noticeably wider and raised rows. These represent regions of the tooth where the serrations were either worn down, or more likely broken off during feeding activities. Such missing serrations can often be seen on tyrannosaurid teeth in the field (DHT, pers. obs.). While this "anomaly" represents tooth pathology on a small scale, it would not impart the owner any real problems during feeding. With numerous serrated teeth that were replaced throughout life, a tyrannosaur could always count on having a mouthful of teeth]. Format: Popular. [DHT]).

____1995b. Jaws of Giants - Bone Scars Suggest Dinosaurs Often Fought. Calgary Herald, Saturday, September 16, 1995:B6. Reprinted as: Museum Collecting Fossilized Bones Marked by Injury. Drumheller Mail, Wednesday, Oct. 4, 1995:5.

(Intraspecific fighting is inferred from healing/healed toothmarks on cranial elements, or unhealed striated toothmarks on the teeth of large carnivorous dinosaurs such as *Allosaurus*, *Albertosaurus* and *Tyrannosaurus*. Such battles could be related to territoriality, mating rights or food. See also Tanke and Currie, 1995, 1998 (2000). Illustrated. Format: Popular. [DHT]).

Schulp, A.S. and Brokx, W.A. 1999. Maastrichtian Sauropod Footprints from the Fumanya Site, Bergueda, Spain. Ichnos, 6(4):239-250.

(The author's describe trackways found on a steeply inclined (60 degrees) rock face. They make the important observation that the inclined rock is undergoing strain which also affects the footprints preserved therein. This rock strain deforms the tracks and creates asymmetrical dinosaur tracks and "limping dinosaur trackways." This observation has serious implications for the study of supposed limping dinosaur trackway sites worldwide. See Brokx and Schulp, 1998, Brokx et al., in prep. [DHT]).

Schwartz, H.L. and Gillette, D.D. 1994. Geology and Taphonomy of the *Coelophysis* Quarry, Upper Triassic Chinle Formation, Ghost Ranch, New Mexico. Jour. Paleo., 68(5):1118-1130.

(Description of the celebrated small theropod *Coelophysis bauri* (*Rioarribosaurus* to some authors) quarry. This is a classic mass mortality event with no less than 1,000 individuals represented. Many more skeletons are still *in situ* and await excavation. Despite the large numbers of specimens available for study, no evidence of osteopathy has been observed. The presence of smaller skeletons within larger individuals is evidence of cannibalism. The author's conclude the animals died during a drought; the carcasses were later washed downriver and collected at a common locality. Illustrated. [DHT]).

Schweitzer, M.H. 1993. Biomolecule Preservation in *Tyrannosaurus rex*. (Abstract). Jour. Vert. Paleo., 13(3):56A.

(A nearly complete, mostly articulated skeleton of *Tyrannosaurus rex*, found in the Hell Creek Formation of eastern Montana, shows remarkable preservation of microstructure, including vascular canal spaces within the bone. Trabecular bone taken from within the marrow cavities of the long bones shows no infilling with sediment, and the bone itself is light-weight and appears unreplaced.

Elemental analysis shows calcium and phosphorus in the bone, while structures in the vascular canals consist primarily of iron. Scanning electron microscopy shows preservation of microstructure that appear cell-like in nature, while transmission electron microscopy shows preservation of apparent collagen fibers, as well as canaliculi extending from osteocyte lacunae. Gas chromatography/mass spectrometry and high performance liquid chromatography performed on bone, which was organically extracted, reveal the possible preservation of biomolecules, including nucleic acids and peptides or proteins. [Author's abstract]. See Schweitzer et al., 1997).

____ 1997. Museum Of The Rockies. p. 459. In: Encyclopedia of Dinosaurs. Edited by P.J. Currie and K. Padian. Academic Press, San Diego. xxx + 869 pp.

(Museum of the Rockies, Bozeman, Montana, USA. Includes mention on dinosaur paleopathology research being done there, especially dealing with healed fractures and disease in the Upper Jurassic theropod *Allosaurus*. See entries under Laws (including Hanna) in this bibliography. Unillustrated. [DHT]).

____ 1998. Claws, Beaks, Scales and Feathers: The Evolutionary Implications of Keratin Preservation in the Fossil Record. (Abstract). p. 52. In: The Dinofest Symposium. Edited by D.L. Wolberg, K. Gittis, S. Miller, L. Carey and A. Raynor. The Academy of Natural Sciences, Philadelphia, Pennsylvania. April 17-19, 1998.

(Discussion of evidence of keratin preservation on a Cretaceous bird ungual from Madagascar and possible feather fibers associated with a *Mononykus* skeleton from Mongolia. [DHT]).

____ and Cano, R.J. 1994. Will the Dinosaurs Rise Again? pp. 309-326. In: Dino Fest. Edited by G.D. Rosenberg and D.L. Wolberg. The Paleontological Society Special Publ. No. 7.

(The movie Jurassic Park has engendered much excitement and some speculation among both the general public and scientific community as to the possibilities of genetic research and molecular preservation. But will the dinosaurs "rise" again? Will scientists be able to "clone" a dinosaur out of bits of genetic material and once again unleash these great beasts to walk the earth? If it is possible, should it be attempted? If not, why are time, money and effort being expended by several groups of investigators in attempts to isolate and characterize the DNA of these extinct creatures, if such DNA can possibly exist? What can we hope to learn from these efforts, should they be fruitful?

We will examine the following issues dealing with this line of study:

1. Information to be gained from the study of DNA;
2. Strategies of analysis: new technologies and techniques;
3. Selections of gene sequences for analysis;
4. Preservation of potential biomolecules;
5. Role of protein or amino acid analysis;
6. Sources of ancient DNA;
7. Problems of working with "extinct" DNA;
8. Obstacles to the resurrection of extinct animals;
9. Brief review of current progress.

[Authors' introduction]).

____, ____, Starkey, J.R. and Horner, J.R. 1994. Multiple Lines of Evidence for the Preservation of Collagen and Other Biomolecules from *Tyrannosaurus rex*. (Abstract). Jour. Vert. Paleo., 14(3):45A.

(The role of hydroxyapatite in the preservation of biomolecules in ancient or fossil specimens has been largely overlooked in theoretical predictions regarding the longevity of such biomolecules. Current predictions are based on patterns of degradation observed in molecules in solution. However, the strong affinity of both DNA and collagen for hydroxyapatite, which is the principal mineral of the bony matrix, effectively removes these molecules from solution and affords them considerable protection from normally observed degradation processes.

A largely unreplaced, articulated skeleton of *Tyrannosaurus rex*, found in [Late Cretaceous] Hell Creek sediments, provides an unusual opportunity to test the hypothesis that ancient DNA and collagenous proteins associated with bone mineral might have survived.

Trabecular bone samples from the long bones of the *T. rex* were subjected to a variety of analytical approaches to determine if the unusual degree of preservation seen macroscopically extended to the microscopic, molecular, and elemental levels.

Results, although preliminary, have been promising. Elemental analysis verifies the bones are unreplaced. Chromatographic separations show fractions with absorbance maxima corresponding to nucleic acids and/or proteins. Amino acid analysis shows values congruent with those expected for collagen. SDS-Page analysis for proteins reveals low molecular weight bands. [Author's abstract]).

____ and Lessem, D. 1997. Jurassic Park. pp. 385-387. In: Encyclopedia of Dinosaurs. Academic Press, San Diego. xxx + 869 pp.

(Commentary on dinosaur DNA, cloning, etc. Unillustrated. [DHT]).

____, Marshall, M., Carron, K., Bohle, S., Arnold, E., Busse, S. and Starkey, J. 1996a. Identification of Possible Blood-Derived Heme Compounds in *Tyrannosaurus rex* Trabecular Tissues. (Abstract). p. 99. In: DinoFest International Symposium. Program and Abstracts. April 18-21, 1996. Arizona State University, Tempe. Edited by D.L. Wolberg and E. Stump.

(See Schweitzer et al., 1997 for details).

____, ____, ____, ____, ____, ____ and ____ 1996b. Identification of Possible Blood-Derived Heme Compounds in *Tyrannosaurus rex* Trabecular Tissues. (Abstract). 6th North Amer. Paleont. Conv., Paleontological Society Special Publications, No. 8:348.

(NOT SEEN. NOT INDEXED. See Schweitzer et al., 1996a).

____, ____, ____, ____, ____, Arnold, E.V., Barnard, D., Horner, J.R. and Starkey, J.R. 1997a. Heme Compounds in Dinosaur Trabecular Bone. Proc. Natl. Acad. Sci., 94:6291-6296.

(Six independent lines of evidence point to the existence of heme-containing compounds and/or hemoglobin breakdown products in extracts of trabecular tissues of the large theropod dinosaur *Tyrannosaurus rex*. These include signatures from nuclear magnetic resonance and electron spin resonance that indicate the presence of a paramagnetic compound consistent with heme. In addition, UV/visible spectroscopy and high performance liquid chromatography data are consistent with the Sorbet absorbence characteristic of this molecule. Resonance Raman profiles are also consistent with a modified heme structure. Finally, when dinosaurian tissues were extracted for protein fragments and were used to immunize rats, the resulting antisera reacted positively with purified avian and mammalian hemoglobins. The most parsimonious explanation of this evidence is the presence of blood-derived hemoglobin compounds preserved in the dinosaurian tissues. [Author's abstract]. Illustrated).

____, ____, Barnard, D., Bohle, S., Carron, K., Arnold, E. and Starkey, J.R. 1997b. Blood from a Stone? pp. 101-104. In: Dinofest International:Proceedings of a Symposium Held at Arizona State University. Edited by D.L. Wolberg, E. Stump and G.D. Rosenberg. 587 pp.

(Details as per Schweitzer et al. above).

____, Johnson, C., Zocco, T.G., Horner, J.R. and Starkey, J.R. 1997c. Preservation of Biomolecules in Cancellous Bone of *Tyrannosaurus rex*. Jour. Vert. Paleo., 17(2):349-359.

(An exceptionally well preserved specimen of the tyrannosaurid dinosaur *Tyrannosaurus rex* Osborn shows little evidence of permineralization or other diagenetic effects. It appears that the cancellous bone tissues of the specimen may have been protected from water infiltration or mineral deposition by the very dense cortical bone which surrounds them. The cancellous tissues provided an opportunity to test the hypothesis that indigenous biomolecules might be preserved over the course of millions of years under the appropriate conditions. HPLC analysis of extracts from the bone tissues revealed the presence of molecules with light absorbance maxima consistent with nucleic acids and peptides/proteins. Analyses of bone extracts for amino acid content yielded ratios similar to those found for modern ostrich and horse bone. A high molar glycine ratio and the presence of hydroxylysine peaks in bony tissue samples from the *T. rex* suggests the presence of collagen type I remnants. Results indicate that the analyzed tissue contains numerous biomolecules. While some of the biomolecules are most likely contaminants, the probable presence of collagen type I suggests some molecules of dinosaurian origin remain in these tissues. [Author's abstract]. Illustrated).

____ and Horner, J.R. 1999. Intravascular Microstructures in Trabecular Tissues of *Tyrannosaurus rex*. Ann. Palaeontol., 85:179-192.

(NOT SEEN. NOT INDEXED).

Sebes, J.I., Langston, J.W., Gavant, M.L. and Rothschild, B.M. 1991. MR Imaging of Growth Recovery Lines in Fossil Vertebrae. Amer. Jour. Roentgenol., 157:415-416.

(An important article, not for directly illustrating dinosaur pathology, but because it demonstrated for the first time that magnetic resonance imaging could be used to examine fossils. 12 million year old *Eurinodelphis* vertebral growth lines were clearly visualized. [BMR]).

Seitz, A.L.L. 1907. Vergleichenden Studien uber den Mikroskopischen Knochenbau Fossiler und Rezenter Reptilien und Dessen Bedeutung fur das Wachstum und Umbildung des Knochengewebes im Allgemeinen. [Comparative Studies of the Microscopic Bone Structure of Fossil and Recent Reptiles and the Significance for the Growth and Modification of the Bone Tissue in General]. Nova Acta Akad. Caeser. Leop. Carol., 87:230-370.

(NOT SEEN. Described possible fossil blood in Early Cretaceous *Iguanodon*, though presented his finding with some reservation. See Moodie, 1920d, Reid, 1993, Martill and Unwin, 1997. Language: German).

Sereno, P. and Wild, R. 1992. *Procompsognathus*: Theropod, "Thecodont" or Both? Jour. Vert. Paleo., 12(4):435-458.

(The right fibula of a partial skeleton of *Procompsognathus triassicus* (SMNS 12591) figured on page 438 exhibits a peculiar twisting of the proximal shaft. Other bones nearby appear normal, suggesting this anomaly is pathologic and not related to post-mortem crushing. This anomalous condition is not described or discussed. [DHT]).

____ and Novas, F.E. 1993. The Skull and Neck of the Basal Theropod *Herrerasaurus ischigualastensis*. Jour. Vert. Paleo., 13(4):451-476.

(Mention on pp. 472-473 of three bites marks to the back of the skull of this small Upper Triassic theropod. All show some slight degree of healing. One affects the left parietal and two the ventral side of the left splenial. Distribution and orientation of the lesions indicates the pathology represents bites, probably received from a conspecific. Distribution and orientation indicate more than one bite was responsible for the lesions. Lesions of a similar type and distribution are also known for large carnivorous dinosaurs, see Tanke and Curre, 1998 (2000). Illustrated. [DHT]).

Silbernagel, B. 1996. Dinosaur Stalkers. Dinamation International Society, Fruita, Colorado. 64 pp.

(Fruita Paleo Area, Colorado, USA. The site contains the remains of many smaller vertebrates (*Fruitachampsa*, sphenodonts, mammals and unspecified snake) including the small dinosaur *Echinodon*. As to how the site formed, researcher Dr. George Callison suggests an ashfall from a volcanic eruption overwhelmed the local fauna- a mass mortality. Format: Popular. [DHT]).

Simpson, G.G. 1953. Life of the Past- An Introduction to Paleontology. Yale Univ. Press, New Haven. xii + 198 pp.

(On the topic of paleopathology, Simpson states: "Evidences of disease are rather common in fossils and have been studied in great detail, especially by the late R. L. Moodie. They do not, however, suffice for any very significant study of the history of disease. The causative agent in true disease as opposed to injury can never be surely identified in fossils. Furthermore, only diseases that visibly affect the hard parts, shells or bones, are recorded, and these are not, after all, the most important diseases today. It is fairly common for fossil vertebrate skeletons to show abnormal fusion of joints and outgrowths of diseased bone, exemplifying some form of arthritis. Fusion of the tail vertebrae in one of the great sauropod is an example, and many other examples are known." (pp. 69-70). Format: Semi-Popular/Technical).

Slaughter, B. 1957. Ancient Footprints. Texas Game & Fish, 15(8):13, 31.

(Comments on the famous theropod/sauropod trackway collected at Glen Rose, Texas by R. Bird for the AMNH. Includes a figure (painted by Charles Knight) of intraspecific fighting in *Tyrannosaurus*. Format: Popular. [DHT]).

Smith, D.K. and Lisak, F.J. 2001. An Unusual Specimen of *Allosaurus* from Southeastern Utah. Brigham Young Univ. Geol. Stud., 46:93-98.

(The specimen is unusual in possessing an expanded nasal crest and increased paranasal pneumaticity compared to other specimens. The unusual traits are attributed to individual variation. [DHT]).

Smith, P. 1992. Digging the Dirt on a Dinosaur. The Guardian (England), Oct. 9, 1992:30.

(Newspaper article mentions the following pathologies affecting this "female?" *Tyrannosaurus rex* skeleton recovered from the Late Cretaceous of South Dakota, USA: ".... badly broken lower leg bone, torn ligaments, a crushed caudal vertebra, a broken cervical rib, a hit on the head and a bite on the neck." Smith concludes: "*T. rex* ..... was no stranger to accident or attack." Format: Semi-Popular. [DHT]).

Sobel, D. 1989. The Dinosaur That Never Was. Omni, November:36.

(Short, popular account of the discovery of a pathological (multilayered) dinosaur egg studied by Hirsch, Stadtman, Miller and Madsen, 1988. Illustrated. [DHT]).

Sochava, A.V. 1971. Two Types of Eggshell in Senonian Dinosaurs. Palaeont. Jour., 5(3):353-361.

(Pathological multilayered Senonian-aged (Upper Cretaceous) dinosaur eggshell of unknown taxonomic affinities collected from Naran-Bulak Spring in the Trans-Altay Gobi. Comparisons are drawn to pathologic eggshell of extant birds (grebe *Podiceps* sp.). Illustrated; see Plate X, figs 7-9 for pathological examples. [DHT]).

Sokoloff, L. c.1960. Comparative Pathology of Arthritis. pp. 193-250. In:

Advances in Veterinary Science. Edited by C.A. Brandly and E.L. Jungherr, Vol. 6, Academic Press, London.

(On pp. 237-238, the author discusses infectious spondylitis in *Apatosaurus*. Fusions of cervical and caudal vertebrae in *Camarasaurus, Tyrannosaurus* and *Diplodocus* are noted. That in the latter genus are compared to spondylitis deformans in man, although Sokoloff acknowledges that fusions could be non-pathological such a fusions of thoracic vertebrae seen in extant birds. Unillustrated [DHT]).

Spalding, D.A.E. 1999. Dinosaur Hunters — 150 Years of Extraordinary Discoveries. Key Porter Books Ltd., Toronto. 305 pp.

(Includes mention of gout in Late Cretaceous tyrannosaurids. Osteopathy unillustrated. Format: Popular. [DHT]).

Spassov, N.B. 1979. Sexual Selection and Evolution of Horn-Like Structures of Ceratopsian Dinosaurs. Paleontol. Stratigr. Lithol., 11:37-48.

(NOT SEEN. NOT INDEXED. Includes fighting behavior).

Spieker, E.M. 1960. The Cretaceous-Tertiary Boundary in Utah. pp. 14-24. In: Report of the Twenty-First Session Norden- Denmark, Finland, Iceland, Norway, Sweden. Part V, Proceedings of Section 5. The Cretaceous-Tertiary Boundary. Inter. Geol. Congress. Det Berlingske Bogtrykkeri, Copenhagen. 215 pp.

(On the possible cause of the extinction of dinosaurs, Spieker (p. 23) writes: "....a possible agent might be found in epidemic disease of specific power. It is at least conceivable that some virus effective only upon large reptiles may have spread devastation similar to that of past human epidemics but more completely potent because of reduced numbers and greater susceptibility among the dinosaurs.").

Spinar, Z.V. and Currie, P.J. 1994. The Great Dinosaurs. Sunburst Books, London. 176 pp.

(Pages 137-138, mention of intraspecific fighting in Late Cretaceous ceratopsians, some holes in bony neck frills may be healed horn thrust injuries or pathological in origin. One *Pachyrhinosaurus* skull (TMP89.55.1234) shows a large hole below and in front of the eye- the presence of a cyst is suggested. This specimen was described by Rothschild and Tanke, 1996, 1997. Mating may have been hazardous for some females who show "broken bones" [caudal neural spines] at the base of the tail. [DHT]).

Stadtman, K. 1992. News from Members. Soc. Vert Paleo., News Bull., 155:45.

(Report on current paleopathological studies of Jurassic Morrison Formation dinosaur bones at the Brigham Young University Earth Science Museum by Wade Miller and Ken Stadtman. Also, a notation of the widespread interest in an *Allosaurus* humerus from the Dry Mesa Quarry which exhibits a massive abnormal bone growth affecting the distal end, the specimen being studied by California medical doctor Leon Goldman. [This specimen was cited in the popular literature of the time as a possible cancerous tumor. [DHT]). Personal examination of the specimen reveals an infected healed fracture. This is not cancer. [BMR].

____ 1993. Untitled. The Morrison Times, 2:22.

(Mention of a pathologic Upper Jurassic *Allosaurus* humerus as possible evidence of bone cancer (but actually it is an infected, healed fracture). Discovery of this and other similar specimens has raised local interest in dinosaur paleopathology and additional collaborative research projects are now expected. [DHT]).

Staedter, T. 1997. *T. rex* Bites- Model Suggests Powerful Jaws. Earth, 6(1):13.

(Another of the numerous popular articles on G. Erickson and colleagues work on the tooth and bite strength in the Late Cretaceous *Tyrannosaurus rex*. Illustrated. [DHT]).

Standhardt, B.R. 1986. Vertebrate Paleontology of the Cretaceous/Tertiary Transition of Big Bend National Park, Texas. Ph.D. thesis, Louisiana State University.

(NOT SEEN. Some teeth described as *Paronychodon* in this thesis are actually aberrant teeth of better known small theropod taxa. See Currie, Rigby and Sloan, 1990:117 and Baszio, 1997 for discussion. [DHT]).

Steel, R. 1969. Encyclopedia of Paleoherpetology. Part 15. Ornithischia. Gustav Fischer Verlag, Stuttgart, 81 pp.

(Several brief notations of paleopathology in ceratopsians. These are unillustrated. [DHT]).

Stephenson, R.A. 1998. Personal Communication to DHT, Nov. 12, 1998.

(Reported on the occurrence of two Late Cretaceous (Hell Creek formation) hadrosaurs (*Edmontosaurus*) bonebeds in Corson County, South Dakota, USA. One is on Standing Rock tribal land and excavation there have not been conducted so far. The second site is at Grand River and is being excavated by members of the Grand River Museum, Lemmon, South Dakota. Bone occurs in a 35-51 cm thick layer and is preserved in a very fine dark mudstone. Nearly all bones are hadrosaur. 5-8 bones per linear meter are exposed at the base of a steep cliff over a distance of approximately 100 meters. There is little evidence of sorting, large and small (femora and phalanges) are preserved side by side. How deep the layer extends into the cliff and how much has been possibly lost to erosion is unknown. Stephenson estimates the remains of 1,000-3,000 animals are preserved in this site. Osteopathy has been observed, with some bones showing healed fractures. [DHT]).

Sternberg, C.M. 1921. A Popular Description of Dinosaurs. Can. Field-Nat., 35(4):61-66.

(Includes comments on page 64 of the writer's observation of ceratopsian bonebeds in what is now Dinosaur Provincial Park, Alberta, Canada. [These sites represent mass mortality events; see *Centrosaurus* bonebed entries under Currie, Eberth, Ryan, etc.]. Unillustrated. Format: Popular. [DHT]).

____ 1926. Notes on the Edmonton Formation of Alberta. Can. Field-Nat., 40(5):102-104.

(Notes on page 104, the common occurrence of the Late Cretaceous ceratopsian *Anchiceratops* in a bonebed(s?) Located along the Red Deer River just upstream from Drumheller, Alberta, Canada. [These types of low diversity bonebeds which have been studied in Dinosaur Provincial Park further downstream have been identified as representing mass mortality events; see *Centrosaurus* bonebed entries in this bibliography under Currie, Eberth, Ryan, etc. This bonebed needs to be examined in detail to confirm whether or not a similar agent is responsible for its formation]. Format: Popular. Unillustrated. [DHT]).

____ 1927. Horned Dinosaur Group in the National Museum of Canada. Canadian Field-Nat., 41(4):67-73.

(Description of two ceratopsian (*Chasmosaurus belli*) skeletons recovered from the Late Cretaceous (Campanian) Judith River Fm. [now Dinosaur Park Fm.] of Dinosaur Provincial Park, Alberta, Canada. The one with the more lightly constructed bones is considered to be male. In one of the specimens (CMN 2280, the "female"), Sternberg briefly states that the right orbital horncore was injured during life. Etiology is not discussed. The skeletons are figured, but any detailed photographs of the affected area are wanting. [DHT]).

____ 1940. Ceratopsidae from Alberta. Jour. Paleo., 14:468-480.

(Includes a description of CMN 8790 "*Monoclonius lowei*," the skull of a Late Cretaceous (Campanian) ceratopsian collected near Manyberries, Alberta, Canada. Sternberg briefly states that the right side of the skull "appears to have been injured during life, and the right fontanelle seems to have been closed by bony growth." This may also be a preservational artifact- a detailed restudy is required. The specimen is illustrated. [DHT]).

____ 1950. *Pachyrhinosaurus canadensis*, Representing a New Family of the Ceratopsia, from Southern Alberta. Nat. Mus. Canada Bull., 118:109-120.

(On page 111, Sternberg suggests that a deep subcircular pit above and behind the orbits in this unusual Late Cretaceous ceratopsian might be the folded frontal complex or it may be abnormal. Subsequent skull finds confirmed the presence of a normal folded frontal complex. The locality contains the remains of the hadrosaur *Edmontosaurus* and *Pachyrhinosaurus* (the former more common) and seems to represent a mass mortality event of some kind. [DHT]).

____ 1961. Field Notes, Dinosaur Provincial Park, 1961. (Unpublished, on file at Royal Tyrrell Museum of Palaeontology library).

(Sternberg mentions the occurrence of multiple fused distal caudal vertebrae from a partial unspecified hadrosaur skeleton (TMP80.23.2, Quarry 126, Display House #1; ex #2) on exhibit in the Late Cretaceous (Campanian) Dinosaur Park Fm. beds of Dinosaur Provincial Park, Alberta, Canada. He suggests at least one foot (approx. 30 cm) of the tip of the tail was lost (amputated) as a result of this injury. See Langston, 1961 and Tanke, submitted a. The affected portions of this specimen are now housed in the collections of the Royal Tyrrell Museum of Palaeontology. [DHT]).

Sternberg, L. 1921. Field Notes, Dinosaur Provincial Park, 1921. (Unpublished, on file at Royal Tyrrell Museum of Paleontology library).

(Includes mention of pathological Late Cretaceous dinosaur material. Specimen number 6 is a portion of a hadrosaur "*Trachodon*" tail ROM 5128ct. (old number), ROM 795 (new number), listed as being "Sent to Pittsburgh in exchange." The specimen shows "peculiar terminal vertebrae;" presumably this means distal caudals. It was found near specimen number 1 (a nearly complete *Prosaurolophus* skeleton[s?], [this has to be Quarry 4; DHT]) in Sec. 32, Tp. 20, R. 11, W. 4. The current whereabouts of this pathological specimen is unknown. Details concerning its present whereabouts are actively solicited.

Specimen number 13 is "A number of fragments of [neural] spines that have been broken and mended together again during life." These are presumably caudal neural spines, pathological examples of which can still be found in the Park on a regular basis. Such specimens exhibit active healing and rarely fully healed simple fractures. Sternberg's samples were found near Quarry 7, a lambeosaurine hadrosaur collected in Sec. 31, T. 20, R. 11, W. 4. No specimen number is given for these pathological neural spines, presumably they still reside somewhere in ROM collections. [DHT]).

Stokes, W.L. 1945. A New Quarry for Jurassic Dinosaurs. Science, 101:115-117.

(Cleveland-Lloyd Dinosaur Quarry, Emery County, Utah, USA. Known for its high percentage (~70%) of large theropod remains, Stokes suggested the deposit represented a predator trap, with animals being mired in sticky, smectitic mud. Richmond and Morris, 1996 confirmed this hypothesis and documented a preponderance of juvenile and subadult *Allosaurus* in the site and suggested group hunting activities, with one group being mired together [ie. mass mortality]. [DHT]).

____ 1985. The Cleveland-Lloyd Dinosaur Quarry: Window on the Past. US Govt. Ptg. Off., 1985-0-576-423, 27 pp.

(Page 23 acknowledges the presence of a number of dinosaur paleopathologies recovered from this Late Jurassic quarry, and notes research plans on these are upcoming. This quarry has yielded mostly remains of the theropods *Allosaurus* and *Ceratosaurus*, *Camarasaurus*, *Stegosaurus*, and *Camptosaurus*. Other less well represented dinosaur forms are also known. See Petersen, lsakson and Madsen, 1972; Madsen, 1976. [DHT]).

Stokstad, E. 1996. *Tyrannosaurus* Packed a Killer Crunch. New Sci., 151(2044):12.

(Popular review of work by Erickson et al., 1996 on tooth strength and biting power of *Tyrannosaurus rex*. [DHT]).

Stolk, A. 1958. Tumors of Reptiles 4. Multiple Osteomas in the Lizard, *Lacerta viridis*. Beaufortia, 7:1-9.

(Multiple chondromas of the tail arising in the vertebral cartilage in an extant green lizard *Lacerta viridis*; comments on possible hemangioma of caudal vertebrae in Late Jurassic sauropod *Diplodocus*. Such occurrences are actually examples of DISH; see Rothschild and Berman, 1991. [DHT]).

Stout, W., Service, W., and Preiss, B. 1981. The Dinosaurs- A Fantastic View Of A Lost Era. Bantam Books, New York, 160 pp.

(A hypothetical (based on fossil evidence) intraspecific fight scene causing injuries in the Late Cretaceous ceratopsian *Triceratops* is presented. Format: Popular. [DHT]).

Stovall, J.W. and Langston, W., Jr. 1950. *Acrocanthosaurus atokensis*, a New Genus and Species of Lower Cretaceous Theropoda from Oklahoma. Amer. Midland Nat., 43(3):696-728.

(Caudal 3 (p. 712; fig. 4) of the type specimen shows an unusual hook-like process [exostosis?] on the anterior blade of the neural spine. This is oriented ventrally and slightly posteriorly forming an nearly fully enclosed opening. Caudal 11 appears to exhibit a poorly healed broken neural spine with strong deviation to the left (p. 728; figs. 9-10). [DHT]).

Stromer, E. 1915. Ergebnisse der Forschungsreisen Prof. E. Stromers in den Westen Agyptens. II. Wirbeltier-Reste der Baharije-Stufe (unterstes Cenoman) 3. Das Original des Theropoden *Spinosaurus aegyptiacus* nov. gen., nov. spec.. Abhandl. Konig. Bayer. Akad. Wissensch. Math.-Phys. Klasse, 28(3):1-32.

(*Spinosaurus aegyptiacus*. Some of the neural spines figured in plate 2 may represent healed fractures, although post-depositional crushing must also be considered. Unfortunately this type specimen was lost during World War ll to Allied aerial bombing. lllustrated. Language: German. [DHT]).

Struzik, E. 1989. Horned Dinosaurs Galore in Grande Prairie. Edmonton Journal, Wednesday, Dec. 6, 1989:A1.

(Newspaper article on mass mortality bonebed containing thousands of *Pachyrhinosaurus* bones, including skulls up to 70% complete. lntraspecific flank-butting behavior is implied from the posterior dorsal ribs which show evidences of healed or healing fractures. Format: Popular. [DHT]).

____ 1993. Prehistoric Sex a Dangerous Affair- Scientists Study Ancient Injuries and Disease for Clues to Dinosaur Life. Edmonton Journal, Tuesday, Jan. 19, 1993:B5. Also reprinted (with minor modifications) in: Calgary Herald, Saturday, Jan. 23, 1993:B6 under the headline: Did the Earth Move for You Too, Darling?- When it Comes to Bone-Breaking Sex, Dinosaurs Couldn't be Beat, Dinosaurs Didn't Practice Safe Sex, Says Researcher-Mating was Dangerous for Massive Creatures. Lethbridge Herald, Tuesday, Feb. 9, 1993:A8; Sex Between Dinos Not Safe: Paleontologist. Grande Prairie Herald-Tribune, Wednesday, May 5, 1993., Dinosaur Sex Was A Dangerous Affair. Ottawa Citizen, Jan. 31, 1993.

(Short article on pathological caudal vertebrae in Late Cretaceous hadrosaurs from Alberta, Canada. Proximal neural spine fractures might be related to accidents incurred during mating, and distal caudal fractures seem to have been caused by accidental intraspecific trampling within large herds. Pelvic and tail fractures (related to mating trauma, (*sensu* Gilmore, 1909, 1912) in the Late Jurassic *Camptosaurus browni* are noted but *C. browni* is erroneously referred to the Hadrosauridae. Format: Popular. [As the above newspaper titles above would indicate, the press had a field day with this topic. Originally, DHT was interviewed over the phone for 45 minutes for a general discussion about examples of dinosaur paleopathology. The entire topic of the healed broken caudal neural spines being possibly fractured as a result of mating activities was addressed for no more than 1 minute. Shortly thereafter, the "Dinosaur Sex" articles appeared- nothing else from the rest of the interview was even mentioned. Local radio stations were especially irresponsible and displayed a lack of professionalism when reporting on this article. ln live radio interviews with DHT, all were disinterested in the actual paleopathological findings, instead they wanted the sex angle, especially how dinosaurs "did it." When subsequent radio stations called asking about interviews with DHT on the subject of "dinosaur sex," and were informed of the real line of research, they would mutter something like "l'll call you back later," but they never did. See Anderson, 1994 for more print media "fun and games" [DHT]]).

Sues, H.-D. 1978. Functional Morphology of the Dome in Pachy-cephalosaurid Dinosaurs. N. Jb. Geol. Palaont. Mh., 1978(8):459-472.

(Morphological analysis supports the hypothesis that the thickened skull roof of the pachycephalosaurid dinosaurs could have served as a battering ram. lmpact forces could have been transmitted through the unusually well ossified lateral walls of the braincase to the occipital condyle and backwards along the rigid vertebral column, with the well-developed nuchal ligament absorbing much of the impact shock. Photoelastic analysis demonstrates the functional suitability of the trabecular architecture of the frontoparietal in butting. [Author's abstract]. lllustrated).

Sullivan, R.M., Tanke, D.H., and Rothschild, B.M. 2000. An Impact Fracture in an Ornithomimid (Ornithomimosauria: Dinosauria) Metatarsal from the Upper Cretaceous (Late Campanian) of New Mexico. pp. 109-111. In: Dinosaurs of New Mexico. Edited by S.G. Lucas and A.B. Heckert. New Mexico Museum of Natural History and Science Bulletin No. 17. 230 pp.

(A right 4th metatarsal of an indeterminate ornithomimid dinosaur, recovered from the Upper Cretaceous (upper Campanian) Kirtland formation (De-na-zin Member) in the San Juan Basin, New Mexico, was fractured in life and shows evidence of early stages of bone remodeling. This osteopathy is interpreted as a comminuted impact fracture, the first of its kind to be reported in a dinosaur. The fracture probably occurred due to a traumatic event, such as the dinosaur landing on uneven ground, during a running or jumping episode. This event consisted of the application of compression and bending forces to the distal end of the metatarsal, resulting in the impaction, fragmentation and angulation of this region. [Authors abstract] Osteopathy well illustrated).

Swain, T. 1974. Cold-Blooded Murder in the Cretaceous. Spectrum, 120:10-12.

(NOT SEEN. NOT INDEXED. Suggested that the presence of potent alkaloids present in newly evolving flowering plants may have poisoned

dinosaurs, causing "physiological disturbance, and even death." Such alkaloids could have led to the dinosaurs extinction. However, a major flaw with this argument is that flowering plants appeared long before dinosaurs went extinct. See Swain, 1976. [DHT]).

____ 1976. Angiosperm-Reptile Coevolution. pp. 107-122. In: Morphology and Biology of Reptiles. Edited by A. d'A. Bellairs and C.B. Cox, Linn. Soc. London Symp., 3. Academic Press, London.

(Evolution of new plant types laced with toxic (in quantity) alkaloids during the Late Cretaceous may have had a serious effect on dinosaurs; possibly the thinning of ceratopsian eggshell is an example. Swain also notes the discovery of fossilized animals found in attitudes (opisthotonus) similar to those assumed in extant mammals that have died from toxins like strychnine. Swain notes that some of these specimens are Jurassic in age and thus predate the Cretaceous plant toxin evolution, so the opisthotonus could not entirely be related to plant poisons. Moodie (1918d) had earlier made this very suggestion and was promptly challenged (Dean, 1919). See also Swain, 1974; Davis, 1996. [DHT]).

____ 1987. Flowers Turned Off Dinosaurs. Nat. Hist., 96(2):4.

(Letter to the editor comment on R. Bakker's recent article "How Dinosaurs lnvented Flowers." Swain points out that evolution of angiosperms was not necessarily a result of dinosaur feeding activities but due to their ability to reproduce and grow faster that older types of plants, plus their feeding deterrents- toxic substances such as aromatic alkaloids, ellagitannins, oxygenated terpenoids, acetylenes, etc. Unillustrated. Format: Popular. [DHT]).

Swinton, W.E. 1934. The Dinosaurs- A Short History of a Great Group of Extinct Reptiles. Thomas Murby and Co., London, xii + 233 pp.

(Opens with a general discussion on the early history of dinosaur paleopathology studies, referring mostly to the work done by Dr. Roy Lee Moodie. The following items are discussed:

1. Bone fractures. Most bone injuries in dinosaurs are from the ribs. These are related to falls or attacks by other animals [ie. predators]. Frill and jaw fractures are known in *Triceratops*. A rib fracture is known in *Apatosaurus*. A poorly healed fracture of the ischium in an *Iguanodon* is related to a fight or mating trauma. Hypertrophy following a fracture of the scapula and coracoid is known from an *Allosaurus* specimen. A severe transverse fracture with poor healing and bad infection is known from the hadrosaur *Hypacrosaurus*. Swinton (p. 170) writes: "ln this case, an isolated left humerus of a hadrosaur, *Hypacrosaurus*, now preserved in the American Museum of Natural History [AMNH 5207; TMP cast TMP 98.11.1], has suffered an oblique fracture, and suppurative periostitis, or infected inflammation of the bone covering, supervened, with the result that the periosteum was elevated and a bridge of bone was formed extending over practically the whole anterior surface of the humerus, and covering a great sub-periosteal abscess. This evidently contained several litres of pus, and the sore discharged throughout the remainder of the life of the animal, although death did not follow very quickly on the injury."

2. lnfections, necroses. Osteomyelitis is known in a few cases. Simple sinuses are known from dermal scutes [presumably this refers to the enlarged dorsal plates] of *Stegosaurus* and necrosis of a *Camptosaurus* ilium has been described by C.W. Gilmore.

3. Tumors. Swinton comments at length on Moodie's efforts to identify caudal fusions in sauropods as tumorous in origin; [these are actually examples of DlSH]. A possible "periosteal sarcoma" is figured (Plate 20;b), this was examined by Campbell, 1966 and cited as an example of osteopetrosis.

Swinton closes with comments on the preservation of blood corpuscles and the nature of some dinosaur skeletons where the head is thrown backwards over the back as if in an agonizing death spasm. Moodie attributed this to strychnine poisoning, but it is accepted today that these are examples of neck musculature undergoing desiccation or subequal rotting/contracting of ligaments.

Osteopathy illustrated. Format: Popular. Reprinted in 1970. [DHT]).

____1965a. Dinosaurs of Canada. Roy. Ont. Mus. Ser., What? How? Why? Where? When? Who? 16 pp.

(Mention of skulls of Late Cretaceous ceratopsians being fractured in combat. Format: Popular).

____ 1965b. Fossil Amphibians and Reptiles. Trustees of the British Museum (Natural History), London. ix + 133 pp.

(Brief mention on pages 95-96 that some bones from the type specimen of the sauropod *Cetiosaurus leedsi* show evidence of "damage or disease" [to distal end of tail]. This is figured in Swinton, 1934; Plate XXC. Osteopathy unillustrated. Format: Popular. [DHT]). The specimen, however, seems to be lost. [BMR]

____ 1966. Giants Past and Present. Robert Hale, London, 192 pp.

(Page 91 mentions the discovery of skulls of the Late Cretaceous ceratopsian *Triceratops* with healed fractures, thereby confirming battles with predators had occurred. Format: Popular).

____ 1970. The Dinosaurs. George Allen and Unwin, London, 331 pp.

(Repeat of original published in 1934. lllustrated. Format: Popular. [DHT]).

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Talbot, V. 1978. Beauty and the Beast. Lapidary Jour., 32(6):1260-1262, 1266.

(Describes the use of petrified dinosaur bone for jewelry. Mention on page 1266 of, how, "in the past few months," the ".... controversy raging among some collectors regarding the possibility of blood as a trace fossil." See Abbey, 1977. Evidently certain dinosaur bone samples leach a red "deposit," which is interpreted by some as blood, others as iron oxide during sawing. [ln all likelihood, the "deposit" is simply the bone and rock dust created by the slicing action of the rock saw blade]. Also on same page, there is mention of a Dr. Leon Goldman who is working on pathologic dinosaur bone thin sections in order to study dinosaur osteopathy, in particular arthritis. Results of this work is greatly anticipated. Osteopathy unillustrated. Format: Popular. [DHT]).

____ 1998. Dino Tumor Find Authenticated. Emery County Progress, Castle Dale, Utah [USA], Tuesday, June 23, 1998:1B.

(Upper Jurassic hemangioma affecting an unspecified Upper Jurassic dinosaur bone; see Anonymous, 1993b and Rothschild, Tanke, Hershkovitz and Schultz, 1998 for formal description. lllustrated. Format: Popular. [DHT]).

Tanaka, S. 1998. Graveyards of the Dinosaurs. Scholastic Canada Ltd., Richmond Hill, Ontario. 48 pp.

(lncludes comments on the famous *Velociraptor/Protoceratops* death association; mass mortality (via drowning) in the Late Cretaceous ceratopsian *Centrosaurus*; intraspecific fighting in unspecified ceratopsians leads to punctured cheek and frill bones, and the rediscovery of a *Gorgosaurus* [actually *Albertosaurus*] bonebed in Alberta, Canada in 1997- a possible mass mortality site. It is stated 30-40 animals were found, but this is in error. Barnum Brown collected the partial and disarticulated remains numbering about 10 animals in 1910. Format: Popular (Childrens). [DHT]).

Tanimoto, M. 1988. Tails of Sauropods from the Sichuan Basin, China. Archosaurian Articulations, 1(2):15-16.

(Fusion of caudals 11 and 12 noted and illustrated in the sauropod *Omeisaurus zigongensis*, and an unusual club-like growth on the tip of the tail of the sauropod *Shunosaurus lii* are noted and illustrated. See Olshevsky, 1989. [DHT]).

Tanke, D.H. 1984. Dinosaurs of the Devon Area (Alberta, Canada) With Reference to a Large Hadrosaur Femur. Fossils Quarterly, 3(2):19-30.

(Description of disarticulated hadrosaur (cf. *Edmontosaurus*) material (complete femur TMP81.48.2; proximal tibia TMP81.48.3 and complete scapula TMP81.48.5), collected from a monospecific bonebed preserved in the Horseshoe Canyon Formation-equivalent beds (Maestrichtian) and exposed near the town of Devon, just upstream from the city of Edmonton. [Monospecific bonebeds of this variety are typically ascribed to mass mortality events, but the etiology of this particular bonebed is unknown. Largely through the recent fine efforts of amateur paleontologist Tom Owen of Edmonton, we are now aware of no less than nine separate unspecified hadrosaur bonebeds within city limits and around the Edmonton region]. lllustrated. Format: Popular. [DHT]).

____ 1988a. Cretaceous Critters 2: *Stegoceras*. Bull. Alta. Paleo. Soc., 3(4):12-16.

(lncludes comments on hypothesized head-butting behavior in Late Cretaceous pachycephalosaurids. A lack of cranial paleopathology in numerous "domes" of these forms possibly casts doubt on this hypothesis. ln the pachycephalosaur *Stygimoloch*, the back of the head was adorned by numerous well-developed horns. Even a slightly off-center or glancing head butt in this form would have caused serious head injuries to an opponent, if not the aggressor itself. Earlier workers advocated the head-butting hypothesis. Over the past few years there has been a trend

leaning away from this type of thinking; flank-butting seems the more accepted hypothesis, with some suggestions of no butting whatsoever. See Carpenter, 1993, 1997; Ford, 1998 and Goodwin et al, 1998. [DHT] Format: Semi-Popular).

____ 1988b. Ontogeny and Dimorphism in *Pachyrhinosaurus* (Reptilia, Ceratopsidae), Pipestone Creek, N.W. Alberta, Canada. (Abstract). Jour. Vert. Paleo., 8(3):27A.

(The material utilized in this study was collected from a monospecific bonebed [*Pachyrhinosaurus* accounting for almost 100% of the specimens collected [DHT, pers. obs., 1986-1989]. A mass mortality event (drowning?), similar to *Centrosaurus* bonebeds found in Dinosaur Provincial Park in southern Alberta, Canada seems a likely explanation for this incredibly rich bone deposit. [DHT]).

____ 1989a. Paleopathologies in Late Cretaceous Hadrosaurs (Reptilia:Ornithischia) from Alberta, Canada. (Abstract). Jour. Vert. Paleo., 9(3):41A.

(Paleopathologies in TMP collections are, surprisingly, more common in hadrosaurs than in contemporaneous dinosaur families, accounting for over 85% of the sample. Pathologies noted were usually from full adults. Many injuries consist of broken proximal to mid-caudal neural spines with subsequent healing (usually with the spine angled off center) and/or infection. More distal caudal neural spines show a rapid decrease in numbers of pathologies towards the end of the tail, although fusion of two or three distal caudal centra are not uncommon. Proximal caudal spine injuries may be related to mating activities. Other hadrosaur pathologies at TMP and in the published record include healed radii, tendons, ischia, pedal phalanges, and broken ribs. Extensive rib series breaks, some with associated vertebral trauma, have been observed (type of *Parasaurolophus walkeri*). It is speculated that animals with caudal spine damage were females, while those animals with rib series breaks were males, these injuries resulting from aggressive "rutting" behavior, possibly kicking with the hind foot. Despite their peaceful appearance and gregarious nature, hadrosaurs may have been capable of aggressive intraspecific behavior. [DHT]).

____ 1989b. K/U Centrosaurine (Ornithischia: Ceratopsidae) Paleopathologies and Behavioral Implications. (Abstract). Jour Vert. Paleo., 9(3):41A.

(Examination of thousands of disarticulated elements from monospecific bonebed assemblages (including 1,500+ *Centrosaurus* and *Styracosaurus* elements) in Alberta and Montana yielded only minimal paleopathologies. In 1,000+ *Pachyrhinosaurus* bones, 10 pathologies were noted in two parietals, one quadrate, 3 dorsal ribs, a cervical vertebra, a scapula, a phalanx, and four fused distal caudal vertebrae. Analysis of 30,000 elements revealed a frequency in the range of 0.025-0.5% of *Centrosaurus* and 0.2-1.0% of *Pachyrhinosaurus*. The most common bone paleopathology in centrosaurines was mid and posterior dorsal rib fractures. Several of the pathologies appear to be disease- or accident-related and are not attributed to aggressive intraspecific behavior. All noted pathologies except one were in adults. Mid and especially posterior dorsal rib injuries, while uncommon, are the most frequent pathology noted. The paucity of pathological bone in such large samples is indicative of rare aggressive intraspecific behavior in centrosaurines, contrary to the common belief that they were regularly injured during intraspecific fighting. Adult ceratopsians were probably aware of each other's powerful build and dangerous horns and thus avoided any form of real combat that could result in injury. They may have only indulged in acts of bluff and/or flank-butting (with resultant broken ribs). [DHT]).

____ submitted a. Paleopathologies in Late Cretaceous Hadrosaurs (Reptilia:Ornithischia) from Alberta, Canada: Behavioral Implications.

(NOT LISTED IN PATHOLOGY INDEX. Hadrosaurs account for a surprising 85% of all paleopathology in the entire TMP collections. While pathologies were observed in animals of all ages (including embryonic), most were found predominantly in ribs and caudal vertebrae of adult individuals. Extent and distribution of pathology provides suggestive evidence that hadrosaurs were quite capable of aggressive intraspecific behaviour, perhaps concomitant to breeding season. Rib injuries are attributed to fighting males, while proximal caudal neural spine injuries may actually document accidental injuries caused during mating activities. [Author's abstract]).

____ submitted b. The Rarity of Paleopathologies in "Short-Frilled" Ceratopsians (Reptilia:Ornithischia:Centrosaurinae): Evidence for Non-Aggressive Intraspecific Behavior.

(NOT LISTED IN PATHOLOGY INDEX. Ceratopsians are popularly believed to have been pugnacious and engaged in regular, injury-causing aggressive intraspecific behaviour conducted during territorial disputes or between rival males during the breeding season. It is now evident however, that members of the ceratopsian subfamily Centrosaurinae probably did not engage in this behaviour, a conclusion suggested by the rarity of pathological specimens. Detailed examination of approximately 30,000 disarticulated and articulated cranial and postcranial elements from *Centrosaurus*, *Styracosaurus*, and *Pachyrhinosaurus* bonebeds in Alberta, Saskatchewan and Montana, yielded surprisingly little paleopathology. Localization of nearly half of *Pachyrhinosaurus* pathology to the mid and posterior dorsal ribs is suggestive of a nonlethal flank-butting behaviour. [Author's abstract]).

____ 1996a. The Vertebrate Pathology Bibliography Project. Internet URL address: http://dns.magtech.ab.ca/dtanke

(Internet homepage describing the activities, plans, history and progress of the annotated bibliography project. The bibliography you are reading is an outgrowth of this project. A general case report on the use of paleopathology to determine intraspecific face-biting behaviour in the large Late Jurassic *Sinraptor* and other large Late Cretaceous tyrannosaurids is given. The homepage first went online February 8, 1996. A link to the Royal Tyrrell Museum of Paleontology is included. A counter is keeping track of the number of visits. The 10,000th visitor was recorded in late January, 2002. Illustrated. [DHT]).

____ 1996b. 1996 at the Royal Tyrrell Museum and Dinosaur Provincial Park. Dinosaur Discoveries, 2:7.

(Includes mention of a Late Cretaceous (Campanian) hadrosaur fractured radius and ulna with subsequent healing. In a quadrupedal stance, the animal would have limped about for some time. [There is good realignment and the two bones are fused together at mid-shaft]. Unillustrated. Format: Popular. [DHT]).

____ 1996c. *Pachyrhinosaurus* Paleopathologies. Posted to Dinosaur Mailing List, Jan. 29, 1996. Found on Internet Dec. 1, 2000, at: http://www.cmnh.org/fun/dinosaur-archive/1996Jan/1165.html

(Mentions the rarity of paleopathology in centrosaurine ceratopsians, based on the author's 1 year and 9 months of working in *Centrosaurus*, *Pachyrhinosaurus* and *Styracosaurus* bonebeds in Dinosaur Provincial Park and near Grande Prairie, Alberta, Canada. The most common type of pathology found are healed or healing fractures of the posterior dorsal ribs. Common injury-causing aggressive behavior as postulated in the popular press is not corroborated by the evidence at hand, at least for centrosaurine ceratopsians. Format: Popular. Osteopathy unillustrated. [DHT]).

____ 1996d. Re: Drowned Dinosaurs. Posted to Dinosaur Mailing List, Feb. 1, 1996. Found on Internet Dec. 1, 2000, at: http://www.cmnh.org/fun/dinosaur-archive/1996Feb/0061.html

(Comments on mass mortality [drowned?] *Pachyrhinosaurus* bonebed in N.W. Alberta and raises an interesting taphonomic question. In that site, most of the relatively complete/complete dorsal ribs are from the right side of the body. Those from the left are either missing or were broken up prior to burial. It is speculated that the floating pachyrhinosaur carcasses may have had a preferred orientation, with the left side facing upwards as the bloated carcasses floated downriver. It is hypothesized that this may be due to asymmetrical internal organs (ie. gas-filled stomach) causing the carcass to preferentially flip over onto one side. Once the carcasses were beached, the downside (right) ribs were safely cradled in mud, whereas the exposed left ribs were exposed to scavengers and degrading effects of mother nature. The bones were then picked up once again and redeposited further downstream, with the right vs. left taphonomic bias still preserved. Any further comments or similar observations are welcomed. [DHT]).

____ 1996e. Injuries in (Running) Hadrosaurs. Posted to Dinosaur Mailing List, March 11, 1996. Found on Internet Dec. 1, 2000 at: http://www.cmnh.org/fun/dinosaur-archive/1996Mar/0184.html

(Includes comments on the following: a TMP *Brachylophosaurus* showing well healed bilateral dentary fracture. No examples of manal osteopathy in DPP hadrosaurs are known despite extensive collections. Fractured and healing/healed metarcarpals are known from *Anatosaurus* (Smithsonian; Moodie, 1926b) and *Edmontosaurus* (BHIGR) collections. A seriously fractured hadrosaur humerus from Alberta is in AMNH collections [AMNH 5207; TMP cast TMP98.11.1]. Rib fractures are known in *Parasaurolophus* and *Prosaurolophus* [both specimens at ROM]. A serious bilateral trauma affecting an unspecified lambeosaurine (TMP 79.14.381)

shows fusion of the ischia, the result of a fracture of the bones about 1/4 of the distance below the proximal ends. This is the most serious non-fatal fracture in a hadrosaur the author observed.

Hind limb pathology is also known from Albertan hadrosaurids. One tibia shows infectious swelling similar to a hypsilophodontid tibia from Australia (Monoghan, Rich and Rich, 1991). Healing fibular fractures are known. Infected metatarsals and phalanges are sometimes seen. Trauma to some of the latter are so serious as to suggest post-trauma sloughing off of the affected part.

Caudal neural spines show many injuries. Proximal ones were suggested to be the result of mating trauma. Further down the tail, vertebrae show healing crush fractures of the centrum. In these cases the centrum broke into 2 [typical]-5 pieces which later fused together, but still show distinctive endplate cracks. Sometimes these vertebrae fused to each other at odd angles that would have imparted a kink to the end of the tail. In some of the more serious cases, the end of the tail may have been sloughed off. Osteopathy unillustrated. [DHT]).

____ 1996f. Leg Injuries in Large Theropods, Etc. Posted to Dinosaur Mailing List, March 9, 1996. Found on Internet Dec. 1, 2000 at: http://www.cmnh.org/fun/dinosaur-archive/1996Mar/0150.html

(Mentions of fractured and healing/healed dentary fracture, right fibula fracture and ligament injury (avulsion) of *Albertosaurus* (this should be more properly identified as *Gorgosaurus*) of TMP91.36.500. Subadult tyrannosaurids appear to show fibular injuries more frequently than full adults. Falling in tyrannosaurids and resultant fibular fractures are discussed. Osteopathy unillustrated. [DHT]).

____ 1996g. Tyrannosaur Paleopathologies, Updates. Posted to Dinosaur Mailing List, Nov. 8, 1996. Found on Internet Dec. 1, 2000 at: http://www.cmnh.org/fun/dinosaur-,archive/1996Nov/0208.html

(Includes comments on tyrannosaur fibula fractures. These are not that uncommon with perhaps 10-15% of specimens in TMP collections so affected. Most are undergoing active healing at time of death. Fully healed or nearly completely healed fibular fractures are not known. The animal may have been seriously affected by the injury and was unable to forage before the injury healed fully. Also comments on humeral fractures, possibly fractured during sleep, mating, or falls. The supposed neck rib with an embedded tyrannosaur tooth found in the *Tyrannosaurus* "Sue" was examined directly by the author. He casts doubt on its identification. The incomplete rib appeared to be ornithischian and showed a pseudoarthrosis one end. This formed a swollen hollowed-out cap. Inside the cap was the "tooth" which, on further inspection, appeared to be a piece of ironstone which had become firmly lodged inside. This example of pseudoarthrosis development was similar to examples seen in ceratopsians. Osteopathy unillustrated. [DHT]).

____ 1997a. Ceratopsian Pathology and Dinosaur Arthritis (NOT!). Posted to Dinosaur Mailing List, Feb. 1, 1997. Found on Internet Dec. 1, 2000 at http://www.cmnh.org/fun/dinosaur-archive/1997Feb/0002.html

(Comments on the misuse of the term "osteoarthritis" in the literature to describe many dinosaur pathologies, such as vertebral fusions which are actually referable to DISH or "diffuse idiopathic skeletal hyperostosis." True osteoarthritis is known from several *Iguanodon* specimens from Belgium. Fusions of caudal vertebrae in hadrosaurs appear referable to intraspecific trampling injuries causing crush fractures. Fusion affecting the middle portion of a tail of a ceratopsian skeleton recently collected in Alberta, Canada appear to be another example of DISH. Response by Daniel, 1997. Osteopathy unillustrated. [DHT]).

____ 1997b. Dinosaur "Arthritis" Revisited. Posted to Dinosaur Mailing List, Feb. 8, 1997. Found on Internet Dec. 22, 2000 at: http://www.cmnh.org/fun/dinosaur-archive/1997Feb/0164.html

(Response to Daniel, 1997. The author shows that arthritis can occur in juveniles of extant animals and that the supposed rarity of true osteoarthritis in dinosaurs is simply because not all dinosaurs reached old age and were thus affected with this crippling disease. Despite extensive reviews of fossil collections and actively searching for examples of true dinosaur osteoarthritis, the results continue to be elusive. It does seem then that dinosaurs were very rarely affected by arthritis and the question now is "Why?" [DHT]).

____ and Currie, P.J. 1995. Intraspecific Fighting Behaviour Inferred From Toothmark Trauma on Skulls and Teeth of Large Carnosaurs (Dino-sauria). (Abstract). Jour. Vert. Paleo., 15(3):55A.

(Cranial paleopathology of the type specimen of Upper Jurassic *Sinraptor dongi* and specimens of Upper Cretaceous *Albertosaurus* sp. consists of healing or healed toothmarks. These pathological lesions closely resemble alterations seen in classic toothmarked dinosaur bone, but preserve smoothed edges and new reactive bone tissue in the floor of the lesion. Different bone coloration of uncertain etiology is closely associated with the lesions. Cranial elements of *Sinraptor* preserve a variety of gently curving tooth drags or gouges, shallow, circular punctures and one fully penetrating lesion. *Albertosaurus* wounds are preserved primarily on the dentigerous elements. Injuries are usually only in the early stages of repair upon death of the affected individual. Isolated teeth of Judithian-aged tyrannosaurids (cf. *Albertosaurus*) occasionally show toothmarks in the form of transverse cuts, parallel striations (preserving the serration pattern of the marking tooth), or both. Pathology expressed on these specimens could be the result of intraspecific biting behaviors related to territoriality, courtship, defense, feeding, or dominance determination within a grouping. [Author's abstract]). See Tanke and Currie, 1995, 1998 (2000).

____ and ____ 1998 (not published until 2000). Head-Biting Behavior in Theropod Dinosaurs: Paleopathological Evidence. GAIA, 15:167-184. In: Aspects of Theropod Paleobiology. Edited by B.P. Perez-Moreno, T. Holtz Jr., J.L. Sanz, and J. Moratalla. 403 pp.

(Cranial material of *Sinraptor dongi* (Upper Jurassic, Xinjiang, China), *Gorgosaurus libratus*, *Daspletosaurus torosus* (Upper Cretaceous, Alberta, Canada), and other large theropods exhibit similar paleopathological anomalies indicative of aggressive intra- or interspecific biting. Tooth strike trauma includes osseous lesions caused by solitary or multiple tooth punctures, or by dragging or gouging the tooth tips across the surfaces of cranial elements. Many of these lesions were undergoing active healing at time of death. One isolated tyrannosaurid dentary bears a broken off and embedded tooth tip of another tyrannosaur. Comparison with unhealed large theropod toothmarks on prey bone suggests that sublethal wounds of these types were caused by other large theropods, possibly rival conspecifics. This may indicate aggressive head or face-biting behavior in certain theropod families. Other associated osteopathy typified as localized rib or fibula fractures were observed but cannot be directly correlated with violent intra- or interspecific behavior. Healed and healing bite wounds of the head may be related to a number of factors. Establishment of dominance within a pack and territorial behavior are considered as two of the most likely causes. Study of paleopathologies is demonstrated to be a useful tool for understanding dinosaur behavior. [Author's abstract]. Similar lesions were not observed in *Allosaurus*. Note color variations between pathologic bone at wound site vs. normal non-pathologic bone. See also Tanke and Currie, 1995).

____ and Larsson, H.E. manuscript. First Report of a Non-Fatal Neck Fracture in a Dinosaur.

(The specimen consists of an isolated and unspecified Late Cretaceous ceratopsian (cf. *Centrosaurus*) free cervical vertebra from Dinosaur Provincial Park, Alberta, Canada. While eroded prior to burial and fossilization, it can be seen that, in life, the animal suffered a neck fracture which ran antero-posteriorly through the centrum and extended up to and affected the floor of the neural canal. There is an advanced degree of healing, remarkable given the severity of the injury and it's location. [DHT]).

____ and Rothschild, B.M. 1997. Paleopathology. pp. 525-530. In: Encyclopedia of Dinosaurs. Edited by P.J. Currie and K. Padian. Academic Press, London. xxx + 869 pp.

(Paleopathology in dinosaurs, general overview, present/future status.

Topics discussed: absence of dental caries in dinosaurs; paleopathology in theropod *Poekilopleuron*; tooth fractures in tyrannosaurids, malocclusion based on wear facets on both sides of theropod teeth; intraspecific face-biting behavior in large theropods generally; oral abscesses in hadrosaurs; bone fractures and pseudoarthrosis development; rarity of fractures in dromaeosaurs and ornithomimids; rarity of paleopathology in centrosaurine ceratopsians contra to interpretations of ceratopsians as interspecific aggressive animals; crush (trampled) healing fractures affecting distal caudals in hadrosaurs; bilateral dentary fracture and effect on teeth in hadrosaur *Brachylophosaurus*; serious pelvic fractures in iguanodonts and hadrosaurs; rarity of arthritis in dinosaurs and confusion of this condition with spondylitis deformans and diffuse idiopathic skeletal hyperostosis (DISH); supposed bone cancer in humerus of *Allosaurus* (actually an infected healed fracture); presence of wedge-shaped hemi-vertebra in embryonic hadrosaur *Hypacrosaurus*; twisted metatarsal in juvenile hadrosaur *Maiasaura*; DISH affecting sauropod caudals; multilayering of eggshell layers; thinning eggshell in sauropod *Hypselosaurus*; presence of footprints and trackways of dinosaurs showing deformed (curled) toes,

missing toes and limping (implying pain); potential of parasites on/in dinosaurs; blood-sucking midges; crater-like depressions on dorsal surface of Late Cretaceous ankylosaur scutes- = ectoparasite damage?; care-giving (epimeletic) behavior, is it true?, perhaps within large herds (hadrosaurs, ceratopsians) injured animals were tolerated/ignored and could remain relatively anonymous among a herd of thousands and thus heal; inter- and intraspecific strife; general discussions. Unillustrated. [DHT]).

____ and Farke, A.A. ms. Bone resorption, bone lesions and extra fenestrae in ceratopsian dinosaurs. Manuscript in progress.

(The phenomenon of extra fontanelles in the frills of chasmosaurine ceratopsian or "long-frilled" horned dinosaurs is re-examined. Previous interpretations of their presence have included healed horn thrust injuries incurred during aggressive intraspecific behavior, healed predator damage, vagaries of preservation, or disease. Detailed analysis of these features exhibits none of the trademarks or healed traumatic injury, suggesting their occurrence is due to other circumstances, such as bone resorption or non-traumatic pathology. Centrosaurine "short-frilled" ceratopsian squamosals with extra openings were also examined, these are truly pathological, some possibly bearing evidences of multiple myeloma. Evidence of "many injuries" in *Triceratops* is a myth based on relatively few specimens and represent the passing of incorrect facts from generation to generation, exacerbated by the recent proliferation of often poorly researched popular dinosaur literature. Evidence suggesting that extra fontanelles are not healed intraspecific horn thrust injuries adds to the growing body of evidence that ceratopsians were relatively quiet and peaceful animals, not the aggressive ill-tempered brutes as typically portrayed. [DHT]).

____ manuscript in progress. The Ruins of Magnificence: Memories of Dinosaur Collecting in Alberta, Canada.

(NOT INDEXED. Autobiography in progress, will include discussions on dinosaur paleopathological discoveries and interpretations, etc).

Taquet, P. and Russell, D.A. 1999. A Massively-Constructed Iguanodont from Gadoufaoua, Lower Cretaceous of Niger. Ann. Palaeontol., 85:85-96.

The type specimen of the Aptian-aged *Lurdusaurus arenatus* includes osteopathy in the form "the left prepubis bears two transversely-oriented tooth punctures, and was partly healed with the distal, broken segment offset laterally," p. 87. Osteopathy illustrated; see plate lll, fig. l. [DHT]).

Taylor, P. 1992. Doctors Try to Diagnose Dinosaur Cancer. Toronto Globe and Mail, Jan. 5:A1-A2.

(This article relates the discovery and study of a unique dinosaur specimen that was thought to have been affected by cancer. A humerus of the 140 million year old (Upper Jurassic) theropod *Allosaurus* was collected from Colorado, USA, and recent preparation revealed a large cauliflower-like growth "pitted with three holes the size of golf balls." A diverse team of researchers are examining the specimen; these including orthopedic surgeons, a vertebrate paleontologist, a medical doctor, and a spinal surgeon. All believe the lesion was evidence of a chondrosarcoma. [No followup was done to our knowledge. One of the heads of the research team, Dr. Leon Goldman, passed away December, 1997]. Format: Popular. [DHT]. Subsequent examination by one of us (BMR) revealed an infected healed fracture, with no evidence for any form of neoplasia).

Tazaki, K., Aratani, M., Noda, S., Currie, P.J. and Fyfe, W.S. 1994. Microstructure and Chemical Composition of Duckbilled Dinosaur Eggshell. Sci. Rpts. Kanazawa Univ., 39(1):17-37.

(Hadrosaur eggshell from Dinosaur Provincial Park, Milk River and Devil's Coulee localities in southern Alberta, Canada were examined. A figure of a two-layered thin section of eggshell (TMP87.79.85) is presented. Eggshell sample TMP86.49.15 was studied using heavy ion probe Rutherford scattering and was found to have a significant high iridium content. This in turn is interpreted as possibly representing severe environmental changes "limited the reproductive process and contributed to the extinction of the dinosaurs." This particular point is most unusual, as the eggshell samples come from a time period predating the latest Cretaceous extinctions by some 13 million years! Well illustrated with SEM photographs, although apparently the shell has been extensively altered by diagenetic change (Zelenitsky, pers. comm. to DHT, 1994). [DHT]).

Tchoe, J. 1996. Taking a Bite Out of Time. The Daily Californian, August. 27, 1996:1,9.

(Research by Dr. Gregory Erickson on bite forces of *Tyrannosaurus rex*. Format: Popular. [DHT]).

Tedesco, L.P., Halvorsen, H.E. and Cooper, K. 1998a. Mass Mortality of a Herd of Hadrosaurs: Lance Creek Formation, East-Central Wyoming. (Abstract). p. 60. In: The Dinofest Symposium. Edited by D.L. Wolberg, K. Gittis, S. Miller, L. Carey and A. Raynor. The Academy of Natural Sciences, Philadelphia, Pennsylvania. April 17-19, 1998.

(Drowning-related mass mortality of the Late Cretaceous hadrosaur *Edmontosaurus*. See also Tedesco, Halvorsen and Cooper, 1998b. Unillustrated. [DHT]).

____, ____ and ____ 1998b. Mass Mortality of a Herd of Hadrosaurs: Lance Creek Formation, East-Central Wyoming. Found on the Internet on November 20, 1998 at:
http://www.geology.iupui.edu/LABS/SEDLAB/Publications/Hadrosaur1.htm

(Mass mortality; disarticulated bones representing hundreds of individuals. See also Tedesco, Halvorsen and Cooper, 1998a. Unillustrated. [DHT]).

Telles Antunes, M. and Sigogneau-Russell, D. 1991. Nouvelles Donnees sur les Dinosaures du Cretace Superier du Portugal. [New Data on the Dinosaurs of the Late Cretaceous of Portugal]. C.R. Acad. Sci., 313(II):113-119.

(NOT SEEN. Late Cretaceous *Paronychodon*-like teeth. See Currie, Rigby and Sloan, 1990; Zinke and Rauhut, 1994; Baszio, 1997. Language: French).

Tereshchenko, V.S. 1991. The Reconstruction of the Vertebral Column of *Protoceratops*. Paleont. Jour., 25(2):106-116.

(This paper examines the vertebral column of the Cretaceous ceratopsian *Protoceratops*, in particular various aspects of intervertebral movements, mechanical loading, etc. The author states that "compensatory structural transformations of the vertebral column of the old individual could hardly have eliminated all the contradictions, and this probably led to the development of pathology." What pathology(ies) the author is referring to is unfortunately not discussed or described. [DHT]).

Thaler, L. 1965. Les Oeufs de Dinosaures du Midi de la France Livrent le Secret de leur Disparition. [The Dinosaur Eggs of Southern France Yield the Secret of Their Disappearance]. Sci. Progres La Nature, 93(1):41-48.

(NOT SEEN. NOT INDEXED. Dinosaur egg pathology, extinction. Language: French).

Thulborn, T. 1990. Dinosaur Tracks. Chapman and Hall, London, 410 pp.

(Pages 123-125 briefly review evidence of paleopathology in dinosaurs as expressed by their fossil footprints. Some specimens show absent toes, possibly related to congenital defects resulting in deformities, or injuries causing digit loss or malformation. One trackway shows an individual with an injured foot, and the animal was limping. See also Hitchcock, 1844; Abel, 1935; Tucker and Burchette, 1977; Jenny and Josen, 1982; Ishigaki, 1986. [DHT]).

____ 1994. Mimicry in Ankylosaurid Dinosaurs. Rec. S. Aust. Mus., 27(2):151-158.

(Speculative paper discussing ankylosaur vs. tyrannosaurid interspecific fighting (predation). Thulborn suggests that the ankylosaurs armored tail club may have acted as a mimic of it's more vulnerable head and neck region, and that the distracted carnivore thereby attacked the wrong end of its' prey. This would give the ankylosaur the opportunity to whack the tyrannosaur in the head with the tailclub. Previous workers have suggested the tail club was swung at the ankle region of predators. While a novel interpretation, Thulborns' paper has not led to much acceptance among the paleontological community. [DHT]).

Tiffney, B.H. 1989. Plant Life in the Age of the Dinosaurs. In: The Age of Dinosaurs. Short Courses in Paleo., No. 2, Edited by S.J. Culver, Paleo. Soc.:34-47.

(Comments on R. Bakker's 1986 contention that newly evolved angiosperms near the end of the Cretaceous contained various "toxins" that poisoned the dinosaurs, thus hastening their extinction. Tiffney does not agree with this suggestion. [DHT]).

Tokaryk, T.T. 1986. Ceratopsian Dinosaurs from the Frenchman Formation (Upper Cretaceous) of Saskatchewan. Can. Field-Nat., 100(2):192-196.

(An isolated neck frill of the large ceratopsian *Torosaurus* from the

Late Cretaceous (Maastrichtian) Frenchman Fm. of southern Saskatchewan, Canada bears symmetrical extra fontanelles piercing through the squamosals. These are occasionally found in ceratopsian frills and some interpreted as trauma-related injuries that have healed. Tokaryk suggested they were either pathologic or age-related features. While not mentioned in the text, the skull of the *Triceratops* described and figured on page 193 has an unusual frill on the right hand side. While it appears post-mortem crushing has distorted the ventral profile of the frill, a cast of this skull on display at the Royal Tyrrell Museum (Drumheller) indicates a serious healing transverse fracture of the parietal bar. The possibility that the anomalous frill outline and parietal fracture are, in fact, related cannot be discounted. This unique specimen should be re-examined more closely. [DHT]).

Tomida, Y. 1995. [Dinosaurs; Their Life and Behaviour- *Deinonychus*]. Kaisei-sha Publs. Co., Ltd., Tokyo. 32 pp.

(Includes a fine dorsal aspect photograph of the classic Late Cretaceous "fighting" *Velociraptor* and *Protoceratops* specimens, see page 13. Language: Japanese. Format: Popular. [DHT]).

Torassa, U. 1997. *T. rex*'s Carnivorous Diet Had a Price: Gout. The Plains Dealer, Monday, June 2, 1997:__.

(Newspaper article on the discovery of gout in *Tyrannosaurus rex*. Includes picture of paleopathologist Dr. Bruce M. Rothschild. See Rothschild, Tanke and Carpenter, 1997, 1997a. Osteopathy unillustrated. [DHT]).

Tracy, C.R. 1976. Tyrannosaurs: Evidence for Endothermy? Amer. Nat., 110:1105-1106.

(Includes the suggestion that Late Cretaceous tyrannosaurids were cannibalistic. Given the recent recognition of relatively common healed and unhealed toothmark trauma on tyrannosaurid bone, this suggestion seems entirely plausible now. [DHT]).

Travsky, R. 1996. Big Al, The *Allosaurus*. Internet URL address: http://plains.uwyom.edu/~rtravsky/big__al.htmlx

(Internet site featuring six photographs of "Big Al," a nearly complete skeleton of the Late Jurassic *Allosaurus* on display in the Geology Museum at the University of Wyoming. Big Al is a subadult animal, about 25 feet in total length. Some text accompanying the figures indicates no less than 14 injuries: broken and healing ribs, "damaged finger," and a large hole in the left ilium caused by a blow from above. The hole allowed for pus drainage. 2 of the 6 photographs show pathology: the first the animal from the left side and shows two ribs with large fracture calluses affecting mid-thoracic ribs about halfway down the shafts and just below the ventral border of the right scapula. The other photograph shows the entire right pes a prominent collar-like exostosis affecting the proximal end of pedal phalanx D. lll, P. 1. Travsky notes this young animal had lead a "rough life." This specimen was extensively studied by Rebecca Laws of the Museum of the Rockies, Bozeman, Montana, USA. See entries under Laws, R. and Hanna, R. within this bibliography. [DHT]).

Trueman, C.N. 1997. Biomineralization. pp. 62-65. In: Encyclopedia of Dinosaurs. Edited by P.J. Currie and K. Padian. Academic Press, San Diego. xxx + 869 pp.

(Excellent review of bone biomineralization. Topics covered: growth and mineralization of bone; bone mineral; bone-collagen relationships; nucleation of HAP [hydroxyapatite]; inhibitor molecules; overcoming the energy barrier; matrix vesicles; summary; paleoecological information from conditions of biomineralization and eggshell formation. Unillustrated. [DHT]).

____ and Palmer, M.R. 1997. Diagenetic Origin of REE in Vertebrate Apatite: A Reconsideration of Samoilov and Benjamini, 1996. Palaios, 12:495-497.

(NOT INDEXED. With reply by Samoilov and Benjamini, pp. 497-498).

Tucker, M.E. and Burchette, T.P. 1977. Triassic Dinosaur Footprints from South Wales: Their Context and Preservation. Paleogeogr., Palaeoclimat., Palaeoecol., 22:195-208.

(Footprints of the dinosaur ichnogenus *Anchisauripus* (a prosauropod) are described. A partial trackway of one individual shows a ".... distinctive malformation of digit lll...." See also Lockley, Hunt, Moratalla and Matsukawa, 1994. [DHT]).

Tumanova, T., Gallagher, W.B., Dodson, P. and Axel, L. 1998. Computerized Tomography of Asian Ankylosaur Skulls: Damage and Repair in a *Tarchia* Skull. (Abstract). pp. 60-61. In: The Dinofest Symposium. Edited by: D.L. Wolberg, K. Gittis, S. Miller, L. Carey and A. Raynor. The Academy of Natural Sciences, Philadelphia, Pennsylvania. April 17-19, 1998. See also: Gallagher, W.B., Tumanova, T.A. and Dodson, P. 1998. CT Scanning Asian Ankylosaurs: Paleopathology in a *Tarchia* Skull. (Abstract). Jour. Vert. Paleo., 18(3):44A-45A.

("..... An unexpected result was the detection of a bony growth within the skull of the *Tarchia* specimen. The neuroscans revealed an asymmetrical structure located on the right side of the skull in the sinus between the right nasal passage and the right orbit. This growth had a layered structure, with a dense core of bone surrounded by a spongy outer zone. The abnormal ossification was situated below a hole in the armored surface of the skull. This hole is 3 cm wide and roughly D-shaped on the surface; some of the surrounding dermal bone is concave around it. Since the skull is in pristine condition, with no other traces of breakage or abrasion, the damage is not an artifact of post-mortem transport or burial. The opening appears to be a puncture wound from and [sic] attack of a large theropod. The premaxillary teeth of the Asian tyrannosaur *Tarbosaurus* were measured and compared to the opening in the *Tarchia* skull. They are of the appropriate size and shape to have caused the wound. The angle of the opening with respect to the osteoma suggests an oblique attack. The osteoma itself may be interpreted as repair of the damage caused by the wound, indicating the animal survived the attack and lived for some time afterward. The predisposition of ankylosaurs to generate bone may have also served as a way of repairing injuries." [Author's abstract; in part]. An interesting case of osteopathy. The use of the term "osteoma" in this context must be done so with caution. The term "osteoma" indicates a neoplastic condition, yet here the author's consider the lesion to be a post-traumatic bite wound. [DHT]).

Tumarkin, A.R.

(University of Pennsylvania (Philadelphia, USA) Masters/Ph. D. student working under Dr. Peter Dodson on dinosaur fracture callus histology compared to that of extant vertebrates of known physiology; in an attempt to establish possible dinosaur physiologies and healing rates. Other histologic studies of pathologic dinosaur bone are possible. See Tumarkin, Dodson, Tanke and Rothschild, 1999. [DHT]).

____, Dodson, P., Tanke, D.H. and Rothschild, B.M. 1999. Paleo-histopathology?: A Preliminary Consideration of Modern Fracture Repair for Interpreting Dinosaurian Thermophysiology. (Abstract). Geol. Soc. Amer. Abstr. with Prog., 31(2); N.E. Section, Providence, Rhode Island, March 22-24, 1999:A73.

(The question of dinosaurian physiology is one with which paleontologists have wrestled since Richard Owen first created the term "Dinosaur" in 1842. The members of Dinosauria are highly diverse in body size and mode of life, and it is unlikely that any one physiological model may be applied to all taxa.

Previous investigations have focused on a multitude of lines of evidence; one avenue which remains unexplored, however, is paleopathology. Just as different patterns of normal bone growth are evident across vertebrate taxa, so too are different responses to trauma. Comparative histological studies of fracture repair in extant amphibians, reptiles, and mammals have noted observable distinctions in fracture callus formation, including variation in the relative amounts of bone and cartilage produced by ectotherms and endotherms. This study compares dinosaurian fracture callus specimens with patterns of fracture healing observed among extant avians and eptiles, in an attempt to (1) trace thermophysiological signals in the bone repair process and (2) assess whether healing in various dinosaurian taxa most closely paralleled endothermic avian or ectothermic reptilian repair. Through comparison of extant and fossil forms, this investigation seeks to provide greater insight into patterns of fracture healing in extinct animals, as well as to expand opportunities for interpreting physiologies of various dinosaurian taxa in the context of modern physiological models. Building on previous histological studies of normal bone growth patterns in extinct and extant taxa, this project seeks to open a new line of insight into the question of dinosaurian thermophysiology. [Author's abstract]. See also Paladino et al., 1996).

Turner, P. 1980. Excavation of a Bonebed in Dinosaur Park. Brooks Bulletin, Second Section, Wed., Aug. 20, 1980:11.

(Excavation of mass mortality *Centrosaurus* bonebed in Dinosaur Provincial Park, Alberta, Canada. The disarticulated remains of 400+ animals are expected to be preserved in this site. See Currie and Dodson, 1984. Format: Popular. lllustrated. [DHT]).

Tweedie, M. 1977. The World of Dinosaurs. William Morrow and Co., Inc., New York, 143 pp.

(On page 81, broken and healed horns in the Late Cretaceous ceratopsian *Triceratops* are suggested as evidence that these features were utilized as weapons against predatory dinosaurs. [DHT] Format: Popular).

Tyson, H. 1977. Functional Craniology of the Ceratopsia (Reptilia:Ornithischia) With Special Reference to *Eoceratops*. M. Sc. Thesis, Dept. of Zoology, University of Alberta, Edmonton. xix + 339 pp.

(*Eoceratops* is now accepted as being a junior synonym of *Chasmosaurus*. Includes some comments on osteopathy and related topics in Late Cretaceous ceratopsians. Extra fontanelles in the neck frill are considered non-traumatic in origin, rather, ".... the development of such fenestrae was due to a metabolic saving, rather than an active function," p. 302; ".... due to perforation, by resorption, of unstressed areas of the frill," p. 303. See full discussion, pp. 302-308. A possible anomalous suture arrangement, affecting the right facial region is also discussed. A possible healing puncture wound affecting the left squamosal of a *Centrosaurus* skull (UA 11735), collected from the Campanian Dinosaur Park Formation, Quarry 135, Dinosaur Provincial Park, Alberta, Canada) is described and figured, see Figure 38a,b. This lesion is ascribed to a horn puncture by a conspecific rival. [DHT]).

____ 1981. The Structure and Relationships of the Horned Dinosaur *Arrhinoceratops* Parks (Ornithischia:Ceratopsidae). Can. Jour. Earth Sci., 18:1241-1247.

(Mention of an extra opening through the neck frill of the Late Cretaceous ceratopsian *Arrhinoceratops*. Similar features in this and other ceratopsians have been described as pathologic remnants of healed intraspecific horn thrust injuries. Tyson does not comment on the etiology of the extra opening in this specimen. See Tanke and Farke, ms. [DHT]).

U

Unwin, D.M., Perle, A. and Trueman, C. 1995. *Protoceratops* and *Velociraptor* Preserved in Association: Evidence For Predatory Behaviour in Dromaeosaurid Dinosaurs? (Abstract). Jour. Vert. Paleo., 15(3):57A-58A.

(The discovery of a small herbivorous ornithopod, *Protoceratops*, "embraced" by a small carnivorous theropod, *Velociraptor*, in Late Cretaceous beds of Toogreeg, Mongolia immediately prompted suggestions that these animals had been killed in a death struggle. Various explanations were proposed to account for the supposedly simultaneous demise of both animals including mutual extermination, drowning, bank collapse and cave collapse. None of these is particularly convincing, however, and some have suggested that the association more probably reflects the accidental death of *Velociraptor* while scavenging. A number of features show that both animals were killed simultaneously. *Protoceratops* occupies a semi-erect stance, the skull oriented sub-horizontally. The right forelimb of *Velociraptor* is imprisoned within its jaws and could not have become accidently lodged in this position. *Velociraptor* lies largely in front of and level with the feet of its prey. The left manus grips the skull of *Protoceratops* while the legs are directed upward so that the pedes are located beneath the neck and thorax. The size, distribution and texture of the grains and thick, structureless nature of the sediment in which the animals are preserved suggests that they were smothered by sand deposited during a high-energy wind storm. Startling as it may seem, this association appears to represent fossilized predatory behaviour. In this case, the prey was grasped by the forelimbs and dispatched by rakes and kicks of the hind limbs aimed at the underside of the neck and chest. Digits three and four were flexed backward, clear of the fully extended, sickle-shaped "killing" claw borne by digit two. While a single case such as this must be treated with caution, it suggests that dromaeosaurids were active predators and not just scavengers. Perhaps Mongolian *Velociraptor*s were aware of *Protoceratops*' crouching behaviour during sandstorms and used this to their advantage. [Authors' abstract]).

V

Vance, T. 1989. Probable Use of the Vestigal Forelimbs of the Tyrannosaurid Dinosaurs. Bull. Chicago Herp. Soc., 24(3):41-47.

(Carnosaur (large theropod) bone fracture reports include tyrannosaurid humeri. The author suggests forelimb pathologies occasionally encountered in these large forms were the result of courtship or mating activities. See also Russell, 1970 and Molnar and Farlow, 1990 for alternative suggestions as to causes of pathologies of this type. [DHT]).

(Various authors) 1990. Encyclopedia of Dinosaurs. Pub. Inter., Ltd., 256 pp.

(Mention of intraspecific fighting in the ceratopsian *Triceratops* causing bone injuries. Format: Popular/Semi-Popular).

Varricchio, D.J. 1993. Bone Microstructure of the Upper Cretaceous Dinosaur *Troodon formosus*. Jour. Vert. Paleo., 13:99-104.

(Material used in this study was derived from possible mass mortality event. See also Varricchio, 1997).

____ 1997. The Birthday Site. Nat. Hist., 106(3):65-67.

(The "Birthday Site" is a Late Cretaceous multigeneric bonebed in Montana, USA that apparently formed during a mass mortality event or series thereof. Bones lie ".... grouped by species, suggesting that death struck several individuals at once. One or a series of events apparently affected each species in turn." The site contains many remains of hadrosaurs and rare material of the small theropod *Troodon*. Causative agent(s)? Fire, drought and poisoned water are some possibilities. Perhaps the hadrosaurs died of botulism poisoning (as seen in extant waterfowl), with scavenging theropod then feeding on the carcasses and dying in turn. See also Varricchio, 1993. Format: Popular. [DHT]).

____ and Horner, J.R. 1993. Hadrosaurid and Lambeosaurid Bone Beds from the Upper Cretaceous Two Medicine Formation of Montana: Taphonomic and Biologic Implications. Can. Jour. Earth Sci., 30:997-1006.

(Numerous dinosaur bone beds have been found in the Upper Cretaceous Two Medicine Formation. Taphonomy and size-frequency profiles for the most common skeletal elements of six predominantly hadrosaurid and (or) lambeosaurid assemblages were compared. All six localities are single, highly concentrated bone horizons within silty mudstones. Most are monospecific with some degree of skeletal association, parautochthonous, and likely the result of mass mortality. Four are associated with small lacustrine or waterhole environments and may be the result of drought-related mortality. Within the Two Medicine Formation drought was apparently a common mechanism for generating fossil assemblages.

Both hadrosaurids and lambeosaurids appear to have been gregarious. Lack of association between small (total length <3 m) and larger individuals suggests either that juvenile growth rates were as large ungulates or less likely, that juveniles had a period of non-interaction with adults, perhaps dwelling in strictly juvenile groups. In *Maiasaura peeblesorum*, reproduction appears to have been synchronous among herd members and seasonal. Additionally, mortality was high for juveniles and dropped off rapidly as animals approached adult size. [Authors' abstract]).

____, Jackson, F., Borkowski, J.J. and Horner, J.R. 1997. Nest and Egg Clutches of the Dinosaur *Troodon formosus* and the Evolution of Avian Reproductive Traits. Nature, 385:247-250.

(Includes mention that eggshell in *Troodon* is "very avian-like," yet the presence of pathological multilayering of dinosaur shell seen from other localities indicates the oviduct was more of a reptilian design. See Hirsch, 1994. [DHT]).

Vianey-Liaud, M., Jain, S.L., and Sahni, A. 1987. Dinosaur Eggshells (Saurischia) from the Late Cretaceous Intertrappean and Lameta Formations (Deccan, India). Jour. Vert. Paleo., 7(4):408-424.

(Notation of the discovery of pathological dinosaur eggshell, but not in the form of multilayering as has been reported from other localities. [DHT]).

Vickaryous, M.K., Ryan, M.J., Bell, J.G. and Eberth, D.A. 1995. An Excavation of a Hadrosaur (Ornithischia) Bone Bed from the Horseshoe Canyon Formation (Early Maastrichtian), Alberta, Canada, as a Cost Recovery, Public Participation Program. p. 34. In: Canadian Paleontology Conference Program and Abstracts No. 5. Royal Tyrrell Museum of Palaeontology, Drumheller, 29 Sept. - 2 Oct., 1995.

(Excavation of an extensive *Edmontosaurus* bonebed deposit near Bleriot Ferry, Alberta, Canada. 500+ bones have been excavated from a 100 square meter quarry grids. 50% of the bones show tooth-marking caused by scavenging theropods. Their lost teeth are also found in abundance at this site. While it is unstated in the text, it is probable that this site represents a mass mortality deposit. Unillustrated. [DHT]).

Vickers-Rich, P. and Rich, T.H. 1999. Wildlife of Gondwana — Dinosaurs & Other Vertebrates from the Ancient Supercontinent. Univ. Indiana Press, Bloomington. 304 pp.

(See pp. 134. Osteomyelitis of an unspecified Lower Cretaceous hypsilophodont is figured. [DHT]).

Visser, J. 1986. Sedimentology and Taphonomy of a *Styracosaurus* Bonebed in the Late Cretaceous Judith River Formation, Dinosaur Provincial Park, Alberta. Master's thesis, University of Calgary, Calgary, Alberta, Canada. xiv + 150 pp.

(Mass mortality, Late Cretaceous ceratopsian *Styracosaurus*. Bonebed 42, Dinosaur Provincial Park, Alberta, Canada. The Campanian Judith River Fm. is now called the Dinosaur Park Fm. 57% of the vertebrate material collected from this site was ceratopsian, with 1/4 of this identifiable to *Styracosaurus*. The dimensions of the bonebed is about 550 square meters. No less than 10 styracosaurs died- this number is based on 10 isolated nasal horncore specimens. See Visser and Thomas, 1986. [DHT]).

____ and Thomas, R.G. 1986. Sedimentology and Taphonomy of a *Styracosaurus* Bone Bed in the Late Cretaceous Judith River Formation, Dinosaur Provincial Park, Alberta. North Amer. Paleo. Conv. IV, Univ. Colorado, Boulder:A47. (Abstract).

(Judith River Fm. is now called the Dinosaur Park Fm. Drowning-related mass mortality event preserved in Bonebed 42, Dinosaur Provincial Park of the Late Cretaceous ceratopsian *Styracosaurus*. See Visser, 1986 for more details. [DHT]).

Voynick, S. 1996. World-Class Amber Found — In New Jersey?!. Rock and Gem, September, 1996:45.

(Among the numerous plant and insect fossils found in the 90-94 mya amber collected from central and southern New Jersey, USA was the ".... oldest known mosquito which has mouth parts tough enough to penetrate the skin of some dinosaurs...." Specimen unillustrated. Format: Popular. [DHT].

W

Wade, M. 1989. The Stance of Dinosaurs and the Cossack Dancer Syndrome. pp. 73-82. In: Dinosaur Tracks and Traces. Edited by D.D. Gillette and M.G. Lockley. Cambridge University Press, Cambridge.

(NOT SEEN. See figure 8.5, a Lower Cretaceous small theropod (ichnogenus *Skartopus*) trackway showing animal with possible foot injury and limping; see Lockley, Hunt, Moratalla and Matsukawa, 1994. [DHT]).

Waggoner, B. 1994-1999. *Tyrannosaurus rex*!. Found on Internet on February 15, 1999 at: http://www.ucmp.berkeley.edu/trex/specialt*rex*2.html

(The subject of whether *Tyrannosaurus* was an active predator or simply a scavenger has come under question recently. Waggoner correctly surmises that the discovery of a bone showing healed tyrannosaur toothmarks would be strong evidence for a predaceous lifestyle. Unillustrated. Format: Popular. [DHT]).

Waldman, M. 1969. On an Immature Specimen of *Kritosaurus notabilis* (Lambe), (Ornithischia: Hadrosauridae) from the Upper Cretaceous of Alberta, Canada. Can. Jour. Earth Sci., 6(4):569-576.

(Young (3.3 meters total length) Late Cretaceous (76 million ybp) hadrosaur *Kritosaurus notabilis* collected from Dinosaur Provincial Park, Alberta, Canada. On page 574, the author describes a smooth pit and roughened knob of bone on the right prepubis of CMN 8784, and suggests it might be pathologic in origin. It is unillustrated. If it truly is pathologic, this would be a rare occurrence as nearly all pathological hadrosaur material from the Park is referable to adult-sized animals. [DHT, pers. field obs.]. [DHT]).

Walter, K. 1993. Dinosaurs Needed Chiropractors. The Triangle, August 3, 1993:5.

(Contains yet another example of the erroneous use of term "arthritis" in dinosaurs. Format: Popular. Unillustrated. [DHT]).

Watabe, M., Suzuki, S., Tsogtbaatar, Kh., Barsbold, R. and Weishampel, D.B. 1996. Hatchlings of the Dinosaur *Protoceratops* (Ornithischia: Ceratopsia) from the Upper Cretaceous Locality, Tugrikin Shire, Gobi Desert, Mongolia. (Abstract). Jour. Vert. Paleo., 16(3):71A.

(15 juvenile *Protoceratops* found together. The cause of this mass mortality event is uncertain, but being overwhelmed by a sandstorm or ".... corruption of the nesting hole ...." [presumably meaning a burrow collapse] are suggested. [DHT]).

Webster, D. 1999. A Dinosaur Named Sue. Nat. Geogr., 195(6):46-59.

(*Tyrannosaurus rex* popularly known as "Sue." Heavy emphasis on the paleopathology of this specimen. Results of CT-scan technology on the skull of this specimen are shown. Holes in the right lower jaw [surangular] are identified as possible "infection;" p. 52. Initial reports of "battle damage" in this specimen are being critically reappraised. For example, possible bite marks affecting the left jawbone are ascribed to some type of periodic infection. The puncture holes do not seem to line up forming a "bite line" making paleontologist Christopher Brochu suspicious as to them having traumatic origins, p. 57. A pathologic fibula from this specimen is figured on page 57, the pathology is ascribed to "an infection after a bite or other trauma." Sue did not die in some violent battle, but "simply died," p. 58. A pathological tooth is also mentioned, p. 59. Instead of being about 5 inches [approximately 13 cm] and "varnished brown" in color, the affected tooth is 2 inches [approximately 5 cm] long, twisted and showing a "sickly, blackish gray" coloration, p. 59. Format: Popular. [DHT]).

____ 2000. Debut Sue — Chicago's Field Museum Unveils the World's Most Famous *T. Rex*. Nat. Geogr., 197(6):24-37.

(Mention of fused caudal vertebrae (p. 33, 37). Format: Popular. [DHT]).

Wegweiser, M.D. 2000. Barbecued Bones in Central Wyoming: Evidence of a Wildfire Near the End of the Cretaceous? (Abstract). Jour. Vert. Paleo., 20(3):77A.

(Probable wildfire deposits have been identified in the Upper Cretaceous of Central Wyoming. The fire burned trees and the creatures associated with them, resulting in an associated catastrophic death assemblage of both plant and vertebrate material. Reconnaissance studies result in identification of a bone layer occurring over a faulted geographic area of central Wyoming, in the Bighorn Basin region. The bone assemblage occurs in poorly indurated siliciclastic units, within a lithologically constrained interval. Due to regional faulting, further study is ongoing to better constrain relative stratigraphic position of the barbecued bone interval. Taphonomically, there are at least three types of preservation identified during initial reconnaissance: 1) burned bone in association with burned tree stumps and ash in possible bentonitic clay; 2) burned bone associated with ferruginous crusts in lithic sandstone; 3) burned bone contained in laminated meatballs [sic] found in shale immediately overlying the lithic sandstone. Skeletal articulation varies from isolated but articulated bone to disarticulated and dispersed bone. Frequency of bone occurrence suggests that there could be a larger accumulation of bone than that evaluated during initial reconnaissance as spatial density over geographic area is relatively high. Diagenesis and weathering results in friability of the bone found near or at the surface. Bone preserved in shale meatballs tends to be less friable. Identification of a North American Upper Cretaceous "barbecued bone interval" provides a rare window of opportunity to study trophic relationships and raises the question as to the frequency of wildfires occurring during the Upper Cretaceous. [Author's abstract]. See also Perkins, 2000).

Weigelt, J. 1927 [1989]. Rezente Wirbeltierleichen und Ihre Palaobiologische. [Recent Vertebrate Carcasses and Their Palaeobiological Im-plications]. Verlag von Max Weg, Leipzig. 1989 translation by J. Schaefer and published by University of Chicago Press, Chicago, xvi + 188 pp.

(Discussions on mass mortality of extinct and extant vertebrates, also includes figures of animal carcasses with the characteristic death pose with the head pulled backwards and over the back; see Davis, 1996. Dinosaurs, especially long-necked varieties and theropods of all types are often found coiled up in similar postures. Well illustrated. [DHT]).

Weintraub, B. 1998. Did Gout Really Get to *T. rex*? Nat. Geogr., 193(2):v.

(Gout in *Tyrannosaurus*. With cartoon. See Rothschild, Tanke and Carpenter, 1997. Format: Popular. [DHT]).

Weishampel, D.B. 1992. Plant-Eating Dinosaurs. Franklin Watts, New York. 63 pp.

(Figures two male Early Jurassic *Heterodontosaurus* "threatening each other," p. 34. Also states that the enlarged upper caniform teeth in this form would have been good as weapons for protection or used during intraspecific strife. Format: Popular. [DHT]).

Welles, S.P. 1984. *Dilophosaurus wetherilli* (Dinosauria, Theropoda), Osteology and Comparisons. Palaeontographica, A, 185:85-180.

(UCMP 37302, a nearly complete skeleton of *Dilophosaurus*, recovered from the lower part of the Triassic Kayenta Fm. near Tuba City, Arizona, USA includes several possible paleopathologies. A horizontal groove present just below the articular facet of the prezygapophysis of the 5th cervical vertebra is not present on other vertebrae and might be related

to an injury or postmortem crushing (p. 107). Possible evidence of several abscesses affecting the proximal end of a humerus is presented (p. 128), although these might also be preservational artifacts. [DHT]).

____ and Long, R.A. 1974. The Tarsus of Theropod Dinosaurs. Ann. S. Afr. Mus., 64:191-218.

(Includes mention that the fibula of the Late Jurassic *Allosaurus* USNM 4734 described by Gilmore, 1920 is pathologic, having suffered a crushing fracture which later healed. Specimen unillustrated. Marsh, 1896 illustrated the same region, but with the pathology corrected. [DHT]).

Westrup, H. 1992. Dinosaurs' Injuries Fascinate Modern Scientists-Fossil Bones Show Breaks, Lesions. Can. Sci., 10(39):1.

(Short article on the Royal Tyrrell Museum's dinosaur program technician Darren Tanke and his work on paleopathology of Late Cretaceous hadrosaurs and ceratopsians from Alberta, Canada. Distal caudal vertebrae often show crushed and malformed centra- almost certainly due to accidental crushing from other members within the large herd which hadrosaurs are known to have formed. Broken and healed proximal neural spines in hadrosaurs might be related to mating trauma. Most neural spine fracture injuries are concentrated on the base of the tail and appear as if a great weight had pressed down upon them. Some pieces even show how the tip of the spine had been shoved down the side of the remaining neural spine and healed in the incorrect position. The mating trauma hypothesis has not been welcomed by some paleontologists, but none have been very forthcoming with any alternative ideas.

Ceratopsian injuries are rarer than the literature would suggest. Extensive excavation of ceratopsian bonebeds yields relatively few injured bones. Those that are found in adults are mostly situated on the posterior rib cage, perhaps indicating a non-lethal flank-butting behaviour. Format: Popular. [DHT]).

Whitehead, H. 1989. Paleopathology in Dinosaurs. Bull. Alta. Paleo. Soc., 4(4):5-6.

(Review of a program on paleopathology and possible behavioral implications in hadrosaurs and ceratopsians given to the Alberta Palaeontological Society by Darren Tanke in Calgary, Alberta, Canada, on October 20, 1989. Format: Popular. [DHT]).

____ 1992. Aspects of *Seismosaurus*. Bull. Alta. Paleo. Soc., 7(3):4-5.

(Notes taken from a talk given by Dr. Dave Gillette on this giant sauropod collected from New Mexico, USA. Some earlier reports on this dinosaur included discussion of the discovery of gastroliths "stomach stones." One particularly large (grapefruit-sized) gastrolith was found and implicated as possibly causing the death of this animal. In this talk, Gillette reveals that his suggestion was an off-hand comment that the press ran as "Dinosaur Choked to Death" stories. Format: Popular. [DHT]).

Wieland, G.R. 1925. Dinosaur Extinction. Amer. Nat., 59:557-565.

(Pages 560-561 include mentions "frill lacerations" in Late Cretaceous ceratopsians. R. Lull suggests these are due to intraspecific fighting between bull males during the breeding season. [DHT]).

Wilford, J.N. 1985. The Riddle of the Dinosaur. Alfred A. Knopf, New York. viii + 304 pp.

(On page 249, aggressive intraspecific behaviour in the large Late Cretaceous ceratopsian *Triceratops* is suggested due to the presence of "deep wounds in the bony frill that projected backwards like a shield over their neck and shoulders." Format: Popular. [DHT]).

Williams, D.L.G., Seymour, R.S., and Kerourio, P. 1984. Structure of Fossil Dinosaur Eggshell from the Aix Basin, France. Palaeogeogr., Palaeoclim., Palaeoecol., 45:23-37.

(The authors cast doubt on the hypothesis forwarded by Erben et al., 1979 that pathological thinning of dinosaur eggshells at the close of the Cretaceous led to their extinction. [DHT]).

Williamson, T.E. and Carr, T.D. 1999. A New Tyrannosaurid (Dinosauria: Theropoda) Partial Skeleton from the Upper Cretaceous Kirtland Formation, San Juan Basin, New Mexico. (Abstract). New Mexico Geol., 21(2):42-43.

(A partial skeleton, collected from the Upper Campanian Hunter Wash Member of the Kirtland Formation, San Juan Basin, New Mexico, USA, and possibly representing a new species of *Daspletosaurus* showed several osteopathies. The author's write: ".... possible puncture wound of a palatal bone (ectopterygoid) and related infection of the bone and nearby periosteal tissue and a rib that shows a healed fracture." Unillustrated. [DHT]).

Wiman, C. 1930. Uber Ceratopsia aus der Oberen Kreide in New Mexico. [On Ceratopsians from the Upper Cretaceous in New Mexico]. Nova Acta Regiae Soc. Scient. Upsaliensis, Ser. 4, 7(2):1-19.

(Extra fontanelles or openings in the squamosals of the Late Cretaceous ceratopsian *Pentaceratops fenestratus* collected from New Mexico, USA. These supernumerary fontanelles are often ascribed in the technical and popular literature as examples of intraspecific fighting (horn thrust injuries). See Tanke, submitted b; Tanke and Farke ms. Language: German. [DHT]).

Winkler, D.A., Jacobs, L.L., Branch, J.R., Murry, P.A., Downs, W.R. and Trudel, P. 1988. The Proctor Lake Dinosaur Locality, Lower Cretaceous of Texas. Hunteria, 2(5):1-8.

(Lower Cretaceous Twin Mountains Formation (Trinity Group), Proctor Lake, Comanche County, Texas, USA. New, unnamed genus of hypsilophodontid, related to the European form *Hypsilophodon*. Presumably a mass mortality event of some variety is represented at this locality. "Numerous" partial skeletons are preserved. Bones can be found isolated elements, isolated skeletons or "mass occurrences of many individuals." Juveniles and adult are represented. Much of the site remains to be excavated. lllustrated. See also Winkler and Murray, 1989. [DHT]).

____ and Murry, P.A. 1989. Paleoecology and Hypsilophodontid Behaviour at the Proctor Lake Dinosaur Locality (Early Cretaceous), Texas. pp. 55-61. In: Paleobiology of the Dinosaurs. Edited by J.O. Farlow. Geol. Soc. Amer. Spec. Pap. 238.

(Details as per Winkler et al., 1988. lllustrated. [DHT]).

Wood, J.M. and Thomas, G. 1986. Taphonomy of Dinosaurian Assemblages in Fluvial Deposits of the Judith River Formation (Upper Cretaceous), Dinosaur Provincial Park, Alberta. (Abstract). p. A51. 4th North Amer. Paleo. Conv., August 12-15, 1986, Boulder, Colorado.

(.... two major categories of bonebeds are recognized: multigeneric and monogeneric. Multigeneric bonebeds, common at basal levels of TX [trough cross-bedded sandstone] sequences, are interpreted as channel lag deposits. Monogeneric *Styracosaurus* and *Centrosaurus* bonebeds occur within an lHS [inclined heterolithic strata] and lBS [sandstones with large-scale inclined bedding] sequence, respectively. They are thought to represent catastrophic mass deaths of herding ceratopsians during flood events. Floating carcasses became stranded on point bars as flood waters receded. [Author's abstract; in part]. Unillustrated).

Wood, P., Vaczek, L., Hamblin, D.J. and Leonard, J.N. 1972. Life Before Man. Time-Life Books, New York. 160 pp.

(Includes a figure of the fighting *Velociraptor* and *Protoceratops*; pp. 86-87. Format: Popular. [DHT]).

Woodward, A.S. 1905. On Parts of the Skeleton of *Cetiosaurus leedsi*, a Sauropodous Dinosaur from the Oxford Clay of Petersborough. Proc. Zool. Soc., 1905:232-243.

(Mention on page 239 of the presence of some fractured and healed distal caudal vertebrae in a Jurassic sauropod skeleton. The author states that a "chain" of small and numerous caudal vertebrae at the end of such a massive animal must have been "especially liable to accident." lllustrated (but not pathological specimens). [DHT]).

Woodward, S.R., Weyand, N.J. and Bunnell, M. 1994. DNA Sequence from Cretaceous Period Bone Fragments. Science, 266:1229-1232.

(Discovery of possible dinosaur DNA. See Hedges and Schweitzer, 1995; Heinkoff, 1995; Allard, Young and Huyen, 1995 and Zischler et al., 1995 for critiques. [DHT]).

Wright, K. 1991. Dinosaur Doctors. Discover, 12(9):46-51.

(An up to date review of some of the researchers of paleopathology, their studies, and their specimens. The celebrated case of L. Martin and B. Rothschild's work on a Late Cretaceous marine mosasaur who had its' tail bitten by a shark is reviewed. The shark left part of a tooth in the now partially healed and fused fossil vertebrae. Avascular necrosis in mosasaurs and giant sea turtles is described and a color photograph of an affected mosasaur vertebra is given. Stress fractures in ceratopsian phalanges might be related to a foot stomping activities concurrent to a mating display. G. Bell has found mosasaur skulls that show bite marks on the snout. Bell believes they were received from other mosasaurs during mutual snout-grappling fights over females. D. Tanke has found numbers of pathologic hadrosaur caudal vertebrae; probably received from accidental tail trampling encounters with other members of the herd. Rothschild and Martin's controversial discovery of syphilis in an American Pleistocene bear (*Arctodus*) is presented. The value and impor-

tance of scientists of widely differing disciplines (paleontology/modern medicine) working together towards accurate paleopathological determinations is stressed. Rothschild's work on arthritis in early American lndians; DlSH and osteoarthritis in dinosaurs is also presented. Format: Semi-Popular. [DHT]).

Wyckoff, R.W.G. 1969. Sur la Composition de Quelques Proteines Dinosauriennes. [On the Composition of Some Dinosaur Proteins]. C.R. Acad. Sci., Ser. D, 269:1489-1491.
(Unillustrated. Language: French. [DHT]).

____ 1972. The Biochemistry of Animal Fossils. Scientechnia, Bristol; and Williams and Wilkin, Baltimore. 152 pp.
(NOT SEEN. NOT lNDEXED).

____ 1980. Collagen in Fossil Bones. pp. 17-22. In: Biogeochemistry of Amino Acids. Edited by P.E. Hare, T.C. Hoering and K., King. John Wiley and Sons, London. 172 pp.
(NOT SEEN. NOT lNDEXED).

____, Hoffmann, V.J. and Matter, P. 1962. Microradiography of Fossilized Teeth. Science, 140:78-80.
(NOT lNDEXED).

Wycombe, P. 1992. Dino Had Cancer. Sun, 10(11):33; March 17, 1992.
(Short note in a tabloid newspaper on the possible discovery of a chondrosarcoma affecting the humerus of an American Late Jurassic *Allosaurus*. As is typically the case with tabloid newspaper articles, what, if any kernel of truth has been stretched to the limit. ln this article, the opening sentence states that "Dinosaurs may have disappeared off the face of the earth millions of years ago because they suffered from cancer." ln actuality, the lesion represent a healing infected fracture- BMR. Format: Popular. [DHT]).

X

Xia, W.; Li, X., Li, Y. and Chen, H. 1983. Primary Study of Composition and Microstructure of the Dinosaurian Skeleton in Lower Shaximiao Formation (Middle Jurassic) at Dashanpu, Zigong, Sichuan Province. Jour. Chendu Coll. Geol. Suppl. 1:34-40.
(lt has been confirmed that the mineral composition of the osseous framework of dinosaurian bones are carbonate-fluor-apatite which is determined by thin section, x-ray diffraction, and infrared spectrometry. The comparison with the composition and structure of skeletons of modern vertebrates shows that the carbonate-fluor-apatite is not formed by phosphatization but is primary. The medullary canal and Haversian canal are mainly filled with single crystal calcite, and the osseous framework consists of the parallel osseous laminae of the apatite. lt has been found by scanning electron microscope that the osseous laminae are composed of recurved scaly apatites in ultramicrosize which arranged in certain orientation with parallel each other and with some ultramicropores. The content of arsenic in the skeleton of dinosaurs amounts to 100-160 ppm, which indicates that the high mortality of the dinosaurs may be caused by arsenic poisoning. Language: Chinese; with English abstract).

____, ____, and Zhqiang, Y. 1984. The Burial Environment of Dinosaur Fauna in Lower Shaximiao Formation of Middle Jurassic at Dashanpu, Zigong, Sichuan. ibid, Suppl. 2, Nov.:46-59.
(A description of the geology and depositional environment of this famous Chinese dinosaur locality. The reason for leading the dinosaurs to a mass death is supposed to be poisoning by plants (containing abundant arsenic) which the dinosaurs ate. The abnormal death and the burial in shallow-bank of low energy are the main factors to provide a great deal of well preserved dinosaur fossils in this region. Language: Chinese (with English abstract (presented here)).

Y

Yadagiri, P. and Ayyasami, K. 1979. A New Stegosaurian Dinosaur from Upper Cretaceous Sediments of South India. Jour. Geol. Soc. India, 20:521-530.
(Description of the new genus and species of stegosaur *Dravidosaurus blanfordi*. One spike found with the type was seen to be "bulged at the centre." Could this be the remnants of a fracture callus? A more detailed assessment is necessary. l lllustrated. [DHT]).

Young, D. 1980. Paleontologists: Detectives in Dinosaur Case. Santa Ana Register, Sept. 10, 1980.
(Mention of the discovery of a baby hadrosaur [*Maiasaura*] in the Late Cretaceous deposits of Montana, USA that was clubfooted. The fact that this disabled individual was found in conjunction with other littermates demonstrates that the adults took care of the young hadrosaurs. The senior editor has examined the specimen in question. The use of the term "clubfoot" in this case is a misnomer. A metatarsal in this individual displays a twisted condition, lack of callus or osteomyelitis indicates a possible congenital defect is actually to blame [DHT, personal observation]. See also Carpenter, 1999 for a figure of this specimen. Format: Popular. [DHT]).

Young, S. 1998. The *Rex* Files - The Dinosaur Detectives. Found on the Internet Dec. 22, 2000 on the New Scientist website at: http://www.newscientist.com/nsplus/insight/*rex*files/detectives.html
(Mention of the following topics in *Tyrannosaurus*: septic bites, running and falling- suffering serious/fatal injuries, intraspecific biting, pain ["agony'] and gout. Format: Popular. Osteopathy unillustrated. [DHT]).

Z

Zelenitsky, D. 1995. Fossil Eggs and Eggshell Fragments from the Oldman Formation (Upper Cretaceous: Campanian), Southern Alberta, Canada. Masters thesis, Dept. of Geology and Geophysics, University of Calgary. ix + 151 pp.
(Page 103 includes brief discussion on the occurrences and types of pathological dinosaur eggshell recovered and studied by other researchers. No pathological eggshell is specifically described in this document. See Zelenitsky and Hill, 1997. [DHT]).

____ and Hills, L.V. 1997. Normal and Pathological Eggshells of *Spheroolithus albertensis* Oosp. Nov. From the Oldman Formation (Judith River Group; Late Campanian), Southern Alberta. Jour. Vert. Paleo., 17(1):167-171.

(Eggshell fragments collected from the Oldman Formation, southern Alberta, are described as *Spheroolithus albertensis* oosp. nov. This oospecies exhibits a spheroolithid microstructure, sagenotuberculate outer surface ornamentation, and a shell thickness of 0.98-1.22 mm. A multilayering pathology of *S. albertensis* suggests that the egg laying taxon had a reptilian-like reproductive system. [Authors' abstract]. Illustrated).

Zeng, D.M. and Zhang, J.J. 1979. Fossil Dinosaur Eggs from the Western Part of the Dongting Basin, Hunan Province. Vert. Palasia., 17(2):131-136.

(Dinosaur egg pathology, though the text is in Chinese and the English abstract provided provides no additional details. Unillustrated. [DHT]).

Zhang, Yihong 1988. The Middle Jurassic Dinosaur Fauna from Dashanpu, Zigong, Sichuan. Vol. 1. Sauropod Dinosaurs (I) *Shunosaurus*. Sichuan Publ. House Sci. Tech., Chengdu:__.

("Tail club" on *Shunosaurus lii*. This has previously been called pathological in Chinese paleontological publications, but lately has been accepted as a normal tail club. [But are they, in fact, normal? The distal caudal vertebrae taper in size then suddenly become swollen with "caudal spines." Are these actually neural arches broken off at time of injury and not properly reattached forming a pseudoarthrosis? Is the swelling related to post-trauma healing / infection? Crush-fractured hadrosaur caudals from the Late Cretaceous of Alberta, Canada can also show a similar swollen appearance. Specimen number T5401 looks like a likely candidate for a pathological specimen. These curious specimens need to be examined in more detail to elucidate whether they are truly normal anatomical features or pathologies]. See Dong et al., 1989. [DHT]).

Zhao, Zi-kui 1975. The Microstructures of the Dinosaurian Eggshells of Nanxiong Basin, Guangdong Province. (I) On the Classification of Dinosaur Eggs. Vert. Palasiat., 13:105-117.

(NOT INDEXED. Pathologic dinosaur eggshell. Language: Chinese. Illustrated).

____1978. [A Preliminary Investigation of the Thinning of the Late Cretaceous Fossil Eggshell of Dinosaur and Its Related Problems]. Vert. Palasiat., 16:213-221.

(NOT INDEXED. Dinosaur eggshell pathology. Unillustrated).

____ 1990. Mass Extinction Across the Cretaceous-Tertiary Boundary at Nanxiong Basin, Guandong Province. A Monthly Journal of Science, 35:380.

(Dinosaur eggshell pathology. NOT SEEN. NOT INDEXED).

____ 1994. Dinosaur Eggs in China: On the Structure and Evolution of Eggshells. pp. 184-203. In: Dinosaur Eggs and Babies. Edited by K. Carpenter, K.F. Hirsch and J.R. Horner. Cambridge Univ. Press, Cambridge. ix + 372 pp.

(Comments on thinning of eggshell and occurrences of multilayering of eggshell in *Macroolithus sp.* and *M. yaotunensis*. It is suggested that abnormal concentrations of trace elements lead to the formation of pathological eggshell. Illustrated. [DHT]).

____, Ye, J., Li, H., Zhao, Z., and Yan, Z. 1991. Extinction of Dinosaurs Across the Cretaceous-Tertiary Boundary in Nanxiong Basin, Guandong Province. Vert. Palasia., 29(1):1:13-29 (1-20).

(Pathologic dinosaur eggshells; abnormal mineral crystal arrangement and variable thickness of eggshell; *Macroolithus yaotunensis; M. rugustus; M. sp.; Elongatoolithus andrewsi* and *E. elongatus*. Language: Chinese and English. Illustrated. [DHT]).

____ and Ding, S. 1976. Discovery of the Dinosaurian Eggshells from Alxa, Ningxia, & Its Stratigraphic Significance. Vert. Palasiat., 14(1):42-44.

(NOT SEEN. NOT INDEXED. Dinosaur egg pathology).

____ and Currie, P.J. 1993. A Large Crested Theropod from the Jurassic of Xinjiang, People's Republic of China. Can. Jour. Earth Sci., 30(10-11):2027-2036.

(Middle Jurassic *Monolophosaurus*. A prominent and irregular (asymmetrical) crest atop the head of this new genus is determined to be non-pathological by the virtue of the crest being hollow internally. The type specimen shows osteopathy affecting dorsal vertebrae 10 and 11. The 10th dorsal neural spine is ".... distorted, has thick bony callosities..." It is fused firmly onto dorsal spine 11 which may also have been injured. A traumatic fracture of spine number 10 (and possibly number 11) is postulated. Osteopathy illustrated; see fig. 3, p. 2033. While not mentioned in the text, the gracile dentary of this specimen also revealed some faint parallel ridges externally that appeared to represent well healed intraspecific bite trauma; see Tanke and Currie, 1995, 1998 (2000). [DHT]).

____, Wang, J., Chen, S. and Zhong, Y. 1993. Amino Acid Composition of Dinosaur Eggshells Nearby the K-T Boundary in Nanxiong Basin, Guangdong Province, China.

(NOT SEEN. NOT INDEXED. Dinosaur egg pathology).

Zhou, S. 1984. The Middle Jurassic Dinosaurian Fauna from Dashanpu, Zigong, Sichuan. Vol. II Stegosaurs. Sichuan Sci. and Technol. Publ. House. 52 pp.

(Plate VII (right) shows an articulated distal caudal series of the stegosaur *Haayangosaurus taibaii*. The last 3 or 4 vertebrae form a small club-like mass- pathological? Language: Chinese (with English summary) [DHT]).

Zhuo, Xiaoliang. 2000. Do We know Anything about the Kinds of Diseases that Affected Dinosaurs? Found on Internet on Dec. 1, 2000 on the Scientific American website at: http://www.sciam.com/askexpert/medicine/medicine4.html

(American paleopathologist responds to a readers query. The *Allosaurus* on display at the Smithsonian shows extensive exostosis of the scapula. Exostosis has also been observed in a *Triceratops* dentary. Bone fractures are reported in *Camptosaurus, Iguanodon, Deinonychus, Syntarsus, Tyrannosaurus, Albertosaurus* and *Allosaurus*. Bone fractures are rare in ceratopsians, notably *Centrosaurus* and *Pachyrhinosaurus*, although stress fractures affecting the pedal phalanges are known. Bone infections are known in *Dilophosaurus, Troodon, Camptosaurus, Allosaurus* and unspecified hadrosaurs and ceratopsians. A *Lambeosaurus* [actually an indeterminate hadrosaur] dentary showed a dental abscess. Osteoarthritis is rare in dinosaurs an known from a couple *Iguanodon* from the famous Belgium herd. Other pathological conditions in dinosaurs are frequently mistaken for arthritis. Claims of malignant tumors in dinosaurs are still unsubstantiated. DISH, or diffuse idiopathic skeletal hyperostosis is known in *Apatosaurus*, ceratopsians, hadrosaurs and pachycephalosaurids. Format: Popular. Unillustrated. [DHT]).

Zimmer, C. 1997. Not a Raptor — A Caring Mom. Discover, 18(1):57.

(Late Cretaceous *Oviraptor* found sitting on a nest of its eggs. There is a healed fracture of the left ulna visible in the accompanying picture. Format: Popular. [DHT]).

Zinke, J. 1998. Small Theropod Teeth from the Upper Jurassic Coal Mine of Guimarota (Portugal). Pal. Zeit., 72(1/2):179-189.

(Describes *Paronychodon* teeth. Illustrated. [DHT]).

____ and Rauhut, O.W.M. 1994. Small Theropods (Dinosauria, Saurischia) from the Upper Jurassic and Lower Cretaceous of the Iberian Peninsula. Berliner Geowiss. Abh. (E) 13:163-177.

(Teeth and a fragmentary dentary of small theropod dinosaurs from the Upper Jurassic lignite coal mine of Guimarota (Leiria, Portugal) are described. These teeth are similar to *Paronychodon* in showing longitudinal grooves on the crown, but differ in having serrated edges. Three of those teeth can still be found in the dentary fragment. Also, theropod teeth from the Lower Cretaceous of Galve (Teruel, Spain), which show the same characteristics are described. The significance of these specimens for the judgment of the appearance of the longitudinal grooves on theropod teeth as well as for the systematic position of *Paronychodon* are discussed. [Author's abstract]. Well illustrated. Fourth (posterior-most) tooth in the dentary fragment is angled strongly backwards; whether this is a pathological condition or simply due to crushing was not determined, although the latter is suspected. Some authors consider "*Paronychodon* teeth" to be abnormal teeth of previously established Late Cretaceous small theropod taxa. In this paper, the authors conclude that these ridges and grooves are in fact normal, and that the North American *Paronychodon* teeth may represent valid new taxa. See also Telles Antunnes and Sigogneau-Russell, 1991. [DHT]).

Zischler, H., Hoss, M., Handt, O., von Haesler, A., van der Kuyl, A.C., Goudsmit, J. and Paabo, S. 1995. Detecting Dinosaur DNA. Science, 268:1192-1193.

(Critique of Woodward, Weyand and Bunnell, 1995 claim of the discovery of Late Cretaceous dinosaur DNA. It is suggested that the DNA is actually *Homo sapiens* contamination. See also pages 1191-1192 for additional critiques. With response by Woodward on page 1194. [DHT]).

Zocco, T.G. and Schwartz, H.L. 1994. Microstructural Analysis of Bone of the Sauropod Dinosaur *Seismosaurus* by Transmission Electron Microscopy. Palaeontology, 37(3):493-503.

(TEM (Transmission Electron Microscope) imaging of Late Jurassic sauropod *Seismosaurus*, Pleistocene woolly mammoth *Mammuthus primigenius*, Late Cretaceous ?*Albertosaurus* and recent unspecified crocodile bone. Younger fossil bone microstructure appears unaltered; older bone is a unique blend of original bone apatite and diagenetic apatite. Collagen fibrils can be seen in the younger bone samples. Well illustrated. [DHT]).

Zorab, P.A. 1961. The Historical and Prehistorical Background of Ankylosing Spondylitis. Proc. Roy. Soc. Med., 54:415-420.

(Predominantly a review of other works. However, he does describe a Lower Cretaceous *Polacanthus foxi* from the Isle of Wight, England with bamboo appearance [fusion] of 5 or 6 thoracic or lumbar vertebrae. [BMR]).

Zuo, Q. and Jing, W.-d. 1995. First Report on Studying Dinosaur Egg Fossils with Method of Medical CT Scanning. Acta Palaeont. Sin., 34(6):777-779.

(By studying dinosaur egg fossils with the method of medical CT scanning, we can clearly distinguish egg cell, egg white, yolk and blastodisc, and measure their concrete dates. This opens up a new path for the study of dinosaur egg fossils. Language: Chinese; with English summary [presented here]. Illustrated. [DHT]).

FAMILY/GENUS

Citations below are arranged chronologically and then alphabetically. With new discoveries and revised diagnoses, dinosaurian taxonomy is in a constant state of flux. The taxonomy presented here is believed generally accurate but should be used as a rough guide only.

ORDER: HERRERASAURIA

FAMILY: HERRERASAURIDAE

Herrerasaurus: Sereno and Novas, 1993. (The taxonomic status of this genus is not entirely clear. It is considered by some not to be a dinosaur).

ORDER: SAURISCHIA

ORDER: THEROPODA

FAMILY: PODOKESAURIDAE

Coelophysis (*Rioarribosaurus*) *bauri*: Colbert, 1947; Ratkevitch, 1976; Fisher, 1981; Colbert, 1989; Schwartz and Gillette, 1994; Johnson and Stucky, 1995; Coy, 1997; Helder, 2000; Eberth and McCrea, 2002.

Procompsognathus: Sereno and Wild, 1992

Syntarsus: Raath, 1969, 1990; Rothschild and Martin, 1992; Lessem and Glut, 1993; Rothschild, 1997; Zhuo, 2000.

FAMILY: HALTICOSAURIDAE

Dilophosaurus wetherilli: Welles, 1984; Currie and Koppelhus, 1996; Rothschild, 1997; Zhuo, 2000; Molnar, 2001.

FAMILY: CERATOSAURIDAE

Ceratosaurus: Baur, 1890; Marsh, 1892a, 1896; Gilmore, 1920; Battaglia, 1979; Harding, 1988; Rowe and Gauthier, 1990.

FAMILY: SINRAPTORIDAE

Sinraptor dongi: Currie and Zhao, 1993; Farlow and Molnar, 1995; Tanke and Currie, 1995, 1998 (2000); Tanke, 1996a; Niiler, 2000.

FAMILY: SPINOSAURIDAE

Carcharodontosaurus saharicus: Anonymous, 1996d.

Spinosaurus aegyptiacus: Stromer, 1915.

carcharodontosaur, n. gen.: Eberth, Currie, Coria, Garrido and Zonneveld, 2000; Eberth and McCrea, 2001, 2002.

FAMILY: ALLOSAURIDAE

Acrocanthosaurus atokensis: Stovall and Langston, 1950; Harris, 1997, 1998.

Allosaurus (*Antrodemus*) *fragilis*: Gilmore, 1915; Moodie, 1917; Gilmore, 1920; Moodie, 1923a; Swinton, 1934; Stokes, 1945; Swinton, 1970; Petersen, Isakson and Madsen, 1972; Welles and Long, 1974; Madsen, 1976a; Battaglia, 1979; Dodson, Behrensmeyer, Bakker and McIntosh, 1980; Hunt, 1986; Rothschild, 1987a,b; Molnar and Farlow, 1990; Graham, 1992; Greenburg, 1992; Molnar, 1992; Rothschild and Martin, 1992; Rothschild and Tanke, 1992; Stadtman, 1992; Taylor, 1992; Wycombe, 1992; Laws, 1993; Stadtman, 1993; Erickson, 1995; Laws, 1995; Schowalter, 1995b; Claessens, 1996; Travsky, 1996; Laws, 1996; Richmond and Morris, 1996; Breithaupt, 1997; Laws, 1997; Rothschild, 1997; Schweitzer, 1997; Tanke and Rothschild, 1997; Anonymous, 1998f; Breithaupt, 1998; Bryant, 1998; Hecht, 1998; Tanke and Currie, 1998; Anonymous, 2000c; Ayer, c. 2000; Hanna, 2000 (see Laws); Niiler, 2000; Rothschild, Tanke and Ford, 2001; Zhuo, 2000; Anonymous, 2001a; Smith and Lisak, 2001; Carpenter, 1999; Claessens, ms.

Labrosaurus [= *Allosaurus*?]: Gilmore, 1920; Rothschild, 1997.

Neovenator: Hutt, Martill and Barker, 1996.

Allosauroid: *Cryolophosaurus*: Hammer and Hickerson, 1993; Hammer, Hickerson and Slaughter, 1995; Anonymous, 1994c; Hammer, 1997; Lore, 1998.

FAMILY: TYRANNOSAURIDAE

Albertosaurus: Lambe, 1917; Parks, 1928; Russell, 1970; Molnar and Farlow, 1990; Erickson, 1993a,b, 1995; Anonymous, 1994a; Schowalter, 1995a,b; Tanke and Currie, 1995; Anonymous, 1997c; Currie [in Anonymous, 1997e]; Anonymous, 1997i; Currie, 1998 (2000); Felber, Currie and Sovak, 1998; Tanaka, 1998; Young, 1998; Erickson, 1999, 2000; Fischman, 1999; Anonymous, 2000f; Hanna, 2000 (see Laws); Helder, 2000; Milstein, 2000; Niiler, 2000; Zhuo, 2000; Abler, 2001; Eberth and McCrea, 2001; Rothschild, Tanke and Ford, 2001; Eberth and McCrea, 2002.

?*Albertosaurus*: Zocco and Schwartz, 1994; Schowalter, 1995a.

Alectrosaurus olsoni: Erickson, 1993a,b, 1995.

Aublysodon: Lehman and Carpenter, 1990.

Daspletosaurus torosus: Russell, 1970; Erickson, 1993a,b; 1995; Jacobsen, 1996; Anonymous, 1997i; Tanke and Currie, 1998; Hanna, 2000 (see Laws); Milstein, 2000; Niiler, 2000.

D. new species?: Williamson and Carr, 1999.

Gorgosaurus libratus: Lambe, 1917; Parks, 1928; Russell, 1970; McGowan, 1983; Molnar and Farlow, 1990; McGowan, 1991; Jacobsen, 1996; Poling, 1996; Tanke, 1996f (incorrectly identified as *Albertosaurus*); Anonymous, 1997i; Currie, 1997a; Rothschild, 1997; Tanke and Currie, 1998; Keiran, 1999; Milstein, 2000; Niiler, 2000.

Tarbosaurus bataar: Kielan-Jaworowska, 1969; Pawlicki, 1977b; Rothschild, Tanke and Ford, 2001.

Tyrannosaurus rex: Moodie, 1919b; Slaughter, 1957; Sokoloff, c. 1960; Molnar, 1973; Carpenter, 1979; McGinnis, 1982; Norman, 1985; Harding, 1988; Lessem, 1988; Carpenter, 1990; Harlan, 1990; Molnar and Farlow, 1990; Reid, R., 1990a; Anonymous, 1991b; Larson, 1991; Molnar, 1991; Anonymous, 1992b,c; Bakker, 1992; Burnham, 1992; Horner and Lessem, 1992; Horner and Lessem, 1993; Larson, 1992; Molnar, 1992; Smith, Peter, 1992; Erickson, 1993a,b; Fischman, 1993; Gore, 1993; Kiernan, 1993; Morell, 1993a,b; Reid, 1993; Schweitzer, 1993; Anonymous, 1994b; Barrick and Showers, 1994; Larson, 1994a,b; Luck-Baker, 1994; Psihoyos, 1994; Schweitzer and Cano, 1994; Schweitzer, Cano, Starkey and Horner, 1994; Crichton, 1995; Erickson, 1995; Farlow, Smith and Robinson, 1995; Hecht, 1995; Larson, 1995; Millard, 1995; Monastersky, 1995a,b; Norell, Gaffney and Dingus, 1995; Schowalter, 1995b; Alexander, 1996; Anonymous, 1996a-c,e,g-h; Dingus, 1996; Erickson and Olson, 1996; Erickson, Van Kirk, Su, Levenston, Caler and Carter, 1996; Hecht, 1996; Holmes, 1996; Naeye, 1996; Schweitzer et al. 1996a; Stokstad, 1996; Tanke (in Janke, 1996); Tanke, 1996g; Tchoe, 1996; Anonymous, 1997a,b,d-g,i; Begley, 1997; Browne, 1997; DeFeo, 1997; Horner and Dobb, 1997; Larson, 1997; Monastersky, 1997;

Olert, 1997; Okino, 1997; Radford, 1997; Rothschild, 1997; Rothschild, Tanke and Carpenter, 1997a,b; Schweitzer et al., 1997; Staedter, 1997; Torassa, 1997; Avila, 1998; Chin, Tokaryk, Erickson and Calk, 1998; Douglas and Young, 1998; Hecht, 1998; Holtz, 1998; Larson, 1998; Ma, 1998; Molnar, 1998 (2000); Paul, 1998 (2000); Rubin, 1998; Weintraub, 1998; Abler, 1999; Erickson, 1999; Webster, 1999; Anonymous, 2000b, e, f; Brochu, 2000; Erickson, 2000; Fiffer, 2000; Ford, 2000b; Hanna, 2000 (see Laws); Niiler, 2000; Tanke and Currie, 1998 (2000); Webster, 2000; Zhuo, 2000; Carpenter and Smith, 2001; Gevock, 2001; Larson, 2001a,b; Perkins, 2001; Rega and Brochu, 2001; Rothschild, Tanke and Ford, 2001.

Tyrannosaurid indeterminate or unspecified: Molnar and Farlow, 1990; Rothschild, 1994; Jacobsen, 1995a; Brandvold and Sweeney, 1996; Jacobsen, 1996; Radford, 1997; Rothschild, Tanke and Carpenter, 1997; Grierson, 1998; Jacobsen, 1998; Ma, 1998; Mongelli, Varricchio and Borkowski, 1999; Spalding, 1999; Rothschild, Tanke and Ford, 2001.

Tyrannosaurs in general: Tracy, 1976; Farlow and Brinkman, 1987; Vance, 1989; Molnar and Farlow, 1990; Farlow, Brinkman, Abler and Currie, 1991; Farlow and Brinkman, 1994; Thulborn, 1994; Tanke, 1996a; Tanke and Rothschild, 1997; Paul, 1998 (2000); Abler, 2000.

FAMILY: COMPSOGNATHIDAE

Compsognathus longipes: Moodie, 1918d, 1923a; Swinton, 1934, 1970; Halstead and Middleton, 1972; Crichton, 1995; Davis, 1996.

FAMILY: DROMAEOSAURIDAE

Deinonychus antirrhopus: Ostrom, 1969, 1976; Paul, 1988; Psihoyos, 1994; Maxwell and Ostrom, 1995; Horner and Dobb, 1997; Rothschild, 1997; Marshall, Brinkman, Lau and Bowman, 1998; Maxwell, 1999; Zhuo, 2000; Martill and Naish, 2000; Eberth and McCrea, 2002.

Dromaeosaurus albertensis: Fiorillo and Gangloff, 2000.

Saurornitholestes langstoni: Currie and Jacobsen, 1995; Jacobsen, 1995a,b; Tanke and Currie, 1998; Rothschild, Tanke and Ford, 2001.

Velociraptor mongoliensis: Kielan-Jaworowska and Barsbold, 1972; Barsbold, 1974; Lessem, 1992; Duchesne and Leitch, 1993; Hamley, 1993; Osmolska, 1993; Horner, 1994a; Crichton, 1995; Norell, Gaffney and Dingus, 1995; Tomida, 1995; Unwin, Perle and Trueman, 1995; Amery, 1997; Currie, 1997b; Carpenter, 1998 (2000); Jerzykiewicz, 1998; Tanaka, 1998; Ford, 2000b.

Unspecified dromaeosaur: Norell and Makovicky, 1997; Rothschild, Tanke and Ford, 2001.

Dromaeosaurs in general: Tanke and Rothschild, 1997.

FAMILY: TROODONTIDAE

Sinornithoides youngi: Currie and Dong, 2001.

Troodon formosus: Russell, 1969; Carpenter, 1982; Currie, 1985; Varricchio, 1993, Varricchio and Horner, 1993; Rogers, 1997; Rothschild, 1997; Varricchio, 1997; Horner and Dobb, 1997; Varricchio, Jackson, Borkowski and Horner, 1997; Carpenter, 1999.

FAMILY: CAENAGNATHIDAE

Chirostenotes: Rothschild, Tanke and Ford, 2001.

FAMILY: ORNITHOMIMIDAE

Gallimimus bullatus: Pawlicki and Bolechala, 1987, 1991.

Ornithomimus: Keiran, 2001.

Struthiomimus altus: Osborn, 1916; Moodie, 1918d, 1923a; Swinton, 1970; Desmond, 1976; Helder, 2000.

Ornithomimid indet.: Kielan-Jaworowska, 1969; Kawakami, 1996; Sullivan, Tanke and Rothschild, 2000.

Ornithomimids in general: Tanke and Rothschild, 1997.

FAMILY: OVIRAPTORIDAE

cf. *Ingenia*: Daszeveg et al., 1995.

Nomingia: Currie, 2002.

Oviraptor: Osborn, 1924; Norell, Clark, Chiappe and Dashzeveg, 1995; Popeo, 1996; Martill, Barker and Dacke, 1996; Chinsamy and Barrett, 1997; Zimmer, 1997; Clark, Norell and Chiappe, 1999.

Unspecified oviraptorid eggs: Dashzeveg et al., 1995.

FAMILY: ?

"*Paronychodon*" or *Paronychodon*-like teeth: Cope, 1876; Marsh, 1892b; Russell, 1935; Sahni, 1972; Lehman, 1981; Breithaupt, 1985; Standhardt, 1986; Currie, Rigby and Sloan, 1990; Telles Antunes and Sigogneau-Russell, 1991; Zinke and Rauhut, 1994; Baszio, 1997; Girouard, 1997; Zinke, 1998; Park, 2000; Peng et al., 2001.

Small theropod unidentified/unspecified: Ishigaki, 1986a,b; 1988; Kellner, 1996; Hecht, 2000; Rodriguez-De La Rosa and Aranda-Manteca, 2000.

LARGE THEROPODS, *incertae sedis*:

Becklespinax: Lessem and Glut, 1993.

Megalosaurus: Owen, 1856; Knight, 1984.

Monolophosaurus jiangi: Zhao and Currie, 1993; Tanke and Currie, 1998.

FAMILY: MEGALOSAURIDAE

(This is a classic "wastebasket family" with numerous indeterminate European large theropods placed within this family. Reference of some animals to this family is probably not correct. A rigorous re-evaluation of the family is needed).

Poekilopleuron: Eudes-Deslongchamps, 1838; Tanke and Rothschild, 1997.

Unspecified large theropod: Bohlin, 1953; Rothschild, 1997; Heckert et al., 1999.

Unidentified ?juvenile small theropod femur: Naish, 2000.

Theropod dinosaurs, unspecified: Hammer and Hickerson, 1993; Dantas, dos Santos, Lockley and Meyer, 1995; Currie and Koppelhus, 1996; Anonymous, 1998b,c; Fischman, 1999 (Argentinean form related to *Giganotosaurus*); Benton, 2000.

See also Anonymous, 1999a and Martill and Davis, 1998a,b.

PROSAUROPODS

FAMILY: PLATEOSAURIDAE

Plateosaurus: Sander, 1992; Norell, Gaffney and Dingus, 1995.

unspecified prosauropod: Isaacs, Little, Currey and Tarlo, 1963.

FAMILY: MELANOROSAURIDAE

Camelotia: Galton, 1998.

SAUROPODS

FAMILY: BARAPASAURIDAE

Vulcanodon: Raath, 1972.

FAMILY: CETIOSAURIDAE

Cetiosaurus leedsi: Woodward, 1905; Moodie, 1917, 1923a; Swinton, 1965b; 1970; Coombs, 1975.

Patagosaurus fariasi: Coria, 1994.

Shunosaurus lii: Tanimoto, 1988; Zhang, 1988; Olshevsky, 1989; Dong et al., 1989; Gore, 1993; Lessem and Glut, 1993; Myhrvold and Currie, 1998.

FAMILY: BRACHIOSAURIDAE

Brachiosaurus brancai: Kaiser, 1954b; Blasius and Kaiser, 1980.

FAMILY: CAMARASAURIDAE

Camarasaurus: Moodie, 1919b; Sokoloff, c. 1960; Hagood, 1971/2; Petersen, Isakson and Madsen, 1972; McIntosh, 1977; Rothschild, 1987a; Rothschild and Berman, 1991; Rothschild, 1994; McIntosh, Miles, Cloward and Parker, 1996; Rothschild, 1997; Fiorillo, 1998; Kaye, 1998; McWhinney, Carpenter and Rothschild, 2001.

FAMILY: DIPLODOCIDAE

Apatosaurus: Riggs, 1903; Moodie, 1920, 1923a; Swinton, 1934; Gilmore, 1936; Kaiser, 1952; Sokoloff, c. 1960; Swinton, 1970; Blasius and Kaiser, 1980; McGinnis, 1982; Rothschild, 1985b; Chenoweth, 1987; Rothschild, 1987a, 1988c, 1989b; Reid, R., 1990a; Rothschild and Berman, 1991; Reid, 1993; Rothschild, 1994; Christiansen, 1996b; Horner and Dobb, 1997; Rothschild, 1997; Kaye, 1998; Myhrvold and Currie, 1998; Hanna, 2000 (see Laws); Zhuo, 2000.

Barosaurus: Choy and Altman, 1992; Naeye, 1993; Norell, Gaffney and Dingus, 1995.

Diplodocus: Osborn, 1899; Hatcher, 1901; Osborn, 1904; Holland, 1906; Hay, 1908; Holland, 1910; Moodie, 1919b, 1923a, 1927; Gilmore, 1930; Schlumberger and Lucke, 1948; Ackerknecht, 1953; Look, 1955; Stolk, 1958; Sokolof, c. 1960; Blumberg and Sokoloff, 1961; Miller and Wyckoff, 1968; Swinton, 1970; Coombs, 1975; McGinnis, 1982: Machotka, 1984; Rothschild, 1985b, 1987a, 1988c, 1989b; Lambert, 1990; Mclntosh, 1990; Rothschild and Berman, 1991; Michard, 1992; Rothschild and Tanke, 1992; Gertsch, 1994; Rothschild, 1994; Christiansen, 1996b; Rothschild, 1997; Kaye, 1998; Rothschild and Tanke, 1998a,b.

Seismosaurus: Anonymous, 1991a; Begley and Yoffe, 1991; Gillette, 1991; Monastersky, 1991; Michard, 1992; Gurley, Valdez, Spall, Smith and Gillette, 1991; Monastersky, 1991; Gore, 1993; Lessem and Glut, 1993; Zocco and Schwartz, 1994; Christiansen, 1996a.

FAMILY: EUHELOPODIDAE

Mamenchisaurus hochuanensis: Anonymous, 1965.

M. sinocanadorum: Russell and Zheng, 1993.

Omeisaurus tianfuensis: Tanimoto, 1988; Myhrvold and Currie, 1998.

FAMILY: TITANOSAURIDAE

Hypselosaurus priscus: Anonymous, 1969; Erben, Hoefs and Wedepohl, 1979; Anonymous, 1982; Ewert, Firth and Nelson, 1984; Albritton, 1989; Rothschild, 1997; Tanke and Rothschild, 1997; Hirsch, unpublished.

unspecified titanosaurs: Anonymous, 1998e; Chang, 1998; Hayden, 1999; Ritter, 1999; Jackson, Garrido and Loope, 2001.

Sauropods unspecified: Moodie, 1916b, c; Moodie, 1918a,c; Swinton, 1934, 1970; Anonymous, 1972; Gonick, 1978; Begley and Yoffe, 1991; Dantas, dos Santos, Lockley and Meyer, 1995; Anonymous, 1998g; Anonymous, 1998g; Chiappe, 1998; Chiappe et al., 1998, 1999.

Sauropods in general: Penner, 1983; Williams, Seymour and Kerourio, 1984; Rothschild, 1987a; Tanke and Rothschild, 1997; Hanna, 2000 (see Laws).

SEGNOSAURS

FAMILY: THERIZINOSAURIDAE

unspecified Late Cretaceous therizinosaur embryos: Cohen, Cruickshank, Joysey, Manning and Upchurch, 1995; Anonymous, 1998a.

THEROPODS OF UNCERTAIN CLASSIFICATION

Marshosaurus: Madsen, 1976b.

Scipionyx samniticus: Dal Sasso and Signore, 1998a, b.

ORDER: ORNITHISCHIA

FAMILY: DRYOSAURIDAE

Dryosaurus [*Dysalotosaurus*] *lettowvorbeki*: Janensch, 1934.

FAMILY: HETERODONTOSAURIDAE

Echinodon: Silbernagel, 1996 [= Fabrosauridae?].

Heterodontosaurus: Weishampel, 1992.

FAMILY: CAMPTOSAURIDAE

Camptosaurus: Gilmore, 1909, 1912; Moodie, 1917, 1923a; Swinton, 1934, 1970; Petersen, Isackson and Madsen, 1972; Lewin, 1982; Sawyer and Erickson, 1985; Rothschild, 1987a; Erickson, 1988; Rothschild and Martin, 1992; Struzik, 1993; Rothschild, 1997; Anonymous, 1998f; Zhuo, 2000.

FAMILY: HYPSILOPHODONTIDAE

(This "wastebasket" family is undergoing a major revision. Taxonomic placement of animals listed here is tentative at best).

unspecified Hypsilophodonts: Rothschild, 1987a; Winkler et al., 1988; Winkler and Murray, 1989; Rich and Rich, 1990; Monaghan, Rich and Rich, 1991; Gross, Rich and Vickers-Rich, 1993; Tanke and Rothschild, 1997; Long, 1998; Vickers-Rich and Rich, 1999 (*Leaellynasaura*); Hanna, 2000 (see Laws); Hirsch, 2001.

FAMILY: IGUANODONTIDAE

Iguanodon: Seitz, 1907; Moodie, 1920; Swinton, 1934, 1970; Norman, 1980; Rothschild, 1987a; Blows, 1978; Norman, 1980; Cooper and Jackson, 1981; Desse, Meunier, Peron and Laroche, 1981; Rothschild, 1988a; Blows, 1989; Norman and Milner, 1989; Rothschild, 1989b; Reid, R., 1990a; Rothschild, 1989b, 1990c; Rothschild and Martin, 1992; Rothschild and Tanke, 1992; Gardom and Milner, 1993; Reid, 1993; Rothschild, 1993, 1994; Anonymous, 1995d; Clarke and Barker, 1993, 1995; Hawkes, 1995; Radley, 1996; Radford, 1997; Rothschild, 1997; Tanke, 1997a; Tanke and Rothschild, 1997; Anonymous, 2000d.

Lurdusaurus: Taquet and Russell, 1999; Hanna, 2000 (see Laws); Zhuo, 2000.

Tenontosaurus: Forster, 1990b.

HADROSAURS

FAMILY: HADROSAURIDAE

Anatosaurus: Moodie, 1923a, 1926b, 1928; Abelson, 1954a; Reid, 1984; McNamara, 1992a; Rothschild and Martin, 1992; Tanke, 1996e; Helbling, Rothschild and Tanke, 2001.

Brachylophosaurus: Tanke, 1996e; Tanke and Rothschild, 1997; Hanna, LaRock and Horner, 1999 (see Laws).

"*Claosaurus annectens*": Beecher, 1902.

Edmontosaurus annectens: Parks, 1935; Lull and Wright, 1942; Tanke, 1984; Carpenter, 1988a; Johnson and Stucky, 1995; Derstler, 1996; Anonymous, 1998-1999; Erickson, 1999, 2000; Carpenter, 1998 (2000); Paty, 2001.

Edmontosaurus sp.: Sternberg, 1950; Langston, 1976; Tanke, 1984; Anonymous, 1994a; Vickaryous, Ryan, Bell and Eberth, 1995; Erickson and Olson, 1996; Tanke, 1996e; Anonymous, 1997e; Horner and Dobb, 1997; Carpenter, 1998 (2000); Stephenson, 1998; Tedesco, Halvorsen and Cooper, 1998a,b; Anonymous, 2000f; Campagna, 2000; Helbling, Rothschild and Tanke, 2001; Tanke, submitted a.

Gilmoreosaurus: Helbling, Rothschild and Tanke, 2001.

Hadrosaurus: Helbling, Rothschild and Tanke, 2001.

Kritosaurus (more properly *Gryposaurus*): Waldman, 1969; Horner, 1992; Horner and Dobb, 1997.

Maiasaura: Young, 1980; Horner and Gorman, 1985; Hooker, 1987; Horner and Gorman, 1988; Gore, 1993; Barreto, 1994; Horner, 1994a; McDonald, 1994; Horner and Dobb, 1997; Tanke and Rothschild, 1997; Schmitt, Horner, Laws and Jackson, 1998; Carpenter, 1999; Tanke, submitted a.

?*Maiasaura*: Burnham, Derstler and Linster, 1996.

Nipponosaurus: Brett-Surman, 1989.

Orthomerus: Campbell, 1966; Reid, R., 1990a.

Prosaurolophus: Lull and Wright, 1942; McGowan, 1983; Rogers, 1989, 1990; Cronkite, 1991; McGowan, 1991; Tanke, 1996e; Horner and Dobb, 1997; Rogers, 1997; Tanke, submitted a.

FAMILY: LAMBEOSAURIDAE

Bactrosaurus: Helbling, Rothschild and Tanke, 2001.

Barsboldia: Maryanska and Osmolska, 1981; Brett-Surman, 1989.

Corythosaurus: Moodie, 1927; Dodson, 1971; Helder, 1991; Evans, 2001, 2002.

Hypacrosaurus: Swinton, 1934, 1970; Currie, 1988; Acorn, 1993; Grady, 1993; Horner, 1994a,b; Tazaki, Aratani, Noda, Currie and Fyfe, 1994; Tanke, 1996e; Horner and Dobb, 1997; Rogers, 1997; Tanke and Rothschild, 1997; Tanke, submitted a; Hirsch, 2001 (listed only as Hadrosaur);

Lambeosaurus: Zhuo, 2000; Tanke, submitted a.

?*L. laticaudus*: Morris, 1976, 1981.

Parasaurolophus: Parks, 1922; Lull and Wright, 1942; Ostrom, 1963; Tanke, 1989a; Lowey, 1992; Horner, 1994a; Tanke, submitted a.

Lambeosaurine, indet.: Lowey, 1992; Tanke, 1996e; Horner and Dobb, 1997.

Hadrosaur, indet.: Lambe, 1902; Moodie, 1919b; Sternberg, 1921; Gilmore, 1924; Moodie, 1927; Gilmore, 1929; Moodie, 1930b; Lindblad, 1954; Langston, 1961; Sternberg, 1961; Das, Doberenz and Wyckoff, 1967; McDonald and Sibley, 1969; Tanke, 1984; Tanke, 1989a; Norman and Milner, 1989; Cronkite, 1991; Grant, 1991; Wright, 1991; Anonymous, 1992b; Rothschild and Martin, 1992; Westrup, 1992; Clouse and Horner, 1993; Anonymous, 1994a; Spinar and Currie, 1994; Tazaki, Aratani, Noda, Currie and Fyfe, 1994; Clouse, 1995; Tanke, 1996b; Rothschild, 1997; Anderson et al., 1998; Anonymous, 1998a; Monastersky, 1999a; Anonymous, 2000a; Milstein, 2000; Tanke, submitted a.

Hadrosaurs in general: P, 1924; Rothschild, 1987a; Whitehead, 1989; Monastersky, 1990; Rein, 1990; Cronkite, 1991; Begley and Yoffe, 1991; Rothschild and Tanke, 1992; Westrup, 1992; Struzik, 1993; Rothschild, 1994; Currie and Koppelhus, 1996; Kawakami, 1996; Tanke, 1997a; Tanke and Rothschild, 1997; Labandiera, 1998; Tanke (in Hanna, 2000 [see Laws]); Zhou, 2000; Rothschild, Helbling and Tanke, 2001.

PACHYCEPHALOSAURS

FAMILY: PACHYCEPHALOSAURIDAE

Gravitholus: Maryanska, 1990; Lessem and Glut, 1993.

Pachycephalosaurus: Carpenter, 1997.

Prenocephale: Carpenter, 1997.

Stegoceras: Sues, 1978; Tanke, 1988a; Carpenter, 1997.

Stygimoloch: Tanke, 1988a; Carpenter, 1993; Goodwin and Johnson, 1995; Johnson and Stucky, 1995; Carpenter, 1997; Ford, 1998; Goodwin, Buchholts and Johnson, 1998.

Pachycephalosaurs in general: Galton, 1970; Rothschild, 1987a; Zhuo, 2000.

Lack of paleopathologies in: Tanke, 1988a; Carpenter, 1993, 1997; Ford, 1998; Goodwin et al., 1998.

PROTOCERATOPSIANS

FAMILY: PROTOCERATOPSIDAE

Leptoceratops: Gurney, 1992; Chinnery and T*rex*ler, 1999.

Protoceratops andrewsi: Barsbold, 1974; Tereshchenko, 1991; Duchesne and Leitch, 1993; Hamley, 1993; Watabe et al., 1996; Amery, 1997; Currie, 1997b; Jerzykiewicz, 1989; Carpenter, 1998 (2000); Jerzykiewicz, 1998; Ford, 2000b.

CERATOPSIANS

FAMILY: CERATOPSIDAE

SUBFAMILY: CENTROSAURINAE

Achelosaurus: Anonymous, 1996i; Horner and Dobb, 1997.

"*Brachyceratops*" (juvenile centrosaurine; see Sampson, Ryan and Tanke, 1997): Gilmore, 1917.

Centrosaurus: Brown, 1917; Parks, 1921; Lull, 1933; Langston, 1975; Tyson, 1977; Turner, 1980; Currie, 1981, 1982; Braman, 1982; Currie and Dodson, 1984; Wood and Thomas, 1986; Currie, 1987; Pringle, 1989; Tanke, 1989b; Dodson and Currie, 1990; Rothschild and Martin, 1992; Rothschild and Tanke, 1992; Ryan, 1992, 1993; Horner, 1994a; Norman, 1994; Rothschild, 1994; Ryan and Russell, 1994; Dodson, 1996; Eberth, 1996; Tanke, 1996c; Sampson, Ryan and Tanke, 1997; Eberth, 1998; Tanaka, 1998; Dodson and Smith, 1999; Ryan et al., 1999; Helder, 2000; Zhuo, 2000; Ryan, Russell, Eberth and Currie, 2001; Tanke and Larsson, manuscript; Tanke, submitted b; Tanke and Farke, ms.

Einiosaurus: Rogers, 1989; Rogers and Sampson, 1989; Rogers, 1990; Sampson, 1995; Anonymous, 1996i; Horner and Dobb, 1997; Rogers, 1997; Sampson, Ryan and Tanke, 1997; Hanna, 2000 (see Laws); Tanke and Farke, ms.

"*Monoclonius lowei*": Sternberg, 1940; Tanke and Farke, ms.

Pachyrhinosaurus: Sternberg, 1950; Langston, 1975, 1976; Norman, 1985; Olinger, 1987a,b; Olshevsky, 1988; Tanke, 1988b, Anonymous, 1989c; Tanke, 1989b; Struzik, 1989; Dodson et al., 1990; Rempel, 1990; Eamon, 1991; Rothschild and Martin, 1992; Rothschild and Tanke, 1992; Acorn, 1993; Lessem and Glut, 1993; Horner, 1994a; Rothschild, 1994; Spinar and Currie, 1994; Anonymous, 1996i; Dodson, 1996; Tanke, 1996c-d; Horner and Dobb, 1997; Rothschild and Tanke, 1996, 1997; Sampson, Ryan and Tanke, 1997; Dodson and Smith, 1999; May and Gangloff, 1999; :Glut, 2000; Hanna, 2000 (see Laws); Helder, 2000; Zhuo, 2000; Tanke, submitted b; Tanke and Farke, ms.

Styracosaurus: Anonymous, 1934a-c; Brown and Schlaikjer, 1937; Langston, 1975; Visser, 1986; Visser and Thomas, 1986; Wood and Thomas, 1986; Currie, 1987; Tanke, 1989b; Rothschild and Tanke, 1992; Horner, 1994a; Eberth, 1996; Tanke, 1996c; Sampson, Ryan and Tanke, 1997; Ryan et al., 1999; Tanke, submitted b; Tanke and Farke, ms.

Centrosaurines in general: Tanke and Rothschild, 1997; Tanke and Farke, ms.

INDEX TWO: PATHOLOGICAL CONDITIONS AND RELATED TOPICS

SUBFAMILY: CHASMOSAURINAE

Anchiceratops: Sternberg, 1926; Dodson and Currie, 1990; Rothschild and Tanke, 1992; Forster, 1996b; Rothschild and Tanke, 1997; Tanke, submitted b.

Arrhinoceratops: Parks, 1925; Lull, 1933; Tyson, 1977; Mateer, 1981; Tyson, 1981; Dodson and Currie, 1990; Reid, 1990a; Lessem and Glut, 1993; Dodson, 1996; Forster, 1996b; Rothschild and Tanke, 1997; Tanke, submitted b; Tanke and Farke, ms.

Chasmosaurus: Sternberg, 1927; Lull, 1933; Sternberg, 1940; Molnar, 1977; McGowan, 1983; Russell, 1989; Dodson and Currie, 1990; McGowan, 1991; Godfrey and Holmes, 1995; Norell, Gaffney and Dingus, 1995; Dodson, 1996; Forster, 1996b; Rothschild and Tanke, 1997; Holmes, Forster, Ryan and Shepherd, 2001; Tanke, submitted b; Tanke and Farke, ms.

Diceratops: Lull (in Hatcher, 1905); Lull, 1905; Gilmore, 1906; Hatcher, Marsh and Lull, 1908; Lull, 1908, 1933; Steel, 1969; Tyson, 1977; Lehman, 1990; Forster, 1990a; Lessem and Glut, 1993; Forster, 1996b; Rothschild and Tanke, 1997; Anonymous, 1999b; Hanna, 2000 (see Laws); Tanke and Farke, ms.

Pentaceratops: Wiman, 1930; Lull, 1933; Gilmore, 1935; Tyson, 1977; Mateer, 1981; Rowe, Colbert and Nations, 1981; Czerkas and Czerkas, 1990; Dodson and Currie, 1990; Lehman, 1990; Dodson, 1996; Forster, 1996b; Rothschild and Tanke, 1997; Hanna, 2000 (see Laws); Tanke and Farke, ms.

Torosaurus: Lull, 1933; Tyson, 1977; McGinnis, 1982; Norman, 1985; Tokaryk, 1986; Berghaus and Gabriel, 1988; Johnson, 1989; Anonymous, 1990a,b; Czerkas and Czerkas, 1990; Forster, 1990a; Johnson and Ostrom, 1995; Forster, 1996b; Rothschild and Tanke, 1997; Hanna, 2000 (see Laws); Martill and Naish, 2000; Tanke and Farke, ms.

Triceratops: Hatcher, Marsh and Lull, 1908; Lull, 1908; Gilmore, 1919a, 1920b; Moodie, 1923a; Romer, 1924; Lull, 1933; Anonymous, 1934a-c; Swinton, 1934; Geis, 1959, 1960; Erickson, 1966; de Camp and de Camp, 1968; Swinton, 1970; Tyson, 1977; Tweedie, 1977; Benes and Burian, 1979; Charig, 1979; Macdonald, 1979; Heritage, 1980; Sattler, 1981; Stout, Service, and Preiss, 1981; Glut, 1982; Burton and Dixon, 1984; Wilford, 1985; Ostrom and Wellnhofer, 1986; Tokaryk, 1986; Halstead and Halstead, 1987; Dixon et al., 1988; Russell, 1989; Czerkas and Czerkas, 1990; Dodson and Currie, 1990; Dodson et al., 1990; Forster, 1990a; Reid, 1990a; Various authors, 1991; Gurney, 1992; Rothschild and Tanke, 1992; Gore, 1993; Lessem and Glut, 1993; Horner, 1994a; MacLeod, 1994; Gurney, 1995; Dodson, 1996; Ericksen and Olsen, 1996; Forster, 1996a,b; Forster and Sereno, 1997; Kaye, 1997; Rothschild, 1997; Rothschild and Tanke, 1997; Benton, 2000; Ford, 2000b; Hanna, 2000 (see Laws); Martill and Naish, 2000; Zhuo, 2000; Tanke, ms; Tanke and Farke, ms.

"El Picacho Ceratopsian": Lehman, 1996.

Chasmosaurinae: Lehman, 1990; Tanke and Farke, ms.

Ceratopsian, indet.: Kindle, 1921; Johnson and Storer, 1974; Rothschild, 1988c; Wright, 1991; Anonymous, 1992b; Westrup, 1992; Rothschild, 1997; Tanke, submitted b.

Ceratopsians in general: Gilmore, 1920b; Kindle, 1921; Sternberg, 1921; Wieland, 1925; Anonymous, 1934a,b,c; de Camp and de Camp, 1968; Swinton, 1965a, 1966, Steel, 1969; Swinton, 1970; Cox, 1976; Molnar, 1977; McGinnis, 1982; Rothschild, 1985b, 1987a, 1988b; Russell, 1989; Whitehead, 1989; Farlow, 1990; Begley and Yoffe, 1991; Lessem, 1992; Rothschild and Martin, 1992; Westrup, 1992; Borkent, c. 1993; Olshevsky, 1994; Borkent, 1995; Clos, 1996; Currie and Koppelhus, 1996; Fastovsky and Weishampel, 1996; Rothschild and Tanke, 1997; Sampson, 1997; Tanke, 1997a; Tanaka, 1998; Anonymous, 2000d; Hanna, 2000 (see Laws); Zhuo, 2000; Tanke, submitted b; Tanke and Farke, ms.

STEGOSAURS

FAMILY: STEGOSAURIDAE

Dravidosaurus blanfordi: Yadagiri and Ayyasami, 1979.

Haayangosaurus: Zhou, 1984.

Stegosaurus: Gilmore, 1914; Moodie, 1919b, 1923a; Swinton, 1934; Abelson, 1954a,b; Swinton, 1970; Petersen, Isakson and Madsen, 1972; Paul, 1988; Carpenter, 1996, 1998; McWhinney, Rothschild and Carpenter, 1998; Hanna, 2000 (see Laws); Milstein, 2000; McWhinney, Rothschild and Carpenter.

Stegosaurs in general: Rothschild, 1987a.

unspecified stegosaur: Gertsch, 1994.

ANKYLOSAURS

FAMILY: SCELIDOSAURIDAE

Scelidosaurus: Martill, 1991.

FAMILY: NODOSAURIDAE

Edmontonia: Rothschild, 1997.

Polacanthus: Zorab, 1961.

Stegopelta: Moodie, 1910; Blows, 2001.

Unspeciated nodosaur: Ford, Kirkland and Elder, 1998.

FAMILY: ANKYLOSAURIDAE

Ankylosaurus: Moodie, 1928.

Gastonia: Kirkland, 1998.

Minmi: Molnar and Frey, 1987.

Pinacosaurus: Anonymous, c. 1987; Reynolds, 1988; Currie, 1989; Jerzykiewicz, 1989; Lessem, 1989a,b; Acorn, 1993; Grady, 1993; Jerzykiewicz, Currie, Eberth, Johnston, Koster and Zheng, 1993; Jerzykiewicz, 1998.

Shamosaurus: Ford, 2000a.

Tarchia: Gallagher, Tumanova and Dodson, 1998; Tumanova, Gallagher, Dodson and Axel, 1998; Hanna, 2000 (see Laws).

Ankylosaur indet.: Moodie, 1910; Tanke, submitted b.

Ankylosaurs in general: Rothschild, 1987a; Tanke and Rothschild, 1997.

Unspeciated ankylosaur: Gertsch, 1994; Dashzeveg et al., 1995.

DINOSAURS IN GENERAL

Moodie, 1919b; Swinton, 1934; Favour, Ritts and Bayles, 1956; Hotton, 1963; Campbell, 1966; Pawlicki, Korbel and Kubiak, 1966; Das, Doberenz and Wyckoff, 1967; Miller and Wyckoff, 1968; Kielan-Jaworowska, 1969; Wyckoff, 1969; Swinton, 1970; Sochava, 1971; Desmond, 1976; Droscher, 1976; Abbey, 1977; Talbot, 1978; Macdonald, 1979; Croft, 1982; Goldman, 1982; Ewert, Firth and Nelson, 1984; Xia et al., 1983, 1984; Gillette and Thomas, 1985 (ornithopod); Rothschild, 1985a; Sawyer and Erickson, 1985; Stokes, 1985; Vianey-Liaud, Jain and Sahni, 1987; Carpenter, 1988b; Grogan and Szadziewski, 1988; Rothschild, 1988a; Lougheed, 1989; Rothschild, 1989a; Sobel, 1989; Tiffney, 1989; Benton, 1990; Monastersky, 1990; Rothschild, 1990; Thulborn, 1990; McGowan, 1991; Chinsamy and Raath, 1992; McNamara, 1992b; Muyzer, Sandberg, Knapen, Vermeer, Collins and Westbroek, 1992; Rothschild and Martin, 1992; Rothschild and Tanke, 1992; Anonymous, 1993b; Gore, 1993; Rothschild, 1993; Walter, 1993; Chinsamy, 1994; Woodward, Weyand and Bunnell, 1994; Anderson, Jon 1995; Chinsamy and Dodson, 1995; McLean, 1995; Zuo and Jing, 1995; Rothschild, 1995; Zelenitsky, 1995; Zischler, Hoss, Handt, von Haesler, van der Kuyl, Goudsmit and Paabo, 1995; Barrick, 1996; Burgess, 1996; Currie and Koppelhus, 1996; Feduccia, Martin and Simmons, 1996; Kuris, 1996; Bocherens, 1997; Czerkas, 1997; Daniel, 1997; Horner, 1997; Parrish, 1997; Rothschild, 1997; Sampson, 1997; Tanke, 1997b; Tanke and Rothschild, 1997; Trueman, 1997; Hunt and Lucas, 1998 (ornithopod); Irwin, 1998; Jackson, Solomon and Varricchio, 1998; Loope, Dingus, Swisher and Minjin, 1998; Rothschild and Tanke, 1998a,b; Rothschild, Tanke, Hershkovitz and Schultz, 1998; Lockley, 1999; Monastersky, 1999b; Rothschild, Witzke and Hershkovitz, 1999; Anonymous, 2000d; Benton, 2000; Hanna, 2000 (see Laws); Hirsch, 2001.

CLASS: AVES

ORDER: ARCHAEOPTERYGIFORMES

FAMILY: ARCHAEOPTERYGIDAE

Archaeopteryx: Moodie, 1923a; Davis and Briggs, 1995; Davis, 1996.

DINOSAUR ICHNOGENERA

Anchisauripus (prosauropod): Tucker and Burchette, 1977.

Atreipus-like: Lingham-Solair and Boderick, 2000.

Caririchnium leonardii (ornithopod): Lockley and Hunt, 1995; Lockley, Matsukawa and Hunt, 1993; Hunt and Lucas, 1998.

Eubrontes: Abel, 1935.

Sauroidichnites abnormis (small theropod): Hitchcock, 1844.

Skartopus (small theropod): Wade, 1989.

Unnamed sauropod tracks: Schulp and Brokx, 1999.

DINOSAUR OOGENERA

Elongatoolithus andrewsi: Zhao et al., 1991; Carpenter, 1999.

E. elongatus: Zhao et al., 1991; Carpenter, 1999.

Macroolithus rugustus: Zhao et al., 1991.

M. yaotunensis: Zhao, 1994; Zhao et al., 1991.

M. sp.: Zhao, 1994; Zhao et al., 1991; Carpenter, 2000.

Megaloolithus khempurensis: Mohabey, 1998.

Maiasaura: Carpenter, 2000.

M. sp.: Erben, Hoefs and Wedepohl, 1979; Carpenter, Hirsch and Horner, 1994; Carpenter, 2000.

Preprismatoolithus: Carpenter, 2000.

Spheroolithus albertensis: Zelenitsky and Hills, 1997; Carpenter, 2000.

Other Late Cretaceous oospecies (specific details not given): Zhao et al., 1991.

Notes: Within each of the following headings, the citations are arranged chronologically and then alphabetically. The following detailed index is quite extensive. For example, the hypothetical statement "Intraspecific fighting is inferred from fossilized material recovered from ceratopsian bonebeds that show broken and healed jaws, puncture injuries to the frill and bone infections" would be indexed under INTRASPECIFIC FIGHTING, MASS MORTALITY, FRACTURES, PUNCTURES and OSTEOMYELITIS. As a result, citations of larger works or smaller detailed reports (especially those including literature reviews) will reappear frequently throughout this index.

ABSCESSES (NON-ORAL)

In: proximal humerus of *Dilophosaurus*: Welles, 1984; Rothschild, 1997.

:humerus of Upper Cretaceous unspecified hadrosaur, Alberta, Canada following severe transverse fracture: Moodie, 1923a.

:*Camptosaurus* ilium; *Allosaurus* phalanx; *Troodon* parietal: Rothschild, 1997.

:mention only (popular); Currie and Koppelhus, 1996.

ACROMEGALY

Nopcsa, 1917; Anonymous, 1934a,b,c (all Late Cretaceous ceratopsians); Benton, 1990.

AMPUTATIONS

In: Jurassic *Eubrontes* footprint showing missing toe: Abel, 1935.

:caudal neural spine of Late Cretaceous hadrosaur *Edmontosaurus* possibly incurred during a failed predation attempt by *Tyrannosaurus*: Carpenter, 1988a, 1998 (2000); Anonymous, 2000f; Paty, 2001.

:tail tip (approx. 30 cm) of Late Cretaceous unspecified hadrosaur associated with fusion of remaining distal caudal vertebrae, Alberta, Canada: Langston, 1961.

:"digit loss" as exemplified in dinosaur footprints: Thulborn, 1990; Tanke and Rothschild, 1997.

:Upper Jurassic *Allosaurus* pedal phalanx suggestive of traumatic amputation and associated infection: Petersen, Isakson and Madsen, 1972.

:loss of distal portion of orbital horncore in two Late Cretaceous *Triceratops* specimens: Moodie, 1923a.

:loss of distal horncore, *Triceratops*: Hatcher, Marsh and Lull, 1908.

:serious trauma to tail tip and hind toes in unspecified hadrosaurs from Alberta, Canada leads to sloughing off of affected region: Tanke, 1996e.

:mushroomed distal end of ornithomimid pedal phalanx, suggestive of distal end of digit having been sloughed off: Sullivan, Tanke and Rothschild, 2000.

ANAEROBES

Anonymous, 1975.

ANKYLOSING SPONDYLOSIS

In: caudal vertebrae of Upper Jurassic sauropod *Diplodocus* [actually DISH; see DISH entry below]: Lambert, 1990.

ANTIBIOTICS

Recovered from micro-organisms in 130 Ma amber: Anonymous, 1996f.

ARTERIOSCLEROSIS

In unidentified dinosaurs; mention only: Goldman, 1982.

ARTHRITIS (MOST CASES ARE ACTUALLY EXAMPLES OF "DISH" OR DIFFUSE IDIOPATHIC SKELETAL HYPEROSTOSIS; SEE "DISH" ENTRY BELOW)

:as being found in dinosaurs: Simpson, 1953; Favour, Ritts and Bayles, 1956.

:"hard frills of arthritic growth on toe joints" of *Iguanodon*: Gardom and Milner, 1993.

:unsubstantiated in paper: Goldman, 1982; Harding, 1988 (*Tyrannosaurus*).

:Upper Jurassic sauropod *Diplodocus* [actually DISH]: Look, 1955; Michard, 1992.

:non-infectious erosive arthritis unknown in dinosaurs (mention only): Rothschild and Tanke, 1998a.

:"arthritic condition" possibly leads to fusions of cervical and dorsal vertebrae in Late Cretaceous *Tyrannosaurus*: Dingus, 1996.

:mention only (popular): Currie and Koppelhus, 1996.

:infectious spondylitis of vertebrae in Upper Jurassic sauropod *Apatosaurus*: Sokoloff, c. 1960.

See also: Talbot, 1978; Rothschild, 1988a; Lougheed, 1989; Rothschild, 1990; 1993; Daniel, 1997; Tanke, 1997a, b; Tanke and Rothschild, 1997; Rothschild and Tanke, 1998a; Anonymous, 2000d.

ASYMMETRY

In: slight bilateral asymmetry of braincase in unnamed Late Cretaceous "El Picacho Ceratopsian": Lehman, 1996.

:asymmetrical orbital horncore length in a new *Triceratops* skull: Kaye, 1997.

:asymmetry of frill in unspecified ceratopsians due to fracture early in life (popular): Currie and Koppelhus, 1996.

:asymmetrical fusion of the last cervical and first dorsal vertebra in a *Tyrannosaurus* specimen: Carpenter, 1990.

:minor asymmetries of frill of Late Cretaceous *Chasmosaurus*: Holmes, Forster, Ryan and Shepherd, 2001.

:"striking" asymmetry of Late Cretaceous *Troodon* braincase: Russell, 1969.

ATROPHY

In: atrophied ventral edge of squamosal in Late Cretaceous ceratopsian *Pachyrhinosaurus*; associated with other osteopathic defects and in other unspecified centrosaurine ceratopsians: Rothschild and Tanke, 1996, 1997.

AVIAN OSTEOPETROSIS

In: diagnosed in unidentified Romanian dinosaur specimen: Swin-

ton, 1934; Campbell, 1966; Swinton, 1970.

AVULSIONS (TENDON)

In: humerus of Late Cretaceous *Tyrannosaurus*: Larson, 1991; Anonymous, 1992c; Larson, 1994a,b; Anonymous, 1997e; Rothschild, 1997; Hanna, 2000 (see Laws); Carpenter and Smith, 2001; Larson, 2001b.

:"torn ligaments" in *Tyrannosaurus*: Smith, Peter, 1992.

:unspecified large theropod (mention only): Rothschild and Tanke, 1998a.

:pedal phalanx of subadult *Gorgosaurus*: Tanke, 1996f.

:avulsion injuries of manal and pedal phalanges of *Allosaurus*, *Albertosaurus*, *Tyrannosaurus*, *Tarbosaurus*, indeterminate tyrannosaurids, *Saurornitholestes*, indeterminate dromaeosaurids and *Chirostenotes* as evidence of an active predaceous lifestyle: Rothschild, Tanke and Ford, 2001.

:of adult Upper Jurassic *Camarasaurus* humerus: McWhinney, Carpenter and Rothschild, 2001.

:"hyper*ex*tension" of pedal digit in *Allosaurus* with damage to ungual: Hanna, 2000 (see Laws).

BACTERIA

Fossilization of/role as pathogens (see also SEPSIS): Moodie, 1918c; Goldman, 1982; Clarke and Barker, 1993; Hirsch, 1994b; Anonymous, 1996f; Benton, 2000.

BEHAVIOR

Unusual behavior or possible pathology exhibited in trackway:

:*Atreipus*-like animal with outward rotation of pes prints: Lingham-Solair and Broderick, 2000.

:dominance or territorial-related head and face-biting behavior in large theropods: Tanke and Currie, 1998 (2000).

:injuries in small theropods could be related to prey pursuit or capture: Hanna, 2000 (see Laws); Rothschild, Tanke and Ford, 2001.

BIOMINERALIZATION

Trueman, 1997.

BITE INJURIES (see also: Face-biting behavior under INTRASPECIFIC FIGHTING section)

:injury to fibula of Late Cretaceous *Tyrannosaurus rex* ascribed to possible "infection after a bite": Webster, 1999.

:fatal bite to *Tyrannosaurus* head: Larson, 1997.

:ankylosaur *Tarchia* skull with possible Tarbosaurus bite and associated post-trauma osteopathy: Gallagher, Tumanova and Dodson, 1998; Tumanova, Gallagher, Dodson and Axel, 1998.

:unhealed bitemarks (conspecific?) atop skull of *Velociraptor*: Norell, Gaffney and Dingus, 1995.

:possible bite wound affecting caudal neural spine in *Acrocanthosaurus*: Harris, 1997, 1998.

:supposed bite wounds on skulls of plant-eating dinosaurs related to intraspecific mating activities [unsubstantiated]: Droscher, 1976.

:healed predator damage, skull roof of *Kritosaurus*: Horner, 1992.

:healing predator damage, pubis of *Lurdusaurus*: Taquet and Russell, 1999.

:mid-caudal neural spines of Late Cretaceous hadrosaur *Edmontosaurus*, evidence of possibly bitten by *Tyrannosaurus*: Johnson and Stucky, 1995 (figured only); Carpenter, 1988a, 1998 (2000); Paty, 2001.

:*Edmontosaurus* skull with bite marks on both lower jaws and apparent signs of healing: Campagna, 2000.

BITE STRENGTH

Of *Tyrannosaurus*: Anonymous, 1996b,e; Erickson and Olson, 1996; Erickson, Van Kirk, Su, Levenston, Caler and Carter, 1996; Stokstad, 1996; Tchoe, 1996; Staedter, 1997; Douglas and Young, 1998; Erickson, 1999, 2000.

BLINDNESS

:as a factor contributing to dinosaur extinction: Croft, 1982; Benton, 1985, 1990.

:inferred in a *Pachyrhinosaurus* skull with a large circular lesion affecting face and orbital rim: Rothschild and Tanke, 1996, 1997.

:"poor vision" or blindness in the right eye of the Late Cretaceous *Tyrannosaurus* known as "Sue," due to intraspecific face-biting: Anonymous, 1996g.

BLOOD (FOSSILIZED)

In: *Tyrannosaurus*: Kiernan, 1993; Morrell, 1993b; Reid, 1993; Monastersky, 1995a; Schweitzer, Marshall, Carron, Bohle, Arnold, Buss and Starkey, 1996, 1996a; Horner and Dobb, 1997 [mention only].

Apatosaurus: Moodie, 1920; Reid, 1993.

Iguanodon: Seitz, 1907; Moodie, 1920; Reid, 1993.

Dinosaur: Moodie, 1923a; Swinton, 1934, 1970; Abbey, 1977; Talbot, 1978; Folger, 1993; Martill and Unwin, 1997 (dinosaur and ?pterosaur).

:dinosaur blood inside distended abdomen of 93 million year old biting midge from New Jersey, USA?: Anonymous, 1998a.

Evidence of fossil blood questioned: Martill and Unwin, 1997.

Heme compounds: Schweitzer et al., 1997a-c.

BODY TEMPERATURE

In: *Tyrannosaurus:* Millard, 1995.

BONE

Canaliculi: Pawlicki, 1984c; Schweitzer, 1993 (*Tyrannosaurus*).

Degeneration of: Upper Jurassic *Allosaurus* with unusually shortened and pointed (vs. blade-like) chevron with associated roughened bone texture attributed to possible "bone degeneration": Petersen, Isakson and Madsen, 1972.

Proteins: Wychoff, 1969.

Vascular impressions in: Saul and Saul, 1992, 1993 (non-dinosaur).

Vascular systems of: Pawlicki, 1983, 1984a.

X-Ray microanalysis of: Late Cretaceous ornithomimid *Gallimimus*: Pawlicki and Bolechala, 1987, 1991.

CALCIUM DEPLETION DUE TO EGG PRODUCTION

In: *Oviraptor*: Martill, Barker and Dacke, 1996.

Caution urged in these interpretations: Chinsamy and Barrett, 1997.

CALLUS (See FRACTURES)

CANCER (See also NEOPLASIA)

affecting: unspecified Upper Jurassic dinosaur bone: Anonymous, 1993b.

:affecting Upper Jurassic *Allosaurus* distal humerus: Graham, 1992; Greenburg, 1992; Taylor, 1992; Wycombe, 1992 [called a chondrosarcoma by last three authors]; Tanke and Rothschild, 1997; Hanna, 2000 (see Laws).

:"form of bone cancer" possibly leads to fusions of cervical and dorsal vertebrae in Late Cretaceous *Tyrannosaurus*: Dingus, 1996.

:mention only (popular): Currie and Koppelhus, 1996.

:metastatic cancer, unspecified Upper Jurassic dinosaur: Monastersky, 1999b; Rothschild, Witzke and Hershkovitz, 1999.

:pitting in some ceratopsian frills ".... looks suspiciously similar ...." to cancer: Anonymous, 2000d.

:metastatic cancer, osteoblastoma and desmoplastic fibroma in vertebrae of Late Cretaceous hadrosaurs: Rothschild, Helbling and Tanke, 2001.

CANNIBALISM

In: Late Cretaceous *Tyrannosaurus rex*: Naeye, 1996.

:Triassic *Coelophysis*: Fisher, 1981; Schwartz and Gillette, 1994.

:unspecified tyrannosaurids: Tracy, 1976; see editors comments in Jacobsen, 1995b; Jacobsen, 1998.

CARDIOVASCULAR SYSTEM

Late Jurassic *Barosaurus*: Choy and Altman, 1992; Norell, Gaffney and Dingus, 1995.

CARTOONS (POPULAR)

:unspecified sauropods having tails stepped on by conspecifics: Gonick, 1978.

:*Tyrannosaurus* being bitten by mosquito: Rubin, 1998.

:*Tyrannosaurus* afflicted with gout: Hecht, 1996; Begley, 1997; Okino, 1997; Weintraub, 1998.

CAT (CT) SCANNING and RELATED TECHNOLOGIES

:utilization of on Late Cretaceous *Tyrannosaurus rex* skull: Bakker, 1992.

:study of fused sauropod (*Apatosaurus*, *Camarasaurus* and *Diplodocus*) caudal vertebrae: Rothschild and Berman, 1991.

:Late Cretaceous ankylosaur *Tarchia* skull: Gallagher, Tumanova and Dodson, 1998; Tumanova, Gallagher, Dodson and Axel, 1998.

:UNIX: Manz, 1992.

:MRI (magnetic resonance imaging): Sebes, Langston, Gavant and Rothschild; Rothschild, 1995, 1997.

:dinosaur eggs: Zuo and Jing, 1995.

:general comments/discussions: Leitch, 1988; Rothschild, 1995; Gould, Marcus, Gueziec, Daleo and Reddy, 1996; Rothschild, 1997; Tanke and Rothschild, 1997; Kappleman, 1998 (lasers, hi resolution x-ray, CT, hard copy output and animations).

:Late Cretaceous *Tyrannosaurus rex* "Sue" skull: Webster, 1999.

CHOKING

In: Upper Jurassic sauropod *Seismosaurus* possibly chokes on a large gastrolith (stomach stone): Begley and Yoffe, 1991; Gore, 1993; Lessem and Glut, 1993; Christiansen, 1996a.

Important note: Lucas, 2000 refutes that these gastroliths are actually genuine gastroliths and nothing more than cobbles that have washed into the carcass. If true, this would negate the choking hypothesis. See the following paper: Lucas, S.G. 2000. The Gastromyths of "*Seismosaurus*," A Late Jurassic Dinosaur from New Mexico. pp. 61-67. In: Dinosaurs of New Mexico. Edited by S.G. Lucas and A.B. Heckert. New Mexico Museum of Natural History and Science Bulletin No. 17. 230 pp.

:Antarctic Jurassic theropod *Cryolophosaurus* found with several lengths of prosauropod ribs lodged in the throat region= death by choking?: Hammer and Hickerson, 1993; Anonymous, 1994c; Hammer, Hickerson and Slaughter, 1995; Hammer, 1997; Lore, 1998.

COLLAGEN

In: unspecified prosauropod: Isaacs, Little, Currey and Tarlo, 1963.

:Late Cretaceous *Tyrannosaurus*: Schweitzer, 1993; Schweitzer, Cano, Starkey and Horner, 1994; Schweitzer et al., 1997.

:unspecified Late Cretaceous dinosaur: Pawlicki, Korbel and Kubiak, 1966.

:dinosaurs (general discussion): Bocherens, 1997.

COLOR VARIATIONS; PATHOLOGIC VS. NON-PATHOLOGIC BONE

In: Late Cretaceous *Albertosaurus*; face-bite lesions show yellowish-colored "halos" surrounding some wounds: Tanke and Currie, 1998 (2000); see also comments in Keiran, 1999 entry.

CONGENITAL DEFECTS

In: dinosaur footprints showing missing toes- ?congenital abnormality?: Thulborn, 1990.

:lateral curvature of cervical neural spines in Middle Cretaceous *Acrocanthosaurus;* not post-mortem crushing; congenital?: Harris, 1997, 1998.

:hemi-vertebra wedge in embryonic Late Cretaceous hadrosaur *Hypacrosaurus*

:congenitally twisted metatarsal in hatchling hadrosaur *Maiasaura*: Horner and Gorman, 1985, 1988; Young, 1980; Tanke and Rothschild, 1997.

COPROLITES

Chin, 1991, 1994, 1996, 1997; Chin, Tokaryk, Erickson and Calk, 1998.

CREATIONIST VIEWPOINT

Helder, 1991, 2000.

CYSTS

In: sagittal crest rim of Late Cretaceous small theropod *Troodon*: Currie, 1985.

:dinosaurs (general discussion): Rothschild, 1988a.

:ceratopsian *Pachyrhinosaurus* skull (facial/orbital region): Spinar and Currie, 1994; Rothschild and Tanke, 1997.

:Late Cretaceous ceratopsian *Torosaurus* squamosal: Moodie (in Lull, 1933).

DEFORMITIES

:vertebrae in Early Cretaceous *Iguanodon* following healing of fractures: Anonymous, 1995d; Hawkes, 1995.

:"Crooked Leg" a hatchling Upper Cretaceous hadrosaur *Maiasaura*, so named because of a congenitally deformed (club-footed) metatarsal: Horner and Gorman, 1985, 1988; see also Young, 1980.

DENTAL ANOMALIES (see TOOTH/TEETH)

DIFFUSE IDIOPATHIC SKELETAL HYPEROSTOSIS (DISH)

In: Upper Jurassic sauropod *Diplodocus*: Hatcher, 1901; Osborn, 1904; Holland, 1906; Moodie, 1919b; 1927; Gilmore, 1930; Schlumberger and Lucke, 1948; Ackerknecht, 1953; Stolk, 1958 [who called it a hemangioma]; Blumberg and Sokoloff, 1961; McIntosh, 1977; Machotka, 1984; Rothschild, 1985b, 1987a, 1988c; Rothschild and Berman, 1991; Michard, 1992; Rothschild and Martin, 1992; Rothschild and Tanke, 1992; Rothschild, 1994; Christiansen, 1996b; Rothschild, 1997; Rothschild and Tanke, 1998b.

:Upper Jurassic sauropod *Apatosaurus*: Gilmore, 1936; Blasius and Kaiser, 1980; Rothschild, 1985b, 1987a, 1988c; Rothschild and Tanke, 1992; Rothschild, 1994; Christiansen, 1996b; Rothschild, 1997; Myhrvold and Currie, 1998.

:Upper Jurassic sauropod *Camarasaurus*: Moodie, 1919b; Hagood, 1971/2; McIntosh, 1977; Rothschild, 1987a; Rothschild, 1994; McIntosh, Miles, Cloward and Parker, 1996; Rothschild, 1997.

:Upper Jurassic *Allosaurus*: Rothschild, 1987a.

:unidentified sauropod: Moodie, 1916, 1918a; Gonick, 1978.

:possible occurrence in Late Cretaceous ceratopsian *Pachyrhinosaurus*: Olinger, 1987a.

:fusions of caudal vertebrae/chevron in *Allosaurus* and caudal vertebral fusion in *Camptosaurus* attributed to "neoplastic ankylosis" of traumatic origin or "rheumatoid arthritis" [=DISH]: Petersen, Isakson and Madsen, 1972.

:hadrosaurs, ceratopsians, pachycephalosaurs, *Apatosaurus*: Zhuo, 2000.

:general discussion: Rothschild, 1985a.

General comments: Simpson, 1953 (incorrectly called arthritis); Rothschild, 1987a; McGowan, 1991; Rothschild and Martin, 1992; Rothschild, 1997; Tanke, 1997a, b; Tanke and Rothschild, 1997; Rothschild and Tanke, 1998a.

DISEASE

:causes or contributes to the extinction of dinosaurs: Simpson, 1953; Raymond, 1958; Spieker, 1960; Battaglia, 1979; Bakker, 1986; Benton, 1990; Lidner, 1992; Gore, 1993; Horner and Dobb, 1997.

:"diseased" metatarsal IV and digit III ungual and distal articulating end of penultimate phalanx (the former "small and amorphous," the latter similar but less so) in a specimen of *Gorgosaurus*: Lambe, 1917.

:diseased *Triceratops* bones (no other details given): Russell, 1989.

:"damage or disease" to distal caudal vertebrae of the sauropod *Cetiosaurus*: Moodie, 1923a; Swinton, 1965b.

:parietal of Late Cretaceous ceratopsian *Pachyrhinosaurus*: Tanke, 1989b.

:possibly causing extra openings in ceratopsian frills: Lull, 1933.

:possibly causing exostosis development in Upper Jurassic *Allosaurus* scapula blade: Anonymous, 1998f.

"DISH" (see DIFFUSE IDIOPATHIC SKELETAL HYPEROSTOSIS)

"DIVOTS" (OSTEOCHONDRAL DEFECTS AFFECTING HADROSAUR PEDAL PHALANGES)

:Tanke, 1989a; Rothschild, 1997; Rothschild and Tanke, 1998a.

DNA STUDIES

Rothschild, 1989a; Cherfas, 1990, 1991; Anonymous, 1993a (mention only); Begley, 1993; Paabo, 1993; Schweitzer and Cano, 1994 (*Tyrannosaurus*); Schweitzer, Cano, Starkey and Horner, 1994 (*Tyrannosaurus*); Woodward, Weyand and Bunnell, 1994; Anonymous, 1995a,b,c; Hong, 1995 (rDNA from dinosaur eggs); Currie, 1996 (eggs); Bocherens, 1997 (mention only); Horner and Dobb, 1997 (*Tyrannosaurus*, mention only); Parrish, 1997 (overview); Schweitzer and Lessem, 1997 (discussion); Irwin, 1998 (failure of research to confirm dinosaur and fossil DNA).

DNA STUDIES POPULAR AND/OR REFUTED

Pellegrino, 1985; Johnson, 1991a,b; Kiernan, 1993; McAuliffe, 1993; Morell, 1993b; Lewin, 1994; Aldhous, 1995; Allard, Young and Huyen, 1995; Anonymous, 1995b; Hedges and Schweitzer, 1995; Henikoff, 1995; Marshall, 1995; Monastersky, 1995; Norell, Gaffney and Dingus, 1995; Zischler, Hoss, Handt, von Haesler, van der Kuyl, Goudsmit and Paabo, 1995.

ECTOPARASITES

:activities of affecting dorsal surfaces of scutes of Early Cretaceous ankylosaur *Stegopelta* and unspecified Late Cretaceous ankylosaurs from Alberta, Canada?: Moodie, 1910; Tanke in Moodie, 1910; Tanke in Blows, 2001.

:Late Cretaceous unspecified ankylosaur scutes with crater-like depressions - = to ectoparasite damage?: Tanke and Rothschild, 1997.

:activities of affecting dorsal surfaces of scutes of a new genus(?) of Late Campanian nodosaur and undescribed polacanthid material: Ford, Kirkland and Elder, 1998.

:possible parasite activities leave lesions on fused sacral shield of Early Cretaceous *Gastonia*: Kirkland, 1998.

:Lower Cretaceous bird feather with ?mite eggs attached; some dinosaurs similarly affected?: Anonymous, 1999a; Martill and Davis, 1998a,b; Martill, 2001.

:90-94 million year old tick in amber, New Jersey, USA: Anonymous, 2001b; Klompen and Grimaldi, 2001.

EGGS

"Bad" eggs: Albritton, 1989.

Chemical analysis of eggs vs. pathological condition: Dauphin, 1991; Zhao, 1991; McNamara, 1992b.

Columnar layer with malarranged crystalline calcite:

:Late Cretaceous *Elongatoolithus andrewsi*: Zhao et al., 1991.

Eggshell formation: Trueman, 1997.

Eggshell pathology from Upper Jurassic of Utah, USA more like that of extant Turtles than Birds; evolutionary dino-bird relationship thus questioned: Feduccia, Martin and Simmons, 1996.

Extra spherites:

:Late Cretaceous hadrosaurine *Maiasaura* eggshell: Carpenter, 1999, 2000.

General mentions/discussions of: Carpenter, Hirsch and Horner, 1994a; Zelenitsky, 1995; Carpenter, 1999; 2000.

High Iridium content: Tazaki, Aratani, Noda, Currie and Fyfe, 1994.

Multilayering of eggshell:

:Cretaceous sauropod *Hypselosaurus*: Dauphin and Sirugue, 1958a; Anonymous, 1969 (up to 7 layers); Erben, Hoefs and Wedepohl, 1979; Albritton, 1989; Dauphin, 1991; Rothschild, 1997; Tanke and Rothschild, 1997.

:unspecified Upper Jurassic dinosaur, Utah, USA: Anonymous, 1989a,b; Sobel, 1989.

:egg pathology (multilayering) in extant emydid Turtles (subfamily: Batagurinae) and implications for multilayered eggshells in dinosaurs: Ewert, Firth and Nelson, 1984.

:Jurassic and Cretaceous dinosaur eggs: Hirsch, 1989a,b; 1994a,b; Hirsch, Stadtman, Miller and Madsen, 1988, 1989; Madsen, 1991.

:dinosaur eggs from India: Mohabey, 1984; Jain, 1989.

:Maestrichtian-aged dinosaur eggs, France: Kerourio, 1981.

:unidentified Senonian-aged dinosaur: Sochava, 1971.

:comments on normal "avian-like" Late Cretaceous small theropod *Troodon* eggshell to pathological multilayering of eggshell in contemporaneous dinosaurs; thereby suggesting a more reptile-like oviduct system in the latter: Varricchio, Jackson, Borkowski and Horner, 1997.

:*contra* to the above: Jackson, Solomon and Varricchio, 1998.

:in Late Cretaceous *Spheroolithus albertensis*: Zelenitsky and Hills, 1997.

:in Late Cretaceous *Megaloolithus khempurensis:* Mohabey, 1998.

:in *Megaloolithus* sp.: Carpenter, 1999.

:Late Cretaceous *Macroolithus yaotunensis; M. rugustus* and *M. sp.*: Zhao et al., 1991.

:general discussion: Carpenter, 2000; Hirsch, 2001.

Thickening of eggshell

:*Macroolithus* species: Zhao et al., 1991.

:unspecified titanosaur; 2 or more superimposed layers: Jackson, Garrido and Loope, 2001.

:general discussion: Carpenter, 2000; Hirsch, 2001.

Thinning of eggshell

:Anonymous, 1972; Erben, 1972; Desmond, 1976; Swain, 1976; Cruickshank, 1977; Oelofsen, 1978; Zhao, 1978; Erben, Hoefs and Wedepohl, 1979; Anonymous, 1982; Penner, 1983, 1985; Balsai, 1987; Hirsch, 1989a, unpublished ms.; Benton, 1990; Dauphin, 1990; Zhao, 1994; Tanke and Rothschild, 1997; Hirsch, 2001.

:Cretaceous sauropod *Hypselosaurus*: Erben, Hoefs and Wedepohl, 1979; Anonymous, 1982; Williams, Seymour and Kerourio, 1984; Albritton, 1989; Benton, 1990; Hirsch, 2001.

:unspecified sauropod, France [probably Late Cretaceous, *Hypselosaurus*]: Anonymous, 1972.

:unspecified ceratopsian: Swain, 1976.

:miscellaneous oospecies: Zhao et al., 1991.

:general discussion: Carpenter, 2000.

Thinning eggshell, type(s) unspecified: Desmond, 1976; Cruickshank, 1977; Oelofsen, 1978.

Unspecified pathological condition(s): Jain, 1986; Zeng and Zhang, 1979; Vianey-Liaud, Jain and Sahni, 1987.

EMBEDDED FOREIGN OBJECTS

:*Tyrannosaurus* tooth fragment found embedded in pathologic *Tyrannosaurus* cervical rib: Burnham, 1992; Larson, 1992, 1995; Monastersky, 1995b; Anonymous, 1996g (listed as being embedded in a cervical vertebra); Tanke, 1996g (refuted); Anonymous, 1997d,f; DeFeo, 1997; Olert, 1997; Larson, 2001b; Perkins, 2001 (refuted).

EMBRYOGENESIS

McLean, 1995; Horner, 1997.

EPIMELETIC RESPONSE (CARE OF INJURED/SICK ANIMALS BY CONSPECIFICS/MATE)

:Late Cretaceous tyrannosaur *Tyrannosaurus*: Larson, 1992; Anonymous, 1996c; Anonymous, 1997e; Larson, 1997, 2001a,b; refuted by Rega (in Perkins, 2001).

:Late Cretaceous hadrosaur *Maiasaura* hatchling: Young, 1980.

:Late Cretaceous tyrannosaur *Albertosaurus*: Felber, Currie and Sovak, 1998.

:caution urged in such interpretations: Tanke and Rothschild, 1997.

EROSIVE OSTEOPATHY

:jaws of *Tyrannosaurus*: Gevock, 2001; Rega and Brochu, 2001.

EXOSTOSIS

:associated with healing fibula fracture in *Tyrannosaurus rex*: Anonymous, 1991b.

:on ischium of Late Jurassic sauropod *Seismosaurus* (might actually represent tendons): Gillette, 1991.

:ventral surface of *Triceratops* scapula: Gilmore, 1919a; Moodie, 1923a; Romer, 1924; Rothschild, 1997.

:anterior edge of neural spine of 3rd caudal vertebra in Early Cretaceous *Acrocanthosaurus:* Stovall and Langston, 1950.

:extra bone growth affecting *Allosaurus* pedal phalanx: Madsen, 1976a.

:*Allosaurus* scapula; [associated with a traumatic fracture]: Moodie, 1917; Rothschild, 1987b; Rothschild and Martin, 1992; Rothschild, 1997; Anonymous, 1998f; Zhuo, 2000.

:smooth, gently cratered, low, rounded knob on external surface of scapula, Late Cretaceous ceratopsian *Pachyrhinosaurus*: Olinger, 1987b; Tanke, 1989b.

:unspecified large theropods (mention only): Rothschild and Tanke, 1998a.

:endplate destruction and spur-like exostosis on cervical vertebra and bone spur on articulating surface of quadrate in the Late Cretaceous ceratopsian *Pachyrhinosaurus*: Tanke, 1989b, submitted b.

:collar-like exostosis affecting proximal periarticular region of an Upper Jurassic *Allosaurus* pedal phalanx: Travsky, 1996.

:"exostotic development" associated with caudal vertebrae fracture in Late Cretaceous *Tyrannosaurus*: Anonymous, 1997e.

:cervical vertebra in Late Cretaceous *Tyrannosaurus* "immobilized" by "extra bone growth": Anonymous, 1997f.

:"small bony lump" affecting unspecified region of lower jaw in Late Cretaceous *Tyrannosaurus*: Anonymous, 1996g.

:mushroom-like growth affecting pedal phalanx of *Gorgosaurus*: Keiran, 1999.

:*Triceratops* dentary: Rothschild, 1997; Zhuo, 2000.

EXTINCTION

As a result of comet impact: Hsu, 1980.

As a result of disease: Simpson, 1953; Spieker, 1960; Colbert, 1961; Cooper and Jackson, 1981; Colbert, 1983; Lidner, 1992.

As a result of Oxygen depletion: Hecht, 1993.

As a result of toxins in newly evolved Late Cretaceous plants: Tiffney, 1989 (reply to Bakker's suggestion).

EXTRA OPENINGS (SUPERNUMERARY FONTANELLES) IN FRILLS OF HORNED DINOSAURS (see also PUNCTURES)

Hatcher, 1905; Lull (in Hatcher, 1905); Lull, 1905; Gilmore, 1906, 1920b; Parks, 1925; Wieland, 1925; Wiman, 1930; Lull, 1933; Gilmore, 1935; Geis, 1959, 1960; Erickson, 1966; de Camp and de Camp, 1968; Tyson, 1977; Mateer, 1981; Rowe, Colbert and Nations, 1981; Sattler, 1981; Tyson, 1981; Glut, 1982; McGinnis, 1982; Godfrey and Holmes, 1995; Ostrom and Wellnhofer, 1986; Tokaryk, 1986; Berghaus and Gabriel, 1988; Dixon, Cox, Savage and Gardiner, 1988; Johnson, 1989; Russell, 1989; Dodson and Currie, 1990; Farlow, 1990; Forster, 1990a; Lehman, 1990; Reid, 1990a; Various authors, 1990; Lessem, 1992; Lessem and Glut, 1993; MacLeod, 1994; Olshevsky, 1994; Spinar and Currie, 1994; Godfrey and Holmes, 1995; Johnson and Ostrom, 1995; Clos, 1996; Dodson, 1996; Forster, 1996a,b; Rothschild and Tanke, 1997; Anonymous, 1999b; Glut, 2000; Hanna, 2000 (see Laws); Holmes, Forster, Ryan and Shepherd, 2001; Tanke, submitted b; Tanke and Farke, ms.

FALLS RESULTING IN INJURIES OR DEATH

:*Allosaurus*: Hecht, 1998.

:*Sinraptor*: Tanke and Currie, 1998.

:*Tyrannosaurus*: Alexander, 1996; Hecht, 1995; Anonymous, 1996a; Farlow, Smith and Robinson, 1995; Douglas and Young, 1998; Hecht, 1998 (non-fatal); Paul, 1998 (2000); Young, 1998; Larson, 2001b.

:unspecified Campanian tyrannosaurid: Grierson, 1998.

:*Iguanodon*: Blows, 1978, 1989.

FEATHERS

?Mite eggs attached to Lower Cretaceous bird feather (some dinosaurs affected too?): Anonymous, 1999a; Martill and Davis, 1998a,b; Martill, 2001.

FOOTPRINTS

Footprints showing injuries to foot:

Jurassic *Eubrontes*: Abel, 1935.

:*Sauroidichnites abnormis*: Hitchcock, 1844.

:unidentified mid-Jurassic small theropod, Morocco: Ishigaki, 1986a,b; 1988.

:unspecified: Thulborn, 1990; Tanke and Rothschild, 1997.

:prosauropod *Anchisauripus*; malformed toe: Tucker and Burchette, 1977.

Limping dinosaur trackways:

In: Upper Jurassic theropod, Moab, Utah, USA: Anonymous, 1991c.

:unidentified mid-Jurassic small theropod, Morocco: Jenny and Josen, 1982; Ishigaki, 1986a,b; 1988.

:unidentified sauropod: Ishigaki, 1989.

:*Caririchnium leonardii*: Lockley, Matsukawa and Hunt, 1993; Lockley and Hunt, 1995; Hunt and Lucas, 1998.

:small theropod *Skartopus*: Wade, 1989.

:unspecified dinosaur, site KB-17, Koum Basin, Cameroon: Jacobs, 1993.

:various occurrences: Thulborn, 1990; Lockley, 1991; Lockley, Matsukawa and Hunt, 1993; Lockley, Hunt, Moratalla and Matsukawa, 1994 (bipedal and quadrupedal dinosaurs); Tanke and Rothschild, 1997 (general comments); Lockley, 1999 (general comments).

:rock strain deforms rock and dinosaur tracks, thus creating abnormal appearing tracks and "limping dinosaur trackway" sites: Schulp and Brokx, 1999.

FORENSICS

Rowe, 1990.

FRACTURES (BONE); BY BODY REGION/BONE ELEMENT

Cranial/mandibular ramus:

:?unilateral jaw fracture *Gorgosaurus libratus*, TMP91.36.500: Tanke, 1996f; Tanke and Currie, 1998 (2000).

:fractured and healed horncore in Late Cretaceous *Triceratops*: Benes and Burian, 1979; 1982.

:jaws of Late Cretaceous ceratopsians: Gilmore, 1920b.

:orbital horncore, distal portion lost premortem: Hatcher, Marsh and Lull, 1908.

:skulls of Late Cretaceous *Triceratops*: Swinton, 1934; Camp, 1968; Swinton, 1970; *Triceratops* horncores); Burton and Dixon, 1984; Tokaryk, 1986 (transverse fracture of parietal and associated frill trauma); Martill and Naish, 2000.

:horncore of *Triceratops*: Gilmore, 1919a, 1920b; Moodie, 1923a; de Camp and de Camp, 1968; Gurney, 1992 (science fiction), 1995 (science fiction).

:"*Labrosaurus*" dentary missing anterior end; etiology undetermined: Gilmore, 1920.

:nasal boss in ceratopsian *Pachyrhinosaurus* =snapped off nasal horncore: Norman, 1985.

:parietals of *Pachyrhinosaurus*: Olshevsky, 1988; Tanke, 1989b.

:left lateral parietal of *Centrosaurus* specimen: Parks, 1921.

:orbital horncore, Late Cretaceous ceratopsian *Chasmosaurus* [=fracture?]: Sternberg, 1927.

:right parietal (with fontanelle closure) of Late Cretaceous ceratopsian "*Monoclonius lowei*" [actually a preservational artifact only?]: Sternberg, 1940.

:orbital horncore tip of an unspecified ceratopsian [cf. *Anchiceratops*] with pseudoarthrosis development: Rothschild and Tanke, 1992.

:*Triceratops* dentary: Moodie, 1923a; Swinton, 1934, 1970.

:hadrosaur dentary; frills of ceratopsians, resulting in asymmetry: Currie and Koppelhus, 1996.

:unspecified ceratopsian frill fractures: Rothschild, 1997.

:bilateral dentary fractures and effect on tooth development: Tanke and Rothschild, 1997.

Shoulder girdle:

:*Allosaurus* scapula: Gilmore, 1915; Moodie, 1917, 1923a; Swinton, 1934, 1970; Anonymous, 1998f.

:*Triceratops* scapula with massive exostosis development: Gilmore, 1919a; Romer, 1924; Rothschild, 1997.

:furculum of *Tyrannosaurus*: Larson, 2001b.

:scapula (and humerus) in Late Cretaceous *Ornithomimus* following high speed fall which shatters shoulder region: Keiran, 2001.

Forelimbs:

:severe transverse fracture of humerus of unspecified hadrosaur [AMNH 5207; also plaster cast TMP98.11.1]: Moodie, 1919b, 1923a; P, 1924; Macdonald and Sibley, 1969; Swinton, 1970.

:crush fractures of humeri in Late Cretaceous tyrannosaurids *Daspletosaurus* and *Gorgosaurus*: Russell, 1970; Vance, 1989; Rothschild, 1994; Hanna, 2000 (see Laws).

:radius of Upper Jurassic *Allosaurus*: Petersen, Isakson and Madsen, 1972; Madsen, 1976a; Molnar and Farlow, 1990.

:humeri of *Gorgosaurus* and *Allosaurus*: Molnar and Farlow, 1990.

:metarcarpals of hadrosaur *Anatosaurus* with marked angulation and infection: Moodie, 1926b; Rothschild and Martin, 1992.

:ulna in Late Cretaceous *Oviraptor*: Norell, Clark, Chiappe and Dashzeveg, 1995; Popeo, 1996; Zimmer, 1997; Clark, Norell and Chiappe, 1999.

:radii of unspecified Late Cretaceous hadrosaurs: Tanke, 1989a.

:fusion of unspecified Late Cretaceous hadrosaur radius/ulna following mid-length fracture of both elements: Tanke, 1996b.

:"damaged finger" in Upper Jurassic *Allosaurus*: Travsky, 1996.

:well healed humerus fracture, *Allosaurus*: Petersen, Isakson and Madsen, 1972.

:leg fracture implied based on histology sample of *Tyrannosaurus* limb bone: Horner and Lessem, 1993.

:manal pathology in DPP hadrosaurs unknown; healed/healing fractures of metacarpals in *Edmontosaurus* and *Anatosaurus*; fractured humerus in *Hypacrosaurus*: Tanke, 1996e.

:*Allosaurus*, second finger of right hand, broken and twisted, later on becoming infected; the injury possibly related to prey capture: Hanna, 2000 (see Laws).

:humerus (and scapula) in Late Cretaceous *Ornithomimus* following high speed fall which shatters shoulder region: Keiran, 2001.

Vertebrae/Tendons:

:neck of *Tyrannosaurus*: Larson, 2001b.

:cervical vertebra in cf. *Centrosaurus*: Tanke and Larsson, manuscript.

:proximal caudal neural spines, unspecified Late Cretaceous hadrosaurs: Sternberg, 1921; Tanke, 1989a; Anonymous, 1994a; Rothschild, 1994; Kawakami, 1996; Tanke, 1996e; Rothschild, 1997.

:dorsal neural spines in Late Cretaceous hadrosaur *Parasaurolophus*: Parks, 1922; Lull and Wright, 1942; Tanke, 1989a, submitted a.

:broken and healed vertebrae in Early Cretaceous *Iguanodon*: Anonymous, 1995d; Hawkes, 1995.

:proximal caudal neural spines, *Camptosaurus*: Rothschild, 1997.

:possible broken neural spine in 11th caudal in *Acrocanthosaurus*: Stovall and Langston, 1950.

:broken and healed proximal caudal neural spine tip, with angulation; *Lambeosaurus*: Morris, 1976, 1981.

:trampled and crushed distal caudal vertebrae in Late Cretaceous hadrosaurids: Tanke, 1989a (with associated post-trauma fusions); Begley and Yoffe, 1991; Grant, 1991; Wright, 1991; Westrup, 1992; Struzik, 1993; Rothschild, 1997; Tanke and Rothschild, 1997.

:tail of Late Cretaceous *Tyrannosaurus rex*: Burnham, 1992; Smith, Peter, 1992; Anonymous, 1996g; Anonymous, 1997e (crushed/fractured caudal vertebrae).

:compression fracture of dorsal vertebra (centrum) in Upper Jurassic *Camptosaurus*: Erickson, 1988.

:*Becklespinax* neural spines: Lessem and Glut, 1993.

:dorsal neural spines 10 and 11 of large theropod *Monolophosaurus*, with fusion: Zhao and Currie, 1993.

:"clubbing" of ends of proximal caudal neural spines in Asian lambeosaurine hadrosaur *Barsboldia* [= pathological healed fractures; *sensu* Alberta, Canada hadrosaur material?]: Maryanska and Osmolska, 1981.

:abnormal angulation of dorsal neural spines 5-7 with fusion at tips (with associated rib fracture trauma) in Late Cretaceous hadrosaur *Parasaurolophus*: Parks, 1922.

:hypothetical tail fracture in *Deinonychus*: Psihoyos, 1994.

:"peculiar terminal vertebrae" [ie. distal caudals] in an unspecified Late Cretaceous hadrosaur [presumably an example of crush (trampled) fracturing]: Sternberg, 1921.

:"damage or disease" to extreme distal caudal vertebrae of the sauropod *Cetiosaurus*: Swinton, 1965b; fractured according to Woodward, 1905.

:marked lateral curvature of neural spine of ?16th caudal vertebra in *Acrocanthosaurus*, also possible associated healing bite wound (tooth puncture): Harris, 1997, 1998.

:fused sauropod caudals = healed fracture [actually DISH]: Moodie, 1918a.

:possible healing neural spine fractures in *Spinosaurus* (type specimen): Stromer, 1915.

:trauma to mid-caudal neural spines in Late Cretaceous hadrosaur *Edmontosaurus*: Johnson and Stucky, 1995.

:crush fractures of distal caudal vertebrae in unspecified Late Cretaceous hadrosaurs, Alberta, Canada: Milstein, 2000.

:neural spines of unspecified dinosaurs: Anonymous, 2000d.

:crush fractures of distal caudal centra into 2-5 pieces which later fused together: Tanke, 1996e; 1997a.

:as above, but with two vertebrae fusing together at odd angles, imparting a kink to the tail: Tanke, 1996e.

:*Allosaurus* basal tail region show fracture callus with much bone remodelling suggesting the wound had healed over "several years": Hanna, 2000 (see Laws).

:*Allosaurus* with cervical and basal caudal vertebrae fractures (might not be truly pathological): Ayer, c. 2000.

:fused distal caudal vertebrae in *Tyrannosaurus* "Sue" possibly related to intraspecific trampling: Larson, 2001b.

:healed tendon fractures in unspecified Late Cretaceous hadrosaurs: Tanke, 1989a.

Ribs/Gastralia:

:left posterior dorsal ribs in Upper Jurassic *Sinraptor dongi:* Tanke and Currie, 1998 (2000).

:imperfectly healed cervical rib, Late Cretaceous *Tyrannosaurus rex:* Anonymous, 1992c; Smith, Peter, 1992.

:double-fracture of dorsal rib in shaft Late Cretaceous hadrosaur cf. *Edmontosaurus*: Anonymous, 1994a.

:ribs of Upper Jurassic *Brachiosaurus*: Kaiser, 1954b; Blasius and Kaiser, 1980.

:unspecified sauropod ribs: Rothschild, 1997.

:Upper Jurassic *Apatosaurus*, one forming a pseudoarthrosis: Swinton, 1934, 1970; Chenoweth, 1987.

:gastralia basket (some fractures forming pseudoarthroses) in Upper Jurassic *Allosaurus*: Gilmore, 1920; Claessens, 1996, ms.

:4 dorsal ribs in "Big Al," an *Allosaurus*: Hanna, 2000 (see Laws); Anonymous, 2001a.

:several bilateral dorsal ribs with well healed fractures and one gastralium with imperfectly healed fracture forming a pseudoarthrosis in Late Cretaceous tyrannosaurid *Gorgosaurus*: Currie, 1997a.

:right 3rd dorsal rib and 13th and 14th right gastral ribs of Late Cretaceous *Gorgosaurus*: Lambe, 1917.

:rib(s) *Tyrannosaurus*: McGinnis, 1982; Larson, 1991; Dingus, 1996; Anonymous, 1997e,f; Avila, 1998; Anonymous, 2000b; Brochu, 2000; Gevock, 2001; Larson, 2001a, b (3 in a line, one infected and with an embedded *Tyrannosaurus* tooth fragment and showing post-trauma pseudoarthrosis development); Perkins, 2001; Rega and Brochu, 2001.

:two right dorsal ribs; unspecified lambeosaurine hadrosaur, Alberta, Canada: Lowey, 1992.

:posterior dorsal ribs in ceratopsians *Centrosaurus* and *Pachyrhinosaurus*: Rothschild, 1994.

:dorsal rib fractures in Late Cretaceous hadrosaurs *Edmontosaurus* (single fracture); *Prosaurolophus* and *Parasaurolophus* (multiple contiguous fractures): Lull and Wright, 1942; Tanke, 1996e.

:ribs in Late Cretaceous ceratopsian *Chasmosaurus* and uncrested hadrosaur *Prosaurolophus*; both from Alberta, Canada: McGowan, 1983; Cronkite, 1991; McGowan, 1991.

:possible cervical rib fracture in *Megalosaurus*: Owen, 1856.

:rib fractures in Late Cretaceous hadrosaur *Parasaurolophus* (with associated vertebral anomalies): Parks, 1922.

:rib fracture in Late Cretaceous hadrosaur *Edmontosaurus*: Parks, 1935.

:rib fractures in Upper Jurassic sauropod *Apatosaurus*: Riggs, 1903.

:gastral rib fracture, *Plateosaurus*: Sander, 1992.

:rib fractures (some in series; i.e. type of *Parasaurolophus)* in unspecified Late Cretaceous hadrosaurs: Tanke, 1989a.

:Late Cretaceous ceratopsian *Pachyrhinosaurus*; mid and posterior dorsal rib fractures most common pathology observed in this genus/subfamily: Anonymous, 1989c; Struzik, 1989; Tanke, 1989b; Westrup, 1992; Tanke, 1996c.

:several healing rib fractures in Upper Jurassic *Allosaurus*: Travsky, 1996.

:ribs in Upper Jurassic *Allosaurus* and Late Cretaceous *Tyrannosaurus*; related to falling while running: Anonymous, 1996h (14 ribs, *Allosaurus*); Hecht, 1998, Anonymous, 2000c.

:gastral rib fracture, unspecified Campanian tyrannosaur: Grierson, 1998.

:multiple dorsal rib fractures, one forming a pseudoarthrosis, possible pseudoarthrosis of gastralia. One dorsal showing possible healing bite mark (tooth puncture), *Acrocanthosaurus*: Harris, 1997, 1998.

:rib fracture, Late Cretaceous *Daspletosaurus* (possible new species): Williamson and Carr, 1999.

:ribs, *Gorgosaurus:* Rothschild, 1997.

:ceratopsian ribs in TMP collections showing pseudoarthrosis development: Tanke, 1996g.

:most common type of pathology seen in ceratopsians: Hanna, 2000 (see Laws).

:gastral basket in *Tyrannosaurus*: Larson, 2001b.

Pelvic girdle:

:fusion of right ilium and ischium in Lower Cretaceous *Iguanodon*: Blows, 1978, 1989.

:ischial fracture in Early Cretaceous *Iguanodon*: Swinton, 1934, 1970; Cooper and Jackson, 1981; Norman and Milner, 1989; Gardom and Milner, 1993; Rothschild, 1997.

:ischia of unspecified Late Cretaceous hadrosaurs: Tanke, 1989a.

:large hole in ilium of Upper Jurassic *Allosaurus* "caused by a blow," pus draining sinus evident: Travsky, 1996.

:pelvic fractures in iguanodonts and hadrosaurs: Tanke and Rothschild, 1997.

:"broken hip bones" of unspecified dinosaurs: Anonymous, 2000d.

:serious, but not immediately fatal bilateral ischial fracture, unspecified lambeosaurine: Tanke, 1996e.

Hind limbs:

:leg (unspecified) [in these cases of the fibula]: *Tyrannosaurus rex*: Burnham, 1992; Smith, Peter, 1992; Monastersky, 1995b; Olert, 1997; Larson, 2001a.

:unspecified theropod limb and foot fractures: Rothschild, 1997.

:tibia, unspecified Early Cretaceous hypsilophodontid [later determined to be osteomyelitis only]: Rich and Rich, 1990; Monoghan, Rich and Rich, 1991.

:tibia and metatarsus of *Syntarsus*: Rothschild and Martin, 1992; Rothschild, 1997.

:fibula, *Tyrannosaurus rex*: Anonymous, 1991b; Larson, 1991; Anonymous, 1992c; Larson, 1992, 1995; Anonymous, 1996c,g; Holmes, 1996; Anonymous, 1997e; Browne, 1997; Webster, 1999 (not specifically identified as a fracture); Fiffer, 2000; Larson, 2001b.

:fibula, *Allosaurus*: Gilmore, 1920; Welles and Long, 1974.

:possible fracture of distal fibula in *Gorgosaurus* specimen: Lambe, 1917.

:fibula *Gorgosaurus/Albertosaurus*: McGowan, 1991; Poling, 1996; Rothschild, 1997; Felber, Currie and Sovak, 1998; Keiran, 1999.

:fibula, tyrannosaurids: Tanke, 1996f-g.

:fibula of Late Cretaceous hadrosaur *Parasaurolophus*: Ostrom, 1963.

:metatarsals, type specimen of *Ceratosaurus*: Baur, 1890; Gilmore, 1920.

:*Deinonychus* pedal phalanx: Ostrom, 1976; Rothschild, 1997; Marshall, Brinkman, Lau and Bowman, 1998; Martill and Naish, 2000.

:fibula; unspecified hadrosaur, Bayan Mandahu, Gobi Desert, China: Duncan, 1991.

:metatarsal IV, unspecified ornithomimid, New Mexico, USA and unspecified ornithomimid metatarsal from Alberta, Canada: Sullivan, Tanke and Rothschild, 2000.

:fibula, hadrosaurs: Tanke, 1996e.

Limb/phalanges:

:phalanges- stress fractures: Begley and Yoffe, 1991; Wright, 1991.

:stress fracture of unspecified ceratopsian phalanx: Rothschild, 1988b; Rothschild and Martin, 1992; Rothschild and Tanke, 1992; Rothschild, 1997; Zhuo, 2000.

:stress fractured phalanx of Late Cretaceous ceratopsian *Pachyrhinosaurus*: Tanke, 1989b.

:stress fractured phalanges in *Centrosaurus*, *Styracosaurus*, *Triceratops* and *Pachyrhinosaurus*: Rothschild and Tanke, 1992.

Armour, scutes, plates:

:tail spike in Upper Jurassic *Stegosaurus* with subsequent infection making the spike look like "melted wax": Carpenter, 1996.

:open fractures of tail spikes in *Stegosaurus* with secondary chronic osteomyelitis: Gilmore, 1914; Carpenter, 1998; McWhinney, Rothschild and Carpenter, 1998, submitted; Hanna, 2000 (see Laws); Milstein, 2000.

:*Dravidosaurus blanfordi* tail spike with healed fracture?: Yadagiri and Ayyasami, 1979.

Compression fracture:

:dorsal vertebra centrum in Upper Jurassic *Camptosaurus*: Erickson, 1988.

FRACTURE HEALING RATES IN DINOSAURS

Research/speculations: Tanke, 1996g; Tumarkin, Dodson, Tanke and Rothschild, 1999; Gevock, 2001; Larson, 2001a.

FROSTBITE

Possibly affecting dinosaurs at high paleolatitudes: Paul, 1989.

?FUNGAL EROSIONS

In: ?fungal erosions [probably resorption pitting] in crania of Late Cretaceous ceratopsians *Pachyrhinosaurus*, *Centrosaurus* and *Styracosaurus*: Langston, 1975; see also Sampson, Ryan and Tanke, 1997 for comments.

:?fungal erosions affecting jaws of *Tyrannosaurus*: Gevock, 2001 "lumpy jaw;" Rega and Brochu, 2001.

:fungal or bacterial erosions may explain "face-biting" injuries in *Tyrannosaurus*: Perkins, 2001.

FUSIONS (see also: DIFFUSE IDIOPATHIC SKELETAL HYPEROSTOSIS)

In: two distal caudal vertebrae in Late Cretaceous *Tyrannosaurus rex*: Anonymous, 1991b; Larson, 1991; Anonymous, 1992c (listed as crushed and healed); Larson, 1995; Holmes, 1996; DeFeo, 1997 (listed as "crushed and displaced"); Webster, 2000; Larson, 2001b; Gevock, 2001.

:extensive fusion of medial elements in anteriormost segments of gastralia and fused caudal vertebrae in *Tyrannosaurus*: Brochu, 2000.

:fusions in sauropod caudal vertebrae, tumors?: Swinton, 1934, 1970.

:right ilium and ischium of Lower Cretaceous *Iguanodon*: Blows, 1978, 1989.

:of dorsal vertebrae 4 and 5 in the Late Cretaceous ceratopsian *Styracosaurus*, etiology not attempted: Brown and Schlaikjer, 1937.

:fusion of caudal vertebrae in Upper Jurassic sauropod *Diplodocus*: Moodie, 1923a (probably DlSH).

:of mid-caudal region of unspecified ceratopsian skeleton from southern Alberta, Canada: Tanke, 1997a.

:of two pedal phalanges of an unspecified ornithomimid: Sullivan, Tanke and Rothschild, 2000.

:asymmetrical fusion of last cervical and first dorsal vertebrae in AMNH specimen of Late Cretaceous *Tyrannosaurus rex*: Carpenter, 1990; Rothschild, 1997.

:fusion of 2 cervical vertebrae in *Tyrannosaurus* "Stan": Anonymous, 1997f.

:metatarsals of Upper Jurassic *Ceratosaurus*: Harding, 1988; Rowe and Gauthier, 1990.

:dorsal neural spines 10 and 11 in large theropod *Monolophosaurus*, due to traumatic fracture: Zhao and Currie, 1993.

:two proximal vertebrae in Late Cretaceous ankylosaur *Paleoscincus*: Gilmore, 1930.

:vertebrae in *Iguanodon*: Hawkes, 1995.

:two [distal] caudal vertebrae in *Iguanodon* "not uncommon": Norman, 1980.

:fusions of distal caudal vertebrae into a "bar of bone" following a traumatic distal tail amputation in an unspecified Late Cretaceous hadrosaur, Alberta, Canada: Langston, 1961.

:2 mid-caudal vertebrae [=DlSH?] in Upper Jurassic theropod *Allosaurus*: Madsen, 1976a.

:caudal vertebrae and chevron in Upper Jurassic *Allosaurus* [probably DlSH], but described here as a "neoplastic ankylosis" of traumatic origins: Petersen, lsakson and Madsen, 1972.

:fusion of two caudal vertebrae in Upper Jurassic *Camptosaurus*: Petersen, lsakson and Madsen, 1972.

:cervical vertebrae in Late Cretaceous ceratopsians: Rothschild, 1985b.

:metatarsals of type specimen of *Ceratosaurus*: Baur, 1890; Marsh, 1892a, 1896.

:distal caudal vertebrae of sauropod *Cetiosaurus*: Moodie, 1917.

:vertebrae in *Tyrannosaurus*: Norman, 1985; Larson, 2001a (neck).

:fusions of neural spine tips of dorsal vertebrae 5-7 (and associated rib fracture trauma) in Late Cretaceous hadrosaur *Parasaurolophus*: Parks, 1922.

:of 3rd and 4th caudal vertebrae in the barapasaurid sauropod *Vulcanodon*: Raath, 1972.

:mid caudal vertebrae fusions in Late Jurassic sauropods *Apatosaurus, Camarasaurus and Diplodocus*; alternative explanation to the DlSH interpretation: Kaye, 1998.

:fusions of 2-3 distal caudal vertebrae in unspecified Late Cretaceous hadrosaurs: Tanke, 1989a; Rothschild, 1997.

:fusion of unspecified Late Cretaceous hadrosaur radius/ulna following mid-length fracture an healing of both elements: Tanke, 1996b.

:"bamboo appearance" to vertebrae in *Polacanthus*; =fusion?: Zorab, 1961.

:distal caudal vertebrae of a new *Camarasaurus* specimen: Mclntosh, Miles, Cloward and Parker, 1996.

:cervical vertebrae V and Vl in *Centrosaurus*: Lull, 1933.

:caudal vertebrae in *Iguanodon*: Rothschild and Tanke, 1992.

:fusion of 2 cervical and 2 dorsal vertebrae in Late Cretaceous *Tyrannosaurus*: Dingus, 1996.

:caudal vertebrae of *Diplodocus* and other sauropods generally: Coombs, 1975.

:fusion of tibia, fibula, astragalus and calcaneum of undetermined etiology in a an unidentified Triassic theropod: Heckert et al., 1999.

:fusion of chevron and caudal vertebra of unknown etiology in large theropod *Poekilopleuron*: Eudes-Deslongchamps, 1938.

:fusion of last 3 or 4 caudal vertebrae into a club-like mass; =pathologic?: Zhou, 1984.

:fusions of cervical vertebrae in *Camarasaurus* [erroneous?]; *Diplodo-*

cus [erroneous?] and *Tyrannosaurus*: Moodie, 1919b.

:sauropod caudal fusions = DlSH: Tanke and Rothschild, 1997.

:vertebral fusions in *Tyrannosaurus*, *Camarasaurus* and *Apatosaurus*: Sokoloff, c. 1960.

:distalmost caudal fusions in Late Cretaceous oviraptorid *Nomingia* non-pathologic; represents a true pygostyle: Currie, 2002.

GASTROLITHS (see CHOKING entry)

GENERAL/BOOK REVIEWS

Rothschild and Tanke, 1992, 1997; Hanna, 2000 (see Laws); Zhuo, 2000.

Book review of: Bakker, 1986 by Balsai, 1987.

Book review of: Moodie, 1923a: P, 1924; Romer, 1924.

GOUT

ln: *Tyrannosaurus* and unspecified Judithian-aged tyrannosaurid: Anonymous, 1996h; Anonymous 1997a,g-i; Browne, 1997; Hecht, 1997; Radford, 1997; Rothschild, 1997; Rothschild, Tanke and Carpenter, 1997a,b; Torassa, 1997; Ma, 1998; Rothschild and Tanke, 1998a; Young, 1998; Spalding, 1999; Larson, 2001b; Perkins, 2001.

Popular (newspaper/magazine) articles regarding discovery of gout in tyrannosaurids: Anonymous, 1997a,b; Begley, 1997; Browne, 1997; Hecht, 1997; Monastersky, 1997; Okino, 1997; Torassa, 1997; Douglas and Young, 1998; Weintraub, 1998; Larson, 2001b.

HAEMANGIOMA (HEMANGIOMA)

:unspecified Upper Jurassic dinosaur, Utah, USA: Anonymous, 1993b; Anonymous, 1998d; Rothschild and Tanke, 1998a,b; Rothschild, Tanke, Hershkovitz and Schultz, 1998; Talbot, 1998.

:Upper Jurassic sauropod *Diplodocus*: Stolk, 1958 [actually a case of DlSH; see Rothschild and Berman, 1991].

:unspecified sauropod, USA [actually DlSH]: Moodie, 1918c.

:Late Cretaceous hadrosaur *Edmontosaurus*: Rothschild, Helbling and Tanke, 2001.

"HALF-SIDED VERTEBRAE"

ln: *Dysalotosaurus* (*Dryosaurus*): Janensch, 1934.

:hemi-vertebra wedge in Late Cretaceous embryonic hadrosaur *Hypacrosaurus*: Tanke and Rothschild, 1997.

HEAD-BUTTING IN ANKYLOSAURS

Kirkland, 1998 (*Gastonia*).

HEAD-BUTTING IN PACHYCEPHALOSAURS

Galton, 1970; Sues, 1978; Paul, 1988; Tanke, 1988a; Carpenter, 1993; Goodwin and Johnson, 1995; Johnson and Stucky, 1995; Carpenter, 1997; Goodwin, Buchholts and Johnson, 1998; Ford, 1998.

HEMATOMA (CALCIFIED)

ln: of gastral basket in *Tyrannosaurus* "Sue" following fractures: Larson, 2001b.

HISTOLOGICAL STUDIES

Talbot, 1978; Garland, 1989; Late Cretaceous juvenile *Maiasaura* long bones: Barreto, 1994, 1997; growth plate histology: Barreto, 1996; pathologic Early Cretaceous *Iguanodon* centrum: Clarke and Barker, 1995; Tumarkin, n.d.

:*Iguanodon* abnormal bone histology: Radley, 1996.

:Histology of dinosaur tendons and pathological bone: Reid, R., 1984.

Histological techniques: Chinsamy and Raath, 1992.

Specimens (histological) figured:

:normal vs. pathological dinosaur bone, Alberta, Canada: McGowan, 1991.

HYPOTHERMIA

:affecting Arctic dinosaurs: Reid, 1990b.

INDIVIDUAL VARIATION

:unusual characteristics in skull of *Allosaurus* attributed to individual variation: Smith and Lisak, 2001.

INFECTIONS

:incurred from feeding on carcasses: Laws, 1997; Tanke and Currie, 1998 (2000).

:small holes in Late Cretaceous *Tyrannosaurus* skulls may represent drainage sinuses at sites of infection: Anonymous, 1996g; Brochu (in Webster, 1999).

:infectious periostitis affecting unspecified ceratopsian scapula and coronoid: Rothschild, 1997.

:tibia, Albertan hadrosaur: Tanke, 1996e.

:periostitis affecting an Upper Jurassic *Camarasaurus* humerus: McWhinney, Carpenter and Rothschild, 2001.

:infection affecting toe bone of "Big Al," *Allosaurus*: Hanna, 2000 (see Laws); Anonymous, 2001a.

:pyogenic infection of *Tyrannosaurus rex* fibula: Gevock, 2001.

INSECTS (see also ECTOPARASITES)

Blood-sucking biting flies (fam. Ceratopogonidae): Pellegrino, 1985; Currie, 1987 ("biting flies"); Borkent, c. 1993, 1995; Currie and Koppelhus, 1996; Anonymous, 1998a; Labandiera, 1998; Alonso et al., 2000.

Fossil midges: Pellegrino, 1985; Grimaldi, 1993; McAuliffe, 1993; Tanke and Rothschild, 1997; Anonymous, 1998a; Labandiera, 1998; Nash, 1998.

Parasitic on dinosaurs?: Pellegrino, 1985; Grogan and Szadziewski, 1988; Schneider, 1996; Tanke and Rothschild, 1997; Anonymous, 1998a; Nash, 1998.

INTERSPECIFIC FIGHTING

Velociraptor vs. *Protoceratops*: Kielan-Jaworowska and Barsbold, 1972; Wood et al., 1972; Barsbold, 1974; Lessem, 1992; Duchesne and Leitch, 1993; Hamley, 1993; Osmolska, 1993; Horner, 1994a; Norell, Gaffney and Dingus, 1995; Tomida, 1995; Unwin, Perle and Trueman, 1995; Amery, 1997; Currie, 1997b; Carpenter, 1998 (2000); Tanaka, 1998; Ford, 2000b.

:Ankylosaurs vs. Tyrannosaurids: Anonymous, 1994a; Thulborn, 1994; Currie, 1997a; DeFeo, 1997; Felber, Currie and Sovak, 1998.

:Upper Jurassic *Ceratosaurus* vs. 2 *Allosaurus*: Battaglia, 1979.

:*Tyrannosaurus* vs. *Triceratops*: Geis, 1959, 1960; Ford, 2000b.

:predatory dinosaurs vs. ceratopsians: Swinton, 1966; Tweedie, 1977.

:*Pachyrhinosaurus* vs. other ceratopsian species: Rothschild and Tanke, 1997.

:interspecific biting spreads fatal disease (science fiction): Crichton, 1995.

:Late Cretaceous tyrannosaurids *Albertosaurus* vs. *Daspletosaurus* (science fiction): Felber, Currie and Sovak, 1998.

See also: Gertsch, 1994; Tanke and Rothschild, 1997.

INTRASPECIFIC FIGHTING

Small/Large Theropods: *Tyrannosaurus*: Slaughter, 1957; *Velociraptor* (science fiction): Crichton, 1995; *Allosaurus* Laws, 1997; Utahraptor Bakker, 1995 (science fiction).

:healed puncture wound to rib of *Tyrannosaurus* "Stan" attributed to intraspecific bite: Larson, 2001b.

:puncture wound in sagittal crest of *Tyrannosaurus* attributed to intraspecific biting: Larson, 2001b.

:*Ceratosaurus*, tyrannosaurids, *Apatosaurus*, *Plateosaurus*, *Heterodontosaurus*, *Iguanodon*: Carpenter, 1999.

Hadrosaurs: Tanke, 1989a, submitted; Cronkite, 1991.

Horned dinosaurs: Hatcher, Marsh and Lull, 1908; Lull, 1908; Schelle, 1954; Cox, 1976; Tyson, 1977 [extra holes in frill mostly not related to fighting]; Heritage, 1980; Mateer, 1981 ("extra" holes in frills NOT related to intraspecific fighting); Sattler, 1981; Stout, Service and Preiss, 1981; Halstead and Halstead, 1987; Dixon et al., 1988; Paul, 1988; Tanke, 1989b, ms [rare examples of osteopathy suggest a more peaceful nature than supposed]; Dodson et al., 1990; Farlow, 1990; Various authors, 1991; Rothschild and Tanke, 1992; Westrup, 1992 [rare]; Lessem and Glut, 1993; MacLeod, 1994; Olshevsky, 1994; Spinar and Currie, 1994; Fastovsky and Weishampel, 1996; Rothschild and Tanke, 1997 (rare examples in *Triceratops*; contra popular literature); Tanaka, 1998; Benton, 2000; Hanna, 2000 (see Laws); Martill and Naish, 2000.

Evidence for rarity of fighting in ceratopsians: Mateer, 1981 ("extra" holes in frills of ceratopsians NOT related to intraspecific fighting); Rothschild and Tanke, 1992.

:Eamon, 1991; Dodson, 1996 *Pachyrhinosaurus*; *Centrosaurus* Tanke and Rothschild, 1997.

:*Centrosaurus* and *Pachyrhinosaurus*: Rothschild and Martin, 1992.

:*Triceratops*: Rothschild and Tanke, 1997; Tanke, ms.

:pathology rarely observed in well excavated *Centrosaurus*, *Styracosaurus* and *Pachyrhinosaurus* bonebeds; contra to popular belief that ceratopsians were aggressive to conspecifics: Tanke, 1996c.

Dome-headed dinosaurs: Galton, 1970; Tanke, 1988a; Carpenter, 1993, 1998; Ford, 1998; Goodwin and Johnson, 1995; Johnson and Stucky, 1995; Goodwin, Buchholts and Johnson, 1998.

Face-biting behavior: small and large theropod dinosaurs; Upper Jurassic and Late Cretaceous: Tanke and Rothschild, 1997; Felber, Currie and Sovak, 1998; Anonymous, 2000e-f; Erickson, 1999, 2000; Milstein, 2000; Niiler, 2000; Tanke and Currie, 1998 (2000).

:Late Cretaceous *Tyrannosaurus rex*: Molnar, 1973; Lessem, 1988; Harlan, 1990 (listed as "jaw injury" only); Molnar and Farlow, 1990; Anonymous, 1992c; Larson, 1992; Molnar, 1992; Smith, Peter, 1992; Gore, 1993; Morell, 1993a; Larson, 1994a,b; Psihoyos, 1994; Norell, Gaffney and Dingus, 1995; Schowalter, 1995b; Anonymous, 1996c,h; Holmes, 1996; Naeye, 1996; Tanke (in Janke, 1996); Tanke, 1996a; Anonymous, 1997d-f; Browne, 1997; Currie, 1997a; DeFeo, 1997; Olert, 1997; Douglas and Young, 1998; Tanke (in Larson, 1998); Young, 1998; Anonymous, 2000f; Hanna, 2000 (see Laws); Tanke and Currie, 1998 (2000); refuted in *Tyrannosaurus* by E. Rega (in Perkins, 2001).

:face-biting in *Tyrannosaurus rex* seriously questioned: Brochu (in Webster, 1999).

:"punctured jaw," *Tyrannosaurus*: McGinnis, 1982.

:poorly healed rib, *Tyrannosaurus*: Avila, 1998.

:Upper Jurassic *Allosaurus*: Molnar and Farlow, 1990; Molnar, 1992; Schowalter, 1995b.

:Early Cretaceous *Carcharodontosaurus saharicus*: Anonymous, 1996d.

:unspecified plant-eating dinosaur skulls with conspecific bite wounds; related to mating behavior: Droscher, 1976.

:Upper Jurassic *Sinraptor dongi*: Farlow and Molnar, 1995; Tanke and Currie, 1995, 1998 (2000).

:unhealed bitemarks atop cranium of Late Cretaceous small theropod *Velociraptor* =intraspecific fighting: Norell, Gaffney and Dingus, 1995.

:Late Cretaceous tyrannosaurid *Albertosaurus*: Schowalter, 1995b; Tanke and Currie, 1995; Felber, Currie and Sovak, 1998.

:*Herrerasaurus*: Sereno and Novas, 1993.

:enlarged upper caniform teeth in Early Jurassic *Heterodontosaurus* used as weapons during intraspecific fighting (face-biting not specifically stated): Weishampel, 1992.

General discussion: Molnar, 1977.

Head-butting (non-pachycephalosaurid): in *Tyrannosaurus*: Lessem, 1988.

Horn thrust injuries: frill in Late Cretaceous ceratopsian *Torosaurus*: Berghaus and Gabriel, 1988; Anonymous, 1990a,b.

:frill of *Diceratops* and *Triceratops*: Hatcher, Marsh and Lull, 1908.

See also, Tanke, manuscript.

Skull injuries:

In: *Triceratops*: Hatcher, Marsh and Lull, 1908; Burton and Dixon, 1984.

Tyrannosaurus: Burnham, 1992.

LIGHTNING STRIKES

:Aragon, 1985.

:Late Cretaceous tyrannosaurid *Albertosaurus* moves away from open areas during thunderstorms to avoid being hit by lightning (science fiction): Felber, Currie and Sovak, 1998.

LIMPING (see also FOOTPRINTS)

:?limping in an unspecified Late Cretaceous hadrosaur following severe mid-length fracture of radius and ulna: Tanke, 1996b.

:limping in Late Cretaceous tyrannosaur *Albertosaurus* following fibula fracture (science fiction): Felber, Currie and Sovak, 1998.

:limping in Late Cretaceous *Tyrannosaurus* due to lower leg fracture improperly healed: Browne, 1997.

:large lesion affecting Upper Jurassic *Camptosaurus* ilium possibly makes animal "lame": Anonymous, 1998f.

:occurrence of limping dinosaur trackways: Tanke and Rothschild, 1997 (mention only).

:implied in an adult Upper Jurassic *Camarasaurus* as a result of an avulsion injury and post-trauma complications affecting humerus: McWhinney, Carpenter and Rothschild, 2001.

:*Allosaurus* limped due to toe infection and pain: Hanna, 2000 (see Laws).

:osteomyelitis in *Tyrannosaurus* not debilitating: Rega and Brochu, 2001; (but may have caused limping) Perkins, 2001.

MALFORMATIONS

:dinosaur footprints showing malformation of toes: Thulborn, 1990; Tanke and Rothschild, 1997.

:digit malformation in an *Anchisauripus* (prosauropod) footprint: Tucker and Burchette, 1977.

MALOCCLUSION

Tanke and Rothschild, 1997 (theropods generally); Rothschild, 1997 (*Tyrannosaurus*); Tanke and Currie, 1998 (2000) (*Gorgosaurus*).

MASS MORTALITY

(This section of the index deals mostly with the mass mortality of post-hatchling to full adult-sized dinosaurs. The presence of nests or clusters of dinosaur eggs could represent infertile eggs. However it is difficult to consider preservation of nesting horizons due to all eggs being infertile. Most of these cases probably reflect fertile eggs that perished *in situ*, perhaps due to factors such as flooding, incorrect temperatures during incubation, volcanic ashfall, abandonment, etc. In the strictest sense, then, these do fall under of the category of mass mortality. Most authors, do not specifically address this aspect of research in their papers. There are many papers on eggs, nests and nesting grounds and most of these are probably representative of mass mortality events. However, we present only a selected listing of citations here. In any future updates of this bibliography, coverage of eggs, nests and nesting grounds will be more extensive.

Mass mortality is considered here as involving three or more animals of the same species, dying over a relatively short time (minutes, hours, days), perishing from the same circumstances and being preserved together or in obvious association in the case of disarticulated material. Extinction events are not included in this listing).

Arsenic poisoning:

:dinosaurs in Dashanpu Quarry, China: Xia et al., 1983; Xia et al., 1984; Lessem, 1992.

Bogged down in sticky mud/quicksand:

Mud:

:*Coelophysis*: Ratkevitch, 1976; Fisher, 1981.

:*Allosaurus*: Stokes, 1945; Richmond and Morris, 1996.

:*Plateosaurus*: Sander, 1992.

:possible situation in an *Apatosaurus* bonebed, Montana, USA: Horner and Dobb, 1997.

Quicksand:

:*Coelophysis*: Fisher, 1981; Colbert, 1989.

Botulism poisoning:

:unspecified Late Cretaceous hadrosaurs [*Hypacrosaurus*, *Prosaurolophus*] and small theropods [*Troodon*] who then scavenged on the infected carcasses: Rogers, 1997; Varricchio, 1997; Horner and Dobb, 1997.

Drought/Thirst:

Huene, 1928; Carpenter, 1988b.

:*Maiasaura*: Rogers, 1988; Horner and Dobb, 1997.

:*Prosaurolophus*: Rogers, 1989, 1990; Horner and Dobb, 1997.

:*Hypacrosaurus*: Horner and Dobb, 1997.

:*Einiosaurus*: Rogers, 1989, 1990; Rogers and Sampson, 1989; Horner and Dobb, 1997.

:*Coelophysis*: Schwartz and Gillette, 1994.

:unspecified Late Cretaceous hadrosaurine and lambeosaurine hadrosaurs: Varricchio and Horner, 1993.

:some Late Cretaceous ceratopsian bonebeds: Dodson and Currie, 1990; Sampson, 1997.

:unspecified carcharodontosaurid, Neuquen Province, Argentina: Eberth and McCrea, 2001, 2002.

Drowning:

:Late Cretaceous *Albertosaurus*: Eberth and McCrea, 2001, 2002.

:Late Cretaceous *Centrosaurus*: Currie, 1981, 1982, 1987; Pringle,

1989; Ryan, 1992, 1993; Norman, 1994; Ryan and Russell, 1994; Eberth, 1996, 1998; Tanaka, 1998; Ryan, Russell, Eberth and Currie, 2001.

:Late Cretaceous *Pachyrhinosaurus*: Olinger, 1987a; Tanke, 1989b, 1996d.

:Late Cretaceous *Centrosaurus* and *Styracosaurus*: Wood and Thomas, 1986; Currie, 1987; Eberth, 1996.

:Late Cretaceous *Styracosaurus:* Visser and Thomas, 1986.

:Late Cretaceous hadrosaur *Edmontosaurus*: Tedesco, Halvorsen and Cooper, 1998a,b.

:Late Cretaceous dinosaur type(s) unspecified: Burgess, 1996.

:Upper Triassic *Coelophysis*: Colbert, 1989; Coy, 1997.

:some Late Cretaceous ceratopsian bonebed occurrences: Dodson and Currie, 1990.

:Late Cretaceous titanosaur sauropod eggs suffocated by flooding, Patagonia, Argentina: Anonymous, 1998e; Chang, 1998; Hayden, 1999; Ritter, 1999.

:Late Cretaceous dinofauna, Mongolia: Jerzykiewicz, 1998.

:Late Cretaceous Nemegt dinofauna killed by flooding: Kielan-Jaworowska, 1969; Loope, Dingus, Swisher and Minjin, 1998.

:Biblical Flood implied in formation of *Coelophysis*, *Centrosaurus* and *Pachyrhinosaurus* bonebeds: Helder, 2000.

Famine:

Carpenter, 1988b (herbivorous dinosaurs generally).

Predation attempts:

Early Cretaceous *Deinonychus* vs. *Tenontosaurus*: Ostrom, 1969; Paul, 1988; Maxwell and Ostrom, 1995; Horner and Dobb, 1997 [considered this possibility unlikely]; Maxwell, 1999; Eberth and McCrea, 2002.

Suffocation:

Anonymous, c. 1987; Reynolds, 1988; Currie, 1989; Lessem, 1989a,b; Duncan, 1991; Acorn, 1993; Grady, 1993; Jerzykiewicz, Currie, Eberth, Johnston, Koster and Zheng, 1993 (group of no less than 13 juvenile Late Cretaceous *Pinacosaurus* overwhelmed by sandstorm and buried); Watabe et al., 1996.

:Late Cretaceous dinofauna, due to burial by sand/duststorms: Jerzykiewicz, 1998.

:unspecified oviraptorids cf. *Ingenia*; unspecified oviraptorid eggs (with embryos); unspecified ankylosaurids and numerous small lizards and mammals: Dashzeveg et al., 1995.

:Late Cretaceous vertebrates found in Ukhaa Tolgod, southern Gobi Desert, Mongolia overwhelmed by massive wet debris flows from sand dunes: Dingus and Loope, 2000.

:sandstorm hypothesis refuted: Dingus and Loope, 2000.

Volcanic eruption:

:Late Triassic *Coelophysis*: Colbert, 1947.

:Upper Cretaceous hadrosaur *Maiasaura* herd; ashfall: Hooker, 1987; McDonald, 1994.

:dinosaur eggs, France; selenium poisoning due to volcanic eruption: McNamara, 1992b.

:unspecified hadrosaur eggs, China: Anonymous, 1998a.

:volcanic ashfall overwhelms small dinosaur *Echinodon* and smaller vertebrates, Fruita Paleo Area, Colorado, USA: Silbernagel, 1996.

:volcanic ashfall kills Late Cretaceous hadrosaur *Hypacrosaurus* eggs, embryos, neonates, Montana, USA: Horner, 1994b; Horner and Dobb, 1997.

Other:

:Triassic *Coelophysis*; poisoned by drinking highly alkaline water: Ratkevitch, 1976.

:9+ Late Cretaceous *Albertosaurus* overcome by forest fire smoke: Felber, Currie and Sovak, 1998.

:some Late Cretaceous ceratopsian bonebeds possible mass mortality events induced by fire: Dodson and Currie, 1990.

:Alaskan dinosaurs killed by seasonal cold: Reid, 1990b.

:general comments, *Centrosaurus*, *Pachyrhinosaurus*: Dodson and Smith, 1999.

:"corruption of the nesting hole" kills 15 juvenile *Protoceratops*: Watabe et al., 1996.

:possible dinosaur mass mortality via Cretaceous wildfire, Wyoming, USA: Wegweiser, 2000; Perkins, 2000.

Unstated:

:9+ Late Cretaceous *Albertosaurus*, Alberta, Canada: Anonymous, 1997c, Currie [in Anonymous, 1997e]; Anonymous, 1998b; Currie, 1998 (2000); Erickson, 1999, 2000; Fischman, 1999; Anonymous, 2000f; Currie, 1998 (2000).

:*Centrosaurus* bonebed, Dinosaur Provincial Park, Alberta, Canada: Brown, 1917 (3 bonebeds); Turner, 1980 (Quarry 143, Bonebed 43).

:Upper Jurassic Cleveland-Lloyd Quarry, Utah, USA a predator [*Allosaurus*] trap: Dodson, Behrensmeyer, Bakker and Mclntosh, 1980.

:*Pachyrhinosaurus* bonebed, Colville River, Alaska: May and Gangloff, 1999.

:carcharodontisaur bonebed: Neuquen province, Argentina: Eberth, Currie, Coria, Garrido and Zonneveld, 2000.

:*Edmontosaurus* bonebed and 8 other unspecified hadrosaur bonebeds in and around the city of Edmonton, Alberta, Canada: Tanke [in Tanke, 1984].

:*Edmontosaurus* bonebed [=mass mortality?; unstated as such in paper]: Derstler, 1996.

:*Protoceratops* [actually Oviraptor] eggs, Mongolia: Osborn, 1924.

:4 subadult Late Cretaceous hadrosaurs *Corythosaurus*, Alberta, Canada: Dodson, 1971.

:several small groupings of juvenile Early Cretaceous *Tenontosaurus*: Forster, 1990b.

:5+ juvenile Late Cretaceous ceratopsian "*Brachyceratops*": Gilmore, 1917.

:unspecified numbers of juvenile hadrosaurs collected from one quarry, Montana, USA: Gilmore, 1929.

:Late Jurassic Cleveland-Lloyd quarry (rich in *Allosaurus*) has an unspecified "catastrophic" origin: Hunt, 1986.

:estimated remains of 300,000+ Upper Cretaceous dinosaur eggs, 24 nests also preserved, Bastus, Spain: Sanz et al., 1995; Sanz and Moratalla, 1997.

:Upper Cretaceous hadrosaur *Maiasaura* nestlings: Gore, 1993.

:Upper Cretaceous hadrosaur *Maiasaura* bonebed containing disarticulated remains of thousands of individuals (= mass mortality?); etiology uncertain: Schmitt, Horner, Laws and Jackson, 1998.

:unspecified hadrosaur eggs and embryos, Late Cretaceous, Montana, USA: Clouse and Horner, 1993; Clouse, 1995.

:Late Cretaceous *Edmontosaurus* bonebed, Ruth Mason Quarry: Anonymous, 1998-1999.

:Upper Cretaceous dinosaur eggs, Montana, USA: Horner, 1984.

:Dinosaur eggs, lndia: Jain, 1989.

:Late Cretaceous *Styracosaurus*, *Centrosaurus*, *Triceratops*, *Pachyrhinosaurus*, *Parasaurolophus*, *Maiasaura* and *Hypacrosaurus* bonebeds, Alberta, Canada and Montana, USA: Horner, 1994a.

:unstated dinosaur and ceratopsian bonebeds, compared to extant mass mortality events: Kindle, 1919; 1921.

:Late Cretaceous *Pachyrhinosaurus*; early Jurassic *Syntarsus*: Lessem and Glut, 1993.

:*Plateosaurus* and *Chasmosaurus*: Norell, Gaffney and Dingus, 1995.

:*Syntarsus*: Raath, 1990.

:Late Cretaceous ceratopsian *Einiosaurus*: Sampson, 1995.

:"catastrophic" origins for Late Cretaceous hadrosaur *Edmontosaurus* and contemporaneous ceratopsian *Pachyrhinosaurus* bonebed: Langston, 1976.

:Late Cretaceous hadrosaur *Edmontosaurus*/ceratopsian *Pachyrhinosaurus* bonebed: Sternberg, 1950.

:Late Cretaceous small theropod *Troodon*: Varricchio, 1993.

:Late Cretaceous ceratopsian *Styracosaurus*: Visser, 1986; Visser and Thomas, 1986.

:Late Cretaceous tyrannosaurid *Gorgosaurus* [actually *Albertosaurus*]: Tanaka, 1998; Anonymous, 1998b.

:unidentified large theropod related to *Giganotosaurus*; Argentina: Anonymous, 1998b, c.

:possible "catastrophic mass accumulation" of unknown etiology in the Middle Jurassic cetiosaur sauropod *Patagosaurus*: Coria, 1994.

:Late Cretaceous sauropod eggs/embryos: Anonymous, 1998g; Chiappe, 1998; Chiappe et al., 1998, 1999.

:new genus of Late Cretaceous centrosaurine ceratopsian: Ryan et al., 1999.

:Late Cretaceous unspecified ceratopsian bonebeds: Sternberg, 1921.

:Late Cretaceous ceratopsian *Anchiceratops* bonebed(s?): Sternberg, 1926.

:Late Cretaceous *Hypacrosaurus* neonates, *Prosaurolophus* and *Einiosaurus* low diversity bonebeds, *Troodon* nests and nesting horizons and unspecified hadrosaur and ceratopsian bonebeds: Rogers, 1997.

:Late Cretaceous hadrosaur *Hypacrosaurus* and ceratopsian *Pachyrhinosaurus*, Alberta, Canada: Acorn, 1993.

:Late Cretaceous hadrosaur *Edmontosaurus*: Anonymous, 1997e.

:Late Cretaceous hadrosaur *Hypacrosaurus*: Currie, 1988; Grady, 1993.

:Late Cretaceous bonebeds, Montana, USA: ceratopsian *Achelosaurus*; hadrosaurs *Gryposaurus*, several *Hypacrosaurus* bonebed sites, *Prosaurolophus*, unspecified lambeosaurine nests; *Hypacrosaurus* and *Troodon* eggs and babies: Horner and Dobb, 1997.

:Upper Jurassic *Apatosaurus* bonebed, Montana, USA: Horner and Dobb, 1997.

:Lower Cretaceous Proctor Lake locality, many hypsilophodontid skeletons found together: Winkler et al., 1988; Winkler and Murray, 1989.

:*Leptoceratops* n. sp. bonebed, Late Cretaceous Two Medicine Fm., Montana [unstated as actually representing a mass mortality occurrence]: Chinnery and T*rex*ler, 1999.

:*Coelophysis*, New Mexico, USA: Johnson and Stucky, 1995.

:*Edmontosaurus* bonebed, near Drumheller, Alberta, Canada: Vickaryous, Ryan, Bell and Eberth, 1995.

:bonebed in Montana, USA containing "partly articulated hadrosaur skeletons, presumably *Maiasaura*: Burnham, Derstler and Linster, 1996.

:4 subadult *Corythosaurus* found together, Quarry 11, Dinosaur Provincial Park, Alberta, Canada: Evans, 2001, 2002.

MATING/COURTSHIP TRAUMA AND INJURIES

In: *Camptosaurus*: Gilmore, 1909, 1912; Lewin, 1982; Rothschild and Martin, 1992; Rothschild and Tanke, 1992.

Iguanodon: Blows, 1989.

Sauropods: Begley and Yoffe, 1991.

Tyrannosaurus: injury (fracture) of two distal vertebrae related to mating activities?: Anonymous, 1997e; caudal "overloading" = possible copulation injuries: Larson, 2001a,b.

Tyrannosaurs: Vance, 1989; Rothschild and Tanke, 1992 (humeri fractures); Schowalter, 1995b.

Hadrosaurs: Tanke, 1989a, submitted a; Cronkite, 1991; Wright, 1991; Rothschild and Tanke, 1992; Westrup, 1992; Struzik, 1993; Spinar and Currie, 1994; Tanke, 1996e; Hanna, 2000 (see Laws); Zhuo, 2000.

Unspeciated plant-eating dinosaur skulls bearing conspecific bite wounds; related to mating activities: Droscher, 1976.

Unspecified/general: Fritz, 1988; Anderson, 1994.

METABOLISM

Erben, Hoefs and Wedepohl, 1979; Pawlicki, 1983; Barrick, 1996.

MIMICRY

:ankylosaur tailclub acts as a head mimic, thus attracting attentions of a predator away from vulnerable head region: Thulborn, 1994.

MISCELLANEOUS

:bifurcation of a gastral rib element in and unspecified Late Cretaceous dromaeosaurid: Norell and Makovicky, 1997.

:extensive pitting on proximal end of small theropod femur indicating either pathology of juvenile status: Naish, 2000.

:skull, neck and shoulder injuries" in *Triceratops*, *Einiosaurus* and *Pachyrhinosaurus*: Hanna, 2000 (see Laws).

:unspecified pathologies affecting Late Cretaceous hadrosaur *Brachylophosaurus*: Hanna, LaRock and Horner, 1999.

:erosion and destruction of unknown etiology in pedal phalanx of large theropod *Poekilopleuron*: Eudes-Deslongchamps, 1838.

:discovery of [prey] bone with healed tyrannosaur bite/toothmarks would be good evidence for a predaceous lifestyle in Late Cretaceous *Tyrannosaurus*: Waggoner, 1994-1999.

:unusual twist near mandibular symphysis of a ?*Troodon* dentary related to allowing 1st dentary tooth to cut through egg at time of hatching or a birth defect?: Carpenter, 1982.

:unspecified tail injuries in Late Cretaceous hadrosaurs: Rein, 1990.

:notch in premaxilla of Late Cretaceous ankylosaur *Paleoscincus*: Gilmore, 1930; Rothschild, 1997.

:groove on 5th cervical vertebra prezygapophysis; pathological or post-mortem artifact?: Welles, 1984.

:twisting of proximal right fibula in a *Procompsognathus* skeleton: Sereno and Wild, 1992.

:unspecified pathological growth affecting ?fibula of Upper Triassic prosauropod *Camelotia*: Galton, 1998.

:brief mention of pathological dinosaur specimens recovered from the Upper Jurassic Cleveland-Lloyd Dinosaur Quarry, USA: Stokes, 1985.

:swelling of neural spines in Late Cretaceous hadrosaurs; a pathologic manifestation or just advanced-age related?: Brett-Surman, 1989.

:mention of D. Tanke's work on paleopathology in Late Cretaceous hadrosaurs and ceratopsians: Fiorillo, 1991.

:unspecified tail injury in *Tyrannosaurus*: Harlan, 1990.

:"mushroomed" distal end of ornithomimid pedal phalanx, Late Cretaceous, Alberta, Canada: Kawakami, 1996.

:possible foot injury in small theropod ichnogenus *Skartopus* as revealed by footprints: Wade, 1989.

:smooth pit and roughened knob on right prepubis of immature Late Cretaceous hadrosaur *Kritosaurus*: Waldman, 1969.

:abnormal orientation of orbital horncores in Late Cretaceous ceratopsian *Arrhinoceratops*; abnormal width of pachycephalosaur *Gravitholus* dome: Lessem and Glut, 1993.

:dome of Late Cretaceous pachycephalosaurid *Gravitholus* "pathological;" but unsubstantiated in paper: Maryanska, 1990.

:injured vertebra of *Tyrannosaurus*: McGinnis, 1982.

:trauma-related pathology affecting ilium blade of Upper Jurassic theropod *Marshosaurus*: Madsen, 1976b.

:deep lesion affecting proximal articulating surface of tibia in ?*Lambeosaurus laticaudus:* Morris, 1976, 1981.

:mention of paleopathologies in Late Cretaceous ceratopsians: Steel, 1969.

:unspecified injury affecting right orbital horncore of the Late Cretaceous ceratopsian *Chasmosaurus*: Sternberg, 1927.

:is the "folded frontal" complex in Late Cretaceous ceratopsian *Pachyrhinosaurus* abnormal? [later shown to be a normal feature]: Sternberg, 1950.

:ceratopsian pathology, general mention only: Swinton, 1965a.

:osteopathy of unspecified Late Cretaceous hadrosaur pedal phalanges: Tanke, 1989a.

:mention of rare occurrences osteopathy in the Late Cretaceous ceratopsians *Centrosaurus* and *Styracosaurus*: Tanke, 1989b.

:unspecified vertebral osteopathy in Late Cretaceous *Protoceratops*; related to advanced age: Tereshchenko, 1991.

:anomalous curvature of nasal horncore in 2 specimens of the Late Cretaceous ceratopsian *Pentaceratops*?: Lull, 1933.

:Late Cretaceous ceratopsian *Triceratops* with right mandibular ramus "somewhat pathologic;" no other details provided: Lull, 1933.

:swelling of anterior blade of left ilium in *Edmontosaurus*; figured without comment in Johnson and Stucky, 1995.

:unusual pit affecting second cervical ring (neck armor) of *Shamosaurus*: Ford, 2000a.

:manal pathology in DPP hadrosaurs unknown: Tanke, 1996e.

:ankylosaur *Tarchia* with bony growth within its sinus cavity; caused by an injury or infection that was connected to the outside of the face via an opening in the skull: Hanna, 2000 (see Laws); see also Gallagher et al., 1998; Tumanova et al., 1998.

:unusual notch between second and third epoccipitals in squamosal of Late Cretaceous *Chasmosaurus*: Holmes, Forster, Ryan and Shepherd, 2001.

:injured metatarsal I in Lower Cretaceous troodontid *Sinornithoides*: Currie and Dong, 2001.

MOODIE, ROY LEE

Work by: Parkinson, 1930.

MOSQUITOES

Crichton, 1990; Currie and Koppelhus, 1996; Voynick, 1996; Rubin, 1998; Poinar, Zavortink, Pike and Johnston, 2000.

MULTIPLE MYELOMA

In: Late Cretaceous ceratopsian *Torosaurus* squamosal: Lull, 1933; Moodie (in Lull, 1933); Norman, 1985; see also Tanke, manuscript.

NECROSIS

:Upper Jurassic *Camptosaurus* ilium: Moodie, 1923a; Rothschild, 1997.

:Upper Jurassic *Stegosaurus* plate: Moodie, 1919b, 1923a.

NEOPLASIA (See also CANCER)

:possibly causing jaw erosions in *Tyrannosaurus*: Rega and Brochu,

2001.

:hemangioma present in Late Cretaceous hadrosaur *Edmontosaurus*: Helbling, Rothschild and Tanke, 2001.

:occurrence of metastatic cancer, osteoblastoma and desmoplastic fibroma in Late Cretaceous hadrosaurs *Edmontosaurus*, *Hadrosaurus*, *Bactrosaurus*, *Gilmoreosaurus* and *Anatosaurus*: Helbling, Rothschild and Tanke, 2001.

NEWSPAPER AND MAGAZINE ARTICLES

Anonymous, 1934a; Colbert, 1947, 1961; Anonymous, 1965, 1969; Macdonald and Sibley, 1969; Anonymous, 1972, 1977a; Gonick, 1978; Talbot, 1978; Battaglia, 1979; Young, 1980; Currie, 1981; Anonymous, 1985; Aragon, 1985; Benton, 1985; Byers, 1987; Olinger, 1987a,b; Fritz, 1988; Leitch, 1988; Olshevsky, 1988; Reynolds, 1988; Tanke, 1988a; Anonymous, 1989a; Olshevsky, 1989; Sobel, 1989; Whitehead, 1989; Anonymous, 1990a,b; Harlan, 1990; Monastersky, 1990; Rein, 1990; Rempel, 1990; Anonymous, 1991a,b; Begley and Yoffe, 1991; Eamon, 1991; Johnson, 1991a,b; Monastersky, 1991; Wright, 1991; Anonymous, 1992a,b; Bakker, 1992; Bowler, 1992; Burnham, 1992; Greenberg, 1992; Larson, 1992a; McNamara, 1992b; Taylor, 1992; Westrup, 1992; Whitehead, 1992; Wycombe, 1992; Begley, 1993; Folger, 1993; Hecht, 1993b; McAuliffe, 1993; Morell, 1993a,b; Struzik, 1993; Walter, 1993; Anderson, 1994; McDonald, 1994; Aldhous, 1995; Hecht, 1995a; Larson, 1995; Marshall, 1995; Monastersky, 1995a,b; Anonymous, 1996a-f; Burgess, 1996; Carpenter, 1996; Currie, 1996; Hecht, 1996; Holmes, 1996; Monastersky, 1996; Stokstad, 1996; Tanke, 1996b; Tchoe, 1996; Anonymous, 1997a-c, e; Begley, 1997; DeFeo, 1997; Monastersky, 1997; Olert, 1997; Radford, 1997; Staedter, 1997; Varricchio, 1997; Zimmer, 1997; Anonymous, 1998d; Monastersky, 1999a, b; Webster, 1999; Gevock, 2001; Larson, 2001b; Paty, 2001; Perkins, 2001.

NOTOCHORDAL PROJECTIONS

In: caudal vertebrae of Late Cretaceous ankylosaur *Paleoscincus:* Gilmore, 1930.

OPISTHOTONUS (see also POISONING)

In: Upper Jurassic *Archaeopteryx* and *Compsognathus*; condition explained: Davis, 1996.

:opisthotonic-like condition affecting skeletons of *Archaeopteryx*, *Compsognathus* and *Struthiomimus*; =poisoning?: Moodie, 1923a.

:*Compsognathus:* Halstead and Middleton, 1972.

:taphonomic opisthotonus-like effect in Late Cretaceous *Struthiomimus*: Osborn, 1916; Desmond, 1976.

:taphonomic opisthotonus-like condition in Late Cretaceous *Gorgosaurus* skeleton: Keiran, 1999.

:*Plateosaurus*: Sander, 1992.

:Albian *Scipionyx*, Italy: Dal Sasso and Signore, 1998a, b.

:fossil and modern examples of this condition: Weigelt, 1927 [1989].

General discussions/rebuttals: Moodie, 1918d; Dean, 1919; Moodie, 1919a, b; Matthew and Brown, 1923; P, 1924; Kielan-Jaworowska, 1969; Swain, 1976; Davis, 1996.

ORAL CONDITIONS EXCLUSIVE OF DENTITION

Abscesses, hadrosaur: Lambe, 1902; Gilmore, 1924; Moodie, 1930b; Rothschild and Martin, 1992; Currie and Koppelhus, 1996 (popular); Tanke and Rothschild, 1997; Zhuo, 2000.

Amputation?: premortem loss of anterior dentition and mandibular symphyseal region in "*Labrosaurus*": Rothschild, 1997.

OSTEOARTHRITIS

Incorrectly cited as being common disorder in dinosaurs: Abrams, 1953; Norman, 1985; Rothschild and Tanke, 1992; Walter, 1993; Tanke, 1997 a, b; Tanke and Rothschild, 1997.

Comments on the misuse of the term "osteoarthritis" in dinosaurs/actual misuse: Rothschild, 1988a, 1990; Rothschild and Martin, 1992; Rothschild and Tanke, 1992; Rothschild, 1993; Horner and Lessem, 1993; Rothschild, 1997; Tanke, 1997a, b; Tanke and Rothschild, 1997; Zhuo, 2000.

In: Lower Cretaceous *Iguanodon*: Rothschild, 1988a; 1989b; Rothschild and Martin, 1992; Rothschild and Tanke, 1992; Rothschild, 1993, 1994, 1997; Hanna, 2000 (see Laws).

:affecting distal caudal vertebrae of a new Upper Jurassic sauropod *Camarasaurus*: McIntosh, Miles, Cloward and Parker, 1996 (actually DISH?].

:"degenerative arthritis" affecting pedal phalanges and caudal vertebrae in Upper Jurassic *Allosaurus*: Petersen, Isakson and Madsen, 1972.

OSTEOCYTES

Pawlicki, Korbel and Kubiak, 1966; Pawlicki, 1977a, 1978a, 1984b,c; Fukuda, 1987; Schweitzer, 1993.

OSTEOMA

In: Late Cretaceous ankylosaur *Tarchia* skull (sinus region): Gallagher, Tumanova and Dodson, 1998; Tumanova, Gallagher, Dodson and Axel, 1998 [probably not an osteoma].

OSTEOMYELITIS

In: severe case, affecting tibia of Early Cretaceous unspecified hypsilophodont: Monaghan, Rich and Rich, 1991 [erroneously described here as a healed fracture]; Gross, Rich and Vickers-Rich, 1993; Tanke and Rothschild, 1997; Long, 1998; Vickers-Rich and Rich, 1999; Hanna, 2000 (see Laws).

:tibia of unspecified Late Cretaceous hadrosaur, Alberta, Canada: Lindblad, 1954; Anonymous, 2000a.

:general comment: Rothschild and Tanke, 1998a.

:unspecified Late Cretaceous tyrannosaurid pedal phalanx with associated lesions of gout: Rothschild, Tanke and Carpenter, 1997.

:pus-draining sinus in ilium of Upper Jurassic *Allosaurus*: Travsky, 1996.

:infected pedal phalanx in Upper Jurassic *Allosaurus* suggestive of traumatic amputation: Petersen, Isakson and Madsen, 1972.

:affecting scapulae of 2 *Allosaurus* individuals: Petersen, Isakson and Madsen, 1972.

:rarity of infections in dinosaurs: Rothschild and Tanke, 1992.

:chronic osteomyelitis of tail spikes of Upper Jurassic stegosaur *Stegosaurus* following traumatic open fractures: Gilmore, 1914; Carpenter, 1998; McWhinney, Rothschild and Carpenter, 1998, submitted; Milstein, 2000.

:pedal phalanx in Early Cretaceous theropod *Deinonychus* following fracture: Marshall, Brinkman, Lau and Bowman, 1998.

:hadrosaur manus following fracture; *Camptosaurus* ilium with necrosis: Rothschild, 1997.

:healed osteomyelitis of left fibula, possible presence in proximal humerus of *Tyrannosaurus*: Rega and Brochu, 2001.

:tibia of *Tyrannosaurus*, following fracture: Larson, 2001b.

:neck of *Tyrannosaurus*, following fracture: Larson, 2001b.

OSTEOPHYTES

In: mid-caudal vertebra and phalanx of unspecified Late Cretaceous ceratopsians, Alberta, Canada: Johnson and Storer, 1974.

:"nodes" or protuberances" [=osteophytes?] affecting various elements from unspecified dinosaur elements collected from the Upper Jurassic Cleveland-Lloyd dinosaur quarry: Petersen, Isakson and Madsen, 1972.

:*Edmontonia* dorsal vertebra, *Iguanodon* metatarsals: Rothschild, 1997.

:"exuberant" osteophyte formation affecting *Tyrannosaurus* vertebrae: Rega and Brochu, 2001.

:"bone spurs" affecting hand of *Tyrannosaurus*= gout: Perkins, 2001.

:"osteophytic spurs" affecting right scapula/coracoid region of *Tyrannosaurus*: Larson, 2001b.

:bony interfingerings on proximal neural spines in *Tyrannosaurus*; possibly related to mating trauma: Larson, 2001b.

PAIN

In: Late Cretaceous pachycephalosaurid *Stygimoloch* via flank-butting behavior: Carpenter, 1993, 1997.

:Late Cretaceous pachycephalosaurids *Pachycephalosaurus*, *Prenocephale* and *Stegoceras* via flank-butting behavior: Carpenter, 1997.

:Upper Jurassic unspecified sauropods after having tail stepped on by conspecifics: Gonick, 1978.

:"agony;" Upper Cretaceous hadrosaur *Corythosaurus* as demonstrated by the thrown back posture of the head: Helder, 1991 (creationist viewpoint).

:"severe arthritic pain" in *Tyrannosaurus* due to fusion of vertebrae: Norman, 1985.

:painful rib fractures and cervical and dorsal vertebrae fusions in Late Cretaceous *Tyrannosaurus*: Dingus, 1996.

:baby *Tyrannosaurus* suffering from a mid-fibula fracture (science fiction): Crichton, 1995.

:Late Cretaceous *Albertosaurus* following fracture of fibula and ribs (science fiction): Felber, Currie and Sovak, 1998.

:due to various bone fractures in unspecified dinosaurs (popular): Currie and Koppelhus, 1996.

:implied from limping dinosaur trackways: Tanke and Rothschild, 1997.

:via rib fractures in *Tyrannosaurus*: Anonymous, 2000b.

:due to toe injuries and infection in *Allosaurus*: Hanna, 2000 (see Laws).

:due to broken leg in *Tyrannosaurus*: Perkins, 2001.

:Late Cretaceous *Ornithomimus* following high speed fall which shatters shoulder region and humerus: Keiran, 2001.

PALEOBIOCHEMISTRY and RELATED TOPICS

Amino acids: *Anatosaurus* and *Stegosaurus*: Abelson, 1954a.

Stegosaurus: Abelson, 1954b.

Carbon-13: Folinsbee, Fritz, Krouse and Robblee, 1970 (eggs); McNamara, 1992a (*Anatosaurus* and unspecified hadrosaur bone).

Chemical elements:

:of dinosaur bone: Bocherens, 1997.

Isotopes: Oxygen isotopes in Late Cretaceous *Tyrannosaurus rex:* Anonymous, 1992b; 1994b; Barrick and Showers, 1994.

:dinosaurs generally: Bocherens, 1997.

Lipids: in Late Cretaceous tyrannosaur *Tarbosaurus* bone: Pawlicki, 1977b.

Molecules: biomolecules in Late Cretaceous *Tyrannosaurus:* Schweitzer, 1993; Schweitzer, Cano, Starkey and Horner, 1994.

:dinosaurs generally: Rothschild, 1989a; Bocherens, 1997.

Mucopolysaccharides: Pawlicki, 1977a.

Nitrogen-15: *Anatosaurus* and unspecified hadrosaur bone: McNamara, 1992a.

Osteocalcin: Bowler, 1992; Muyzer, Sandberg, Knapen, Vermeer, Collins and Westbroek, 1992.

Oxygen-16: Folger, 1993.

Oxygen-18: Folinsbee, Fritz, Krouse and Robblee, 1970 (eggs); Folger, 1993.

Proteins: Upper Jurassic sauropod *Seismosaurus*: Anonymous, 1991a; Gurley, Valdez, Spall, Smith and Gillette, 1991; Monastersky, 1991.

:Upper Jurassic sauropod *Diplodocus*: Miller and Wyckoff, 1968.

:Upper Cretaceous *Tyrannosaurus*: Schweitzer, 1993.

PALEOPARASITOLOGY

:potential use of coprolites for study of dinosaur paleoparasitology: Chin, 1994.

:possible role of parasites on dinosaur predator-prey dynamics: Kuris, 1996.

See also MOSQUITOES; Tanke and Rothschild, 1997.

PALEOPATHOLOGY AND BEHAVIORAL IMPLICATIONS

In: large theropod dinosaurs; intraspecific face-biting behavior-possible reasons for: Tanke and Currie, 1995; Milstein, 2000; Niiler, 2000; Tanke and Currie, 1998 (2000).

:Late Cretaceous ceratopsians: Gabriel and Berghaus, 1988; Tanke and Rothschild, 1997.

:Upper Jurassic *Allosaurus* pathologies indicate ".... a good deal of violent activity" (mention only): Bryant, 1998.

PARASITES

:possible parasite damage to skin of Lower Jurassic *Scelidosaurus*, Charmouth, England: Martill, 1991.

:possible role of parasites on dinosaur predator-prey dynamics: Kuris, 1996.

:79 million year old mosquito from Alberta, Canada: Poinar, Zavortink, Pike and Johnston, 2000.

:pitting on ankylosaur scutes possibly attributable to parasites: Moodie, 1910 (*Stegoplata*); Ford et al., 1998; Kirkland, 1998 (*Gastonia*).

:general discussion: Anonymous, 1999a.

:mite eggs on fossil bird feathers: Martill and Davis, 1998a, b; Anonymous, 1999a; Martill, 2001.

"PARONYCHODON" OR *"PARONYCHODON*-LIKE" TEETH

Cope, 1876; Marsh, 1892b; Russell, 1935; Sahni, 1972; Lehman, 1981; Breithaupt, 1985; Standhardt, 1986; Currie, Rigby and Sloan, 1990; Telles Antunes and Sigogneau-Russell, 1991; Zinke and Rauhut, 1994; Baszio, 1997; Girouard, 1997; Zinke, 1998; Peng et al., 2001.

PHYSIOLOGY OF DINOSAURS: REPTILIAN, MAMMALIAN, AVIAN?

Paladino et al., 1996.

PLAY

Causing injuries in extant juvenile *Ibex capra*; did juvenile dinosaurs play too?: Byers, 1987; Tanke and Currie, 1998 (large theropods).

POISONING (see also OPISTHOTONUS)

Alkaline water: Upper Triassic *Coelophysis*: Ratkevitch, 1976.

Arsenic: Xia et al., 1983, 1984; Lessem, 1992.

Botulism: Varricchio, 1997.

Cyanide: Chubb, 1989.

Nickel: Beard, 1990.

Plant toxins: Swain, 1974; Desmond, 1976; Swain, 1976, 1987.

Strychnine: Moodie, 1918d, Dean, 1919; Moodie, 1923a; Desmond, 1976.

POSTURE

In *Diplodocus* and other sauropods: Holland, 1910; Desmond, 1976.

PREDATORY BEHAVIOR

Evidence of: Late Cretaceous *Tyrannosaurus rex* attacks hadrosaur *Edmontosaurus*; the latter escapes with caudal neural spine osteopathy: Carpenter, 1988a; Horner and Lessem, 1993; Johnson and Stucky, 1995 (figured only); Carpenter, 1998 (2000); Erickson, 1999, 2000; Anonymous, 2000f; Paty, 2001.

:*Kritosaurus* skull roof showing possible healed bite marks (punctures and tooth drag marks) on dorsal surface: Horner, 1992.

:Late Cretaceous ankylosaur *Tarchia* skull with possible healed predator (tyrannosaur *Tarbosaurus*) bite wound and osteoma development within sinus cavity: Gallagher, Tumanova and Dodson, 1998; Tumanova, Gallagher, Dodson and Axel, 1998.

:Aptian-aged iguanodont *Lurdusaurus* showing healing transversely-oriented tooth punctures (2) and associated bone trauma to left prepubis: Taquet and Russell, 1999.

PSEUDOARTHROSIS (FALSE-JOINT) DEVELOPMENT

:gastralium of Late Cretaceous *Gorgosaurus*: Currie, 1997a.

:ceratopsian [cf. *Anchiceratops*] orbital horncore tip: Rothschild and Tanke, 1992.

:Upper Jurassic *Apatosaurus* dorsal rib: Chenoweth, 1987.

:Upper Jurassic *Allosaurus* gastral ribs: Tanke (in Gilmore, 1920a); Claessens, 1996, ms.

:sauropod *Shunosaurus* tailclub; are the "caudal spines" actually pathologic caudal neural spines, traumatized and forming pseudoarthroses?: see comments by Tanke (in Zhang, 1988).

:ribs in *Tyrannosaurus*: Perkins, 2001; Rega and Brochu, 2001.

:general comment: Tanke and Rothschild, 1997.

PSEUDOPATHOLOGY

:general discussion: Rothschild, 1997.

:supposed fractures of Upper Jurassic *Allosaurus* scapula and ribs maybe attributed to post-mortem crushing and thus non-pathologic: pseudopathology: Ayer, c. 2000.

"PUNCHED-OUT" LESIONS

In: Late Cretaceous ceratopsian *Pachyrhinosaurus* squamosal and other unspecified centrosaurine ceratopsian cranial elements; the former associated with other cranial osteopathy: Rothschild and Tanke, 1997.

:cystic lesions affecting Late Cretaceous *Torosaurus* squamosal: Lull, 1933.

PUNCTURES (see also EXTRA OPENINGS IN FRILLS OF HORNED DINOSAURS)

:scapula blade in Late Cretaceous hadrosaur "*Claosaurus annectens*": Beecher, 1902; Hatcher, Marsh and Lull, 1908; Moodie, 1923a.

:jugal of Late Cretaceous ceratopsian *Triceratops*: Erickson, 1966; Forster and Sereno, 1997.

:non-penetrating puncture (circular depression) affecting left squamosal of Late Cretaceous ceratopsian *Centrosaurus*: Tyson, 1977.

:cheeks and frills of unspecified Late Cretaceous ceratopsians: Fastovsky and Weishampel, 1996; Tanaka, 1998.

:possible goring injury in Late Cretaceous ceratopsian *Pachyrhinosaurus:* Rothschild and Tanke, 1996, 1997.

:anterior to and just above right orbit in a Late Cretaceous ceratopsian *Torosaurus*: Lull, 1933.

:possible healing bite wounds (tooth punctures) affecting dorsal rib head and ?16th caudal neural spine in *Acrocanthosaurus*: Harris, 1997, 1998.

:frontal of Upper Cretaceous ceratopsian *Triceratops*: Moodie, 1923a.

:back of skull of *Tyrannosaurus* "Stan" shows puncture wound-fits a *Tyrannosaurus* tooth "perfectly": Anonymous, 1997f; Larson, 2001a (general), b.

:complex ridge and groove arrangement of tubercles in hadrosaur skin may have served to add structural reinforcement to add resistance against tearing or puncturing: Anderson et al., 1998.

:puncture-type lesion affecting the ectopterygoid of a possible new species of the Late Cretaceous tyrannosaur *Daspletosaurus*: Williamson and Carr, 1999.

:"dent" affecting side of face [jugal] of *Triceratops*: Benton, 2000.

:healed puncture wound to rib of *Tyrannosaurus* "Stan" attributed to intraspecific bite: Larson, 2001b.

:puncture wounds affecting jaws of *Tyrannosaurus*: Larson, 2001b.

See also Tanke and Farke, manuscript (ceratopsians).

RADIOGRAPHY (X-RAY) TECHNIQUES

Pawlicki and Bolechala, 1987; Fraser and Shelton, 1988; Rothschild, 1989a; Pawlicki and Bolechala, 1991; Rothschild, 1995.

RESORPTION PITTING

In: Late Cretaceous ceratopsian *Einiosaurus*: Sampson, 1995.

:centrosaurine ceratopsian postorbital horncores: Sampson, Ryan and Tanke, 1997; Holmes, Forster, Ryan and Shepherd, 2001; Tanke and Farke, ms.

RICKETS

Anonymous, 1977a; Elisseyev, 1977.

SAUROPOD TAILCLUBS

:*Shunosaurus*: Tanimoto, 1988; Zhang, 1988; Dong et al., 1989; Olshevsky, 1989; Gore, 1993; Lessem and Glut, 1993.

:*Omeisaurus*: Tanimoto, 1988; Dong et al., 1989.

SCANNING ELECTRON MICROSCOPE (SEM) STUDIES

Pawlicki, 1975, 1976, 1978a (see other entries under Pawlicki).

SCARRING

:bodies of *Velociraptor* due to intense intraspecific fighting around kill sites (science fiction): Crichton, 1995.

:bodies of Late Cretaceous tyrannosaurid *Albertosaurus* due to inter- and intraspecific fighting trauma: Felber, Currie and Sovak, 1998.

SCIENCE FICTION/FANTASY

Crichton, 1990, Gurney, 1992; Bakker, 1995; Crichton, 1995; Gurney, 1995; Felber, Currie and Sovak, 1998.

SEPSIS

Rotting meat particles trapped between tooth serrations leads to a septic bite on prey or conspecifics (see also BACTERIA): Abler, 1992, 1997; Douglas and Young, 1998; Young, 1998; Abler, 1999, 2000; Anonymous, 2000f; Benton, 2000; Tanke and Currie, 1998 (2000).

SEX DIFFERENCES

In *Tyrannosaurus*/tyrannosaurids: Fischman, 1993; Larson, 1994a, 1995.

SOFT TISSUE PRESERVATION

Early Cretaceous small theropods: Kellner, 1996; Dal Sasso and Signore, 1998a, b.

Feathers: Davis and Briggs, 1995.

Keratin: Late Cretaceous *Mononykus* ?feathers and Cretaceous bird ungual: Schweitzer, 1998.

Late Cretaceous embryonic dinosaur: Horner, 1997.

Muscles: Lull and Wright, 1942 (hadrosaurs).

Skin: Lull and Wright, 1942; Monastersky, 1999a (hadrosaur); Czerkas, 1997 (sauropod); Chang, 1998 (titanosaur sauropod embryo); Anonymous, 1998g; Chiappe, 1998; Chiappe et al., 1998, 1999 (sauropod).

Unspeciated Late Cretaceous therizinosaur embryos: Cohen, Cruickshank, Joysey, Manning and Upchurch, 1995 (possible skin, muscle and cartilage preservation); Anonymous, 1998a (egg yolk and cartilage).

SPINA BIFIDA

In: spina bifida occulta and spina bifida meningocele affecting distal caudal vertebrae (improperly developed neural arches and arch bases) of Upper Jurassic sauropod *Camarasaurus*: McIntosh, Miles, Cloward and Parker, 1996.

SPONDYLITIS DEFORMANS/SPONDYLOSIS

:general discussion: Rothschild, 1997; Tanke and Rothschild, 1997.

:*Diplodocus*: Ackerknecht, 1953; McGinnis, 1982.

:*Apatosaurus*: McGinnis, 1982.

(These occurrences are actually DISH; see DIFFUSE IDIOPATHIC SKELETAL HYPEROSTOSIS entry above).

:"spondylitis deformans" in dinosaur vertebrae possibly a non-pathological fusion similar to fusion of thoracic vertebrae in extant birds: Sokoloff, c. 1960.

STARVATION

implicated in a specimen of the sauropod *Mamenchisaurus* due to absence of wear on the teeth: Russell and Zheng, 1993.

STROKE

In: *Barosaurus*: Choy and Altman, 1993; Naeye, 1993.

STUDENTS (CURRENT/RECENT) OF DINOSAUR PALEOPATHOLOGY

Brochu, C.: Gevock, 2001.

Hanna (nee Laws), R.: See Hanna and Laws entries; Anonymous, 2001a.

Goldman, L.: Talbot, 1978.

Martin, L.D.: Wright, 1991.

McWhinney, L.: see McWhinney entries.

Rega, E.: Gevock, 2001.

Rothschild, B.M.: Monastersky, 1990; Wright, 1991; Torassa, 1997.

Tanke, D.H.: Monastersky, 1990; Rempel, 1990; Tanke, 1991; Wright, 1991; Westrup, 1992; Spalding, 1999.

Tumarkin, A.: See Tumarkin entry.

TAIL DRAGGING

(Possibly related to pathology):

:ornithopod dinosaur trackway: Gillette and Thomas, 1985; Hunt and Lucas, 1998.

TAPHONOMY

:preferential preservation of right dorsal ribs vs. left in *Pachyrhinosaurus* mass mortality bonebed deposit: Tanke, 1996d.

TENDONS (OSSIFIED)

:Australian ankylosaur *Minmi:* Molnar and Frey, 1987.

:Late Cretaceous hadrosaur Anatosaurus and ankylosaur *Ankylosaurus*: Moodie, 1928.

:general comments: Rothschild and Tanke, 1992.

:hadrosaurs: Lull and Wright, 1942.

THERMOPHYSIOLOGY

:dinosaurs: Barrick, 1996.

:Late Cretaceous *Tyrannosaurus rex*: Barrick and Showers, 1994. [See

annotation following Barrick and Showers entry for addition citations].

TOOTH/TEETH

Cracks in enamel: Rensberger, 1987.

Damage to serrations: Tyrannosaurids: Schowalter, 1995a; Tanke and Currie, 1998 (2000).

Dental caries: absence of in dinosaurs: Rothschild and Tanke, 1992; Currie and Koppelhus, 1996; Tanke and Rothschild, 1997.

Double-cusped: *Tyrannosaurus rex*: Anonymous, 1991b.

Fractures of: Tyrannosaurids: Farlow and Brinkman, 1987, 1994; Farlow, Brinkman, Abler and Currie, 1991; Jacobsen, 1995a, b; Abler, 1997 (mention only); Tanke and Rothschild, 1997; Felber, Currie and Sovak, 1998; Molnar, 1998 (2000); Mongelli, Varricchio and Borkowski, 1999; Tanke and Currie, 1998 (2000); Abler, 2001.

:*Tyrannosaurus rex:* Molnar, 1973; Carpenter, 1979; Lessem, 1988; Molnar, 1991 (premaxilla tooth).

:*Saurornitholestes*: Jacobsen, 1995a; Currie and Jacobsen, 1995.

:*Allosaurus*: Madsen, 1976a.

:unspecified theropod, Early Jurassic, Antarctica: Hammer and Hickerson, 1993; Hammer, 1997.

:unspecified theropods (popular): Currie and Koppelhus, 1996.

Malformed: Late Cretaceous *Tyrannosaurus* tooth, shortened, "squashed serrated edge," "sickly, blackish gray" coloration vs. "varnished brown" coloration of other normal teeth and bone in this specimen: Webster, 1999.

Malpositioning of: *Aublysodon* dentary tooth slanted posteriorly: Lehman and Carpenter, 1990.

:general comment: Tanke and Rothschild, 1997.

Pre- and postmortem cracking of enamel: Rensberger, 1987.

Presence of extra carinae (large theropods): Bohlin, 1953; Erickson, 1993a,b, 1995.

Presence of extra carinae (small theropods): Fiorillo and Gangloff, 2000.

Presence of extra serration rows on tyrannosaur tooth: Abler, 1997.

Serration design helps prevent tooth fracture in tyrannosaurids: Abler, 2001.

Supernumerary serration rows: *Dromaeosaurus*- Fiorillo and Gangloff, 2000; unspecified Campanian tyrannosaur- Abler, 1997.

Toothmarking of: in tyrannosaurids: Abler, 1992; Jacobsen, 1995a; Schowalter, 1995a, b; Tanke and Currie, 1995; Douglas and Young, 1998.

Wear of:

Absences of heavy tooth wear or tooth fractures: *Diplodocus* Hay, 1908.

TOOTH-MARKED BONE

Hammer and Hickerson, 1993; Jacobsen, 1995a, b; Currie and Jacobsen, 1995; Schowalter, 1995a; Erickson and Olsen, 1996; Erickson, Van Kirk, Su, Levenston, Caler and Carter, 1996; Tanke and Currie, 1995; Jacobsen, 1998; Tanke and Currie, 1998 (2000).

TRANSMISSION ELECTRON MICROSCOPE (TEM) STUDIES OF DINOSAUR BONE

Pawlicki, 1978a,b; see other entries under Pawlicki; Zocco and Schwartz, 1994.

TUBERCULOSIS

In: "massive overgrowth" affecting an Upper Jurassic *Allosaurus* pedal phalanx attributed to possible case of tuberculosis or trauma: Petersen, Isakson and Madsen, 1972.

TUMORS

In: unspecified Late Cretaceous hadrosaur vertebrae: Norman and Milner, 1989.

:Late Cretaceous Romanian hadrosaur *Orthomerus*: Campbell, 1966; Swinton, 1970; Reid, R., 1984.

:Upper Jurassic *Allosaurus* humerus (ACTUALLY INFECTED HEALED FRACTURE): Greenberg, 1992; Stadtman, 1992, Taylor, 1992; Wycombe, 1992; Stadtman, 1993; Tanke and Rothschild, 1997.

:claim of malignant tumor in dinosaur withdrawn: Zhuo, 2000.

UNSPECIFIED PATHOLOGICAL CONDITIONS

:affecting cervical and caudal vertebrae, femur and tibia of Chinese Upper Jurassic sauropod *Mamenchisaurus hochuaensis*: Anonymous, 1965.

VASCULAR IMPRESSIONS IN BONE

Saul and Saul, 1992, 1993 (both in *Homo sapiens*, but equally relevant to dinosaurs).

VENOM

:possible envenomation capabilities in an unspecified small theropod, Campanian of Mexico: Hecht, 2000; Rodriguez-De La Rosa and Aranda-Manteca, 2000.

WEAPONRY IN DINOSAURS

:horns in ceratopsians: Berghaus and Gabriel, 1988.

:tailclubs as weapons: Paul, 1988.

:tails as weapons: Paul, 1988 (Stegosaurus); McIntosh, Miles, Cloward and Parker, 1996 (sauropod Camarasaurus).

:teeth in Early Jurassic Heterodontosaurus useful for intraspecific fighting: Weishampel, 1992.

Diplodocus tail, unspecified stegosaur and ankylosaur tails (and associated armor) as weapons: Gertsch, 1994.

:tail in sauropods; was it used as a "whip"?: Coombs, 1975; Christiansen, 1996b.