ANNOTATED BIBLIOGRAPHY

of the

SUBCLASS ARCHOSAURIA
(Class: Reptilia)

Jan 1960 - Dec 1984

by

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ABSTRACT

The subclass Archosauria includes some of the most successful vertebrates to have evolved. Although traditionally viewed as 'cold-blooded' (= ectothermic) and therefore evolutionarily inferior to 'warm-blooded' (= endothermic) mammals and birds, data collected since the 1960s has resulted in significant re-evaluations and a complete re-assessment of archosaur evolution, taxonomy, and inferred physiology and behaviour. Much of the relevant data emanates from the results of post WWII field work conducted in eastern Central Asia (particularly the Gobi Desert) by Russian, Polish and Mongolian palaeontologists. However, due to political, cultural and/or other reasons, there remained little scientific collaboration between them and western (particularly US) scientists until very recently. As a consequence, there developed a dichotomy in this field of archosaur research, not only between east and west, but also between Europe and the US. This thesis reviews the literature on archosaurs published world-wide from Jan 1960 - Dec 1984, with the emphasis on the important Central Asian/Gobi contributions, in order to evaluate the academic discussions that have arisen regarding archosaur evolution, physiology, behaviour, their relationship to the Aves, and the evolution of avian endothermy and flight.

Keywords: Archosaur evolution; Archosaur physiology; Aves; Avian evolution; Avian flight; Dinosaur life habits; Ectothermy; Endothermy; Ornithischia; Pterosauria, Saurischia, Thecodontia

1. INTRODUCTION

The vertebrates have historically been divided into eight classes, namely the Mammalia, Aves, Reptilia, Amphibia, Osteichthyes (higher bony fish), Chondricthyes (shark-like fish), Placodermi (archaic-jawed fish), and Agnatha (jawless fish) (appendix: Romer, 1974, p 37).The distinctions between the classes have traditionally assumed to be due to differing evolutionary advancement, from highest (Mammalia) to lowest (Agnatha), corresponding to their age of origin in the fossil record. The Mammalia and Aves are placed are placed at the top of the vertebrate family tree as much due to their shared characteristic of warm-bloodedness (the state of endothermy) as the fact that they were the most recent groups to evolve (appendix: Romer, 1974, p 36). This view now presents difficulties in interpretation, however, because although mammals first appeared at a similar time as the first dinosaurs (subclass Archosauria), they did not undergo any evolutionary radiation until after most archosaurs (which were assumed to have been cold-blooded or 'ectothermic') had already become extinct. Thus in evolutionary terms, mammals would have to be seen as neither physiologically nor morphologically more advanced than archosaurs. During the 1960s, it was suggested from several quarters that some dinosaurs (particularly the Theropoda which are closely related to the Aves) may have also attained a state of endothermy. These suggestions began a series of academic debates that have continued to this day, and involve the physiology and behaviour of archosaurs, and the evolutionary relationship between theropods and birds. In the same decade, an important series of palaeontological expeditions took place in the Gobi Desert of Mongolia; the joint Polish-Mongolian expeditions (1963-1971). These had followed earlier Russian Academy of Science expeditions (1946-49) to the same area, which had in turn followed the pioneering Gobi field work of the American Museum of Natural History (1922-30). The Polish-Mongolian expeditions found many totally new families of dinosaurs, including new theropods as well as ancestral avians. In addition, they collected more examples of Cretaceous mammals than had previously been collected world-wide (Kielan-Jaworowska, 1969b). They were also able to re-evaluate many of the finds and conclusions of previous field work. Their work, as well as that of subsequent Russian-Mongolian field work carried out from 1969-92, and other field work in Inner Mongolia and China by several countries, has confirmed eastern Central Asia as the most important fossil repository for Cretaceous archosaurs, ancestral avians, and the Mesozoic mammals that co-existed with them. Study of the Gobi material has altered many concepts regarding archosaur/avian evolution and physiology. Much of this research is available for comparative analysis with other archosaur literature (both academic and popular) on related topics.

2. SCOPE OF THE BIBLIOGRAPHY

2.1 Statement of the Problem

Outside of the class Mammalia, the subclass Archosauria includes the most successful vertebrates to have evolved in terms of duration in the fossil record, and successful inhibition of competitors' evolutionary radiation (Mammalia and Aves). The Archosauria comprise five orders, four of which are extinct, namely the Thecodontia, Pterosauria, Saurischia, and Ornithischia. The extant order is the Crocodilia. Because birds are closely related to saurischian archosaurs, the class Aves is generally included in any discussion of the Archosauria. Until recently, the Archosauria has not received the same scientific attention as the Mammalia, partly due to the fact that it has comparatively few surviving members, and partly because it has always been placed within the class Reptilia, long considered less evolutionarily developed than the endothermic Mammalia or Aves (appendix: Romer, 1966, 1974).

Since the 1960s, however, previously accepted views on archosaur physiology, evolution and behaviour began to be questioned, leading to discussion and debate amongst palaeontologists, and between them and ornithologists. Questions centred on the concept that archosaurs may not have exhibited typical reptilian physiology, and on whether or not theropod archosaurs were the direct ancestors of the Aves. It is now recognized that the distinction between the Theropoda and the Aves is not clear, and some authors (eg. Bakker) have proposed including the Aves along with the Theropoda taxonomically within the Archosauria, a move strongly opposed by some ornithologists.

Whereas pre-1960 archosaur literature primarily originated from North American and West European authors, during the 1960s the results of East European field work in Central Asia began to be available in the West. Such work was very relevant to issues under discussion, as it often involved those archosaurs that had been the subject of debate. In spite of this situation, because of political and cultural reasons, there remained almost no scientific interchange between East European and Western palaeontologists until very recently. The first major collaboration between Eastern and Western palaeontologists took place from 1993 - 1996 (appendix: Benton *et al*, 2000, p. xiii).

In addition, it should be noted that aspects of fossil dating techniques and stratigraphic protocols/terminology had developed quite independently in Russia (and, as a result, Poland) compared to those of the US (appendix: Jerzykiewicz, 2000, p 279). There have since been attempts to standardize the two systems (appendix: Benton, *et al*, 2000). This scenario thus presents an opportunity to compile a retrospective review of literature on extinct archosaurs, firstly in order to analyse the stages of arguments raised by authors from the 1960s, and secondly to identify instances where research may have been hindered by the lack of collaboration. The 25-year period 1960-1984 (incl.) has been chosen so as to include most of the extensive literature resulting from the Polish-Mongolian field work (1963-71).

2.2 Study Objectives

The objectives of this thesis are as follows (all refer to the period 1960-1984):

- Identify all relevant literature concerning extinct archosaurs
- Evaluate the East European literature concerning archosaur finds from the Gobi/Central Asia
- Contrast literature on archosaur physiology, behaviour, evolution and ecology by highlighting the debates that emerged during the 1960s
- Contrast the literature concerning the evolution of birds, avian plumage, and the attainment of avian flight
- Discuss or note where research has been hampered or misled by the lack of collaboration between Eastern and Western palaeontologists

2.3 Definition of Subject Material

Although the recognition of many taxonomic groups within the class Reptilia is somewhat loosely based, all forms included in the subclass Archosauria exhibit shared evolutionary trends that fully justify their inclusion in that group (appendix: Romer, 1966, ch. 11). The main features are found in the limb and girdle constructions that led to major improvements in locomotor abilities and the evolution of parasagital femoral movement whereby the limbs are held vertically beneath the body as in mammals and birds rather than splayed to the side as in other reptiles. This factor at least partly if not fully enabled archosaurs to rise to ecological and evolutionary dominance from the late Triassic to the late Cretaceous, after which four of the orders became extinct. Apart from the implications of bipedality (in early and many later archosaurs) and parasagital mobility, changes in the dentition were also evident. Whereas archosaurs were primitively carnivorous (a feature retained by the Theropoda), there was loss of teeth among the ornithischians, in some cases these being replaced by a horny edentulous 'bill'. In many instances, the cheek teeth had also been modified for herbivorous diets. There are few diagnostic osteological features that unite all archosaurs, the possession of two temporal skull openings (the diapsid condition) being the principal one. The condition is not, however, limited to the Archosauria, and is also found within the rhynchocephalians (the extant *Sphenodon*, or tuatara of New Zealand), as well as in other reptiles totally unrelated to archosaurs (appendix: Romer, 1974, p 158).

2.4 Glossary of Main Terms

- Archosaur: reptilian subclass containing five orders, namely Crocodilia, Ornithischia, Pterosauria, Saurischia, Thecodontia
- Aves: vertebrate class directly related to saurischian archosaurs
- Cretaceous: last period of the Mesozoic or Age of Reptiles
- Crocodilia: extant archosaur order including alligators, caimans, crocodiles, ghavials
- Ectothermy: physiological state whereby blood and body temperature are largely dependent on environmental temperature. Most members of Fish, Amphibia, and Reptilia fall into this category
- Endothermy: physiological state whereby blood and body temperature are maintained largely independently of environmental temperature. All members of Mammalia and Aves fall into this category
- Jurassic: middle period of the Mesozoic
- Ornithischia: archosaur order of 'bird-hipped' dinosaurs
- Pterosauria: archosaur order of flying reptiles
- Saurischia: archosaur order of 'reptile-hipped' dinosaurs
- Thecodontia: archosaur order of 'stem reptiles', the basal stock of all archosaurs
- Therapsids: mammal-like reptiles that gave rise to mammals
- Triassic: first period of the Mesozoic

2.5 Delimitations/Limitations

The primary delimitation of the thesis is the exclusion of articles concerning the extant Crocodilia, except in cases where they a) specifically concern topics under consideration, or b) discuss the Crocodilia in relation to other archosaurs. In addition, articles concerned solely with taxonomic descriptions will not be included, unless they have bearing on topics under consideration. The primary limitation is that due to the extensive and multi-lingual nature of the literature, and the fact that access to much of it is via English language abstracting services, it is not possible to cover all literature in such a wide field as the Archosauria. However, primary access to several key East European journals will partially rectify this situation.

3. HISTORICAL CONTEXT OF SUBJECT MATTER

3.1 Dinosaurs

Among archosaurs, the most diverse and prolific evolutionary radiation occurred within the orders Ornithischia and Saurischia (particularly the Theropoda), and it is with these orders (sometimes loosely united under the term 'dinosaur') that much of the literature has been concerned. The first dinosaur remains were described in the 1820s by British naturalists (appendix: Farlow and Brett-Surman, 1997, ch 1), but most descriptions of new types came from North America in the latter half of the 19th century, during which time the general foundations of dinosaur taxonomy were established.

The term 'Dinosauria' was introduced in 1842 by Sir Richard Owen to include several known types of giant reptiles unable to be otherwise classified. Owen's classification stood unaltered until 1877 when H.G. Seeley advanced a more comprehensive grouping involving the two currently recognized orders. Dinosaurs with the pubis bone directed anteroventrally, as in typical reptiles, were assigned to the Saurischia, while those with a postpubic process (the supposed homologue of the saurischian pubis) directed posteroventrally as in birds, were assigned to the Ornithischia (appendix: Spalding, 1993, p 73). This classification is no longer adequate, as some Gobi saurischian theropods (segnosaurs) are known to have had pubes directed posteroventrally (Barsbold and Perle, 1980). Seeley included both orders in the greater subclass Archosauria along with the orders Crocodilia, Pterosauria, and the Thecodontia, the 'stem' group from which the other four orders, and the class Aves, were derived.

By the early 20th century, major dinosaur finds were being made in Tendaguru (Tanzania) by German workers from 1907-1912 (appendix: Spalding, 1993, pp 256-264). After WWI, interest in vertebrate palaeontology shifted toward Central Asia in general, and the Gobi Desert in particular, resulting in the elaborate expeditions of the American Museum of Natural History (1922-1930), followed by Russian field work (1946-49), and Polish-Mongolian field work (1963-71). Because the American work had been inspired by the theories of Henry Fairfield Osborn who had envisaged Central Asia as the origin of many vertebrate groups, there was a tendency for new finds to be summarily relegated to the bases of family trees. In many instances, however, subsequent work has re-evaluated these finds and promoted them to more derived and specialised positions.

3.2 Pterosauria and Thecodontia

In contrast to those of ornithischians and saurischians, finds of pterosaurs and thecodonts have been less prolific/more fragmentary (due to the fact that such forms are generally more fragile), and mainly of basic taxonomic interest. During the 1970s, however, notable pterosaur finds included the largest aerial form yet known, the pterodactyloid *Quetzalcoatlus northropi* from Texas (Lawson, 1975), the hair-insulated and undoubtedly endothermic rhamphorhynchoid *Sordes pilosus* from Central Asia (Sharov, 1971), and two new types of Central Asian thecodonts, both apparently capable of passive flight, *Longisquama insignis* (Sharov, 1970), and *Sharovipteryx* (formerly known as *Podopteryx*, Sharov, 1971). These two forms have been the subject of much debate concerning the evolution of 1) flight and 2) the earliest pterosaurs, respectively.

3.3 Avian-Archosaur Debate

Arguably the single most important historical archosaur find was *Archaeopteryx*, the first specimen (but not the first to be identified as such) of which was found in 1855 (Ostrom, 1970). Coming as it did just two years after publication of Darwin's *Origin of species by natural selection*, the find provided Darwinian evolutionists with a convenient example of a phyletic link between two major vertebrate classes, the Reptilia and the Aves. Although most authorities recognized the avian nature of the fossil (clear imprints of plumage were found associated with it), the osteology was and is still regarded as basically reptilian. T.H. Huxley, Darwin's ardent supporter, used the fossil as an example of a direct link between dinosaurs and birds. The dinosaur-bird link was re-evaluated again in the 1960s following the work of J.H. Ostrom, who claimed a direct theropod (saurischian) ancestry for the fossil (Ostrom, 1976a). Previous to the 1960s, it had been the ornithischian dinosaurs that were seen as the possible bird ancestors due to their pubic arrangement. Contrary to Ostrom, some other authorities favoured a thecodont origin for birds, claiming that some characters listed by Ostrom in support of a saurischian origin were basal and therefore irrelevant (Tarsitano and Hecht, 1980). Among others, Tarsitano and Hecht noted that embryological studies showed that the 4th finger of the manus, which has been retained in the avian wing, had already been lost by the Theropoda, thus precluding them as possible ancestors.

During the 1970s, researchers of dinosaur eggshell microstructure tried to establish relationships between identified eggs of known dinosaur species and other reptiles and birds. This cast doubt on the identification of the numerous nests of eggs that had been found in the Gobi in the 1920s and assigned to the ornithischian *Protoceratops* (many skeletons of which had been found in close association). The owner of these eggs was evetually shown to be the theropod *Oviraptor* (appendix: Norell *et al*, 1994), an animal that had also originally been found in close association but had been assumed at that time to be predating on the eggs. An earlier Mongolian study of *Oviraptor* had questioned the original analysis because of its jaw morphology (Barsbold, 1977).

A new element in the bird-dinosaur question was provided by *Longisquama.* Although this type is now regarded as a highly specialized thecodont probably unrelated to the direct avian lineage, it generated much discussion and debate at the time, because its clavicles are very like those of Archaeopteryx, and the body scales were thought to represent an early stage of proto-feather development. Whatever its true phylogenetic position, this fossil does show how early (Triassic) some thecodonts were already experimenting with passive flight. An additional problem encountered by protagonists of the theropod-ancestry theory involves the orientation of the pubes in *Archaeopteryx,* which, as in ornithischians, appears to have laid posteroventrally. Ostrom claimed that the pubis had been dislocated and the correct orientation was anteroventral (saurischian-like). Finally, the Crocodilia had also been advanced as a possible stem group for the Aves (Walker, 1972), although this alternative is no longer advocated.

3.4 Endothermy vs. Ectothermy Debate

The debate on dinosaur endothermy intensified in the 1960s. Ostrom's study of the theropod *Deinonychus* suggested that it was a far more active animal than an ectothermic physiology would permit (Ostrom, 1969). One of his students, Robert Bakker, proposed the broadened concept of dinosaur endothermy in several papers from 1968. He had based his evidence on fossil predator/prey ratios from data collected in the western USA (predator/prey ratios being indicative of physiology, because an endothermic metabolism requires more food energy supply than an ectothermic one).

Later, many of this data were reinterpreted due to factors such as selective fossilization and collector bias, but Bakker's arguments served to stimulate an ongoing debate that ran for many years. Reid provided a good review of the topic with respect to bone histology (Reid, 1984), but the only consensus reached to date is that the coelurosaur dinosaurs are probably the only group to which most of the evidence in favour of true endothermy is applicable. Studies of the Komodo Dragon monitor (McNab and Auffenberg, 1976) revealed lower than expected heat conductances of reptilian body tissue that thus permits temperature differentials to approach those of mammals when an otherwise ectothermic reptile's body weight exceeds 100kg. Most theropods, however, were far smaller than this, and there is clear evidence from several recent Gobi finds in China that some of these had bird-like plumage to provide insulation. It remains uncertain if this presents proof of a saurischian origin of birds (plumage is not necessarily a diagnostic trait of relationship), or whether it suggests that birds are a far older group than previously believed, as is supported by biomolecular studies of genetic differentials between them and reptiles. However, most dinosaur palaeontologists now appear to agree that birds are directly derived from theropods.

3.5 New Zealand Contributions

Fossil archosaurs have been found on every continent and larger islands throughout the world. Until recently, however, New Zealand was thought to have been lacking in such land fossils, even though those of coastal marine reptiles such as mosasaurs and plesiosaurs are plentiful in South Island strata. However, isolated archosaur finds representing the Saurischia (suborders Theropoda and Sauropodomorpha), Ornithischia (suborders Ankylosauria and Ornithopoda), and Pterosauria (suborder Pterodactyloidea) have recently been identified, all from the same locality in Hawke's Bay (appendix: Wiffen, 1996). Although the finds are fragmentary (New Zealand has large areas of acidic strata that is often unsuitable for fossil preservation), the existence of these finds does suggest that some smaller dinosaurs (including those found recently in South

Australia) were capable of surviving nearer the polar latitudes than ectothermic animals of similar sizes. Additionally, with the *Sphenodon*, New Zealand has a surviving representative of a group that not only pre-dates most archosaurs (the earliest rhynchocephalians are late Triassic), but is one of the few non-archosaurs, together with snakes and lizards, that share the diapsid skull condition (appendix: Romer, 1974, p 158).

4. EXISTING RESOURCES AND VALUE OF STUDY

There are a number of existing bibliographic resources that relate to archosaurs; however, few of them are general in nature and fewer have cross-referenced discussions or annotations. Possibly the most comprehensive one is that maintained by the University of Berkeley, California, which is not generally accessible from outside that institute. Due to the large quantities of literature available on various archosaur orders, it is often not practical or feasible for bibliographers to maintain and update works on all archosaur orders, and hence most examples available on the world wide web are selective for a specific order or even family. Few of these are annotated. A comprehensive bibliography on the Pterosauria, for example, is maintained at Leeds University (www.biology.leeds.ac.uk/staff/jmvr/Flight/bibliog./Pterosaurs.doc) while a non-annotated bibliography of the family Hadrosauridae is maintained by the Smithsonian National Museum of Natural History (www.nmnh.si.edu/paleo/bib/hadrobib.htm) by Michael Brett-Surman. Many other museum bibliographies include primarily taxonomic content intended for in-house comparative research. It remains difficult for researchers to adequately and effectively review the large quantity of archosaur literature published in many languages during recent decades, especially that which impacts on the debates mentioned previously, and particularly so for the extensive series of articles covering the Polish and Russian field work in Central Asia. This thesis will go some way towards assisting students who are researching archosaur finds from 1960-1984, and the associated topics of academic discussion and contention that arose from their study.

5. METHODOLOGY

5.1 Research Sources

Primary access to key East European palaeontological/geological journals that specifically cover Gobi field work was possible. These included the Polish palaeontological journals *Palaeontologica Polonica* and its sister publication *Acta Palaeontologica Polonica* (both in English) published by the Polish Palaeobiological Institute, as well as translations of Russian journals such as *Paleontologiskii Zhurnal* and the *Doklady Akademii Nauk SSSR* series published by the Russian Academy of Sciences. Access to other literature was primarily via two main abstracting sources, *Bibliography and Index of Geology* (published by the American Geological Institute), and *Biological Abstracts* (Philadelphia, Pennsylvania). The first of these covers serials, books, monographs and proceedings, and primarily includes topics on palaeontological discoveries and new taxa. For example, literature on new archosaur finds can be found in the annual cumulative biosystematic subject headings under the following: 'Reptilia – Archosauria'/ 'Reptilia – Ornithischia'/ 'Reptilia – Pterosauria'/ 'Reptilia – Saurischia'/ 'Reptilia – Thecodontia'/ 'Aves' (further subdivided by stratigraphic age). There is also a more general heading under 'Reptiles – dinosaurs'.

Further useful indices for Gobi and other Central Asian archosaur finds include 'Mongolia – paleontology: reptilia' and 'USSR – paleontology: reptilia' (includes the former Soviet Central Asian Republics, now the CIS). One can then access the cumulative bibliographic section which gives full citation details under annual alphabetical author listings.

While *Biological Abstracts* rarely covers purely taxonomic palaeontology articles, it does include biological research literature on archosaur physiology, ecology, behaviour and life habits. The two primary ways of accessing articles are via the B.A.S.I.C. (Biological Abstracts Subjects In Context) search tool where key words in the article title or abstract are listed alphabetically next to the relevant abstract number. This does, however, entail manually sorting through any keyword that may (or may not) be of use. Of more direct use is the Subject Guide to the abstracts section. Relevant sections are 'Chordata, systematics: Reptilia', and 'Chordata, General and Systematic Zoology – Amphibia and Reptilia', both of which refer to numbered abstracts accessible from the main section.

In addition to these sources, the author had access to a collection of reprints and monographs from a private academic collection.

5.2 Use of the Bibliography

Literature from many sources covering the 25-year-period 1960-1984 (incl.) has been assessed for discussion and cross-referencing. Citations follow author alphabetical order in the first instance, then chronologically therein. This allows researchers to follow progressive arguments or studies by individual authorities, and is considered to be preferable to a taxonomic division of citations because the same author may well have discussed different taxa, whilst articles with primarily theoretical discussions (e.g. physiology, extinction) might not have mentioned a specific taxonomic group, or conversely, might have mentioned several taxa within the same paper.

The citations given without annotations were either not accessed (the majority of cases), or were accessed but did not contain information directly relevant to the discussions. All such citations have been included for the sake of completeness. The *Appendix* section lists cited works that were published outside of the review period 1960-1984 under consideration in the general bibliography. A *Generic Index* is provided following the *Appendix*. This lists all papers (including those in the *Appendix*), annotated or not, in which is mentioned a named genus either in the title or body of the text. This is followed in turn by a *General Index* which lists only annotated articles, especially those which are not indexable under the *Generic Index* (primarily because no specific genus is named therein). Thus the two indices are best consulted in conjunction with each other.

ANNOTATED BIBLIOGRAPHY

of the subclass

ARCHOSAURIA

(Class: Reptilia)

Jan 1960 – Dec 1984

ALEXANDER, R.McN., 1976. Estimates of speeds of dinosaurs. *Nature, Lond.* 261:129-130.
One of the first attempts to infer the extent of dinosaur mobility from fossilised trackways. See Coombs, 1978c; Farlow, 1981; Russell and Beland, 1976; Thulborn, 1981, 1982, 1984b.

ALLABY, M., and J. LOVELOCK, 1983. *The great extinction*, Seeker and Warburg, London, 189 p.
A consideration of the possible causes of the mass biotic extinctions that marked the end of the Cretaceous. The authors favour the hypothesis that an iron meteorite collided with the Earth, resulting in widespread ecological disturbances such as volcanic activity, tidal waves, earthquakes and temperature and climatic disruption. See Russell, D.A., 1982.

ANTUNES, M.T. 1976. Dinossaurios Eocretacicos de Lagosteiros. *Ciencias de Terra (Lisboa)* 1:1-35.

AUGUSTA, J., and Z. BURIAN, (illustrator), 1960. *Prehistoric animals*, Spring Books, London, 47 p.
The restorations of extinct forms of life by the Czech artist Zdenek Burian deserve special mention here, in that they are both technically and artistically unequalled. The text by the late Josef Augusta is authoritative. Further works by Burian can be found in Augusta and Burian, 1961, Benes and Burian, 1979, Spinar and Burian, 1972, and Zaruba and Burian, 1983, among others.

AUGUSTA, J., and Z. BURIAN, (illustrator), 1961. *Prehistoric reptiles and birds*, Paul Hamlyn, London, 104 p.
This now highly collectable and rare volume features stunningly lifelike and convincing restorations of early avians and pterosaurs (even by today's standards). Augusta/Burian's restoration of an arboreal, gliding proto-avian is remarkably similar to forms recently inferred from fossil evidence in China.

AVNIMELECH, M. 1962. Dinosaur tracks in the lower Cenomanian of Jerusalem. *Nature, Lond.* 196:264.

AVNIMELECH, M.A. 1966. Dinosaur tracks in the Judean Hills. *Proc. Israel Acad. Sci. Humanities (Sci. Sect.)* 1:1-19.

AXELROD, D.I. 1968. Cretaceous dinosaur extinction. *Evolution* 22:595-611.
The author uses botanical and climatic data to argue that the extinction of the dinosaurs may have resulted from stresses produced by decreased climatic equability during the closing stages of the Cretaceous period. Major changes in flora took place over this time, with many gymnosperms, araucarians, and ancient angiosperms dying out. Dinosaurs had evolved for 130 million years in relative climatic stability, but suffered 20 million years of instability during post Santonian times, during which their adaptive responses to environmental change might have been exceeded.

BAIRD, D. 1979. The dome-headed dinosaur *Tylosaurus oratus* (Reptilia: Ornithischia: Pachycephalosauridae). *Not. Nat. (Phila.)* 456:1-11.

BAIRD, D., and P.M. GALTON, 1981. Pterosaur bones from the Upper Cretaceous of Delaware, USA. *J. Vertebr. Paleontol.* 1(1):67-72.

BAIRD, D., and J.R. HORNER, 1979. Cretaceous dinosaurs of North Carolina, USA. *Brimleyana* 2:1-28.

BAKKER, R.T. 1968. The superiority of dinosaurs. *Discovery, New Haven* 3(1):11-22.
The first of a series of articles by the author (a former student of J.H. Ostrom) dealing with the possibility that dinosaurs were far more active than had traditionally been thought. Evidence given includes their upright posture and the probability that they possessed four-chambered hearts. The morphology of sauropods is analysed and appears to indicate a terrestrial mode of life. Ceratopsians are described as cursorial, even large forms such as *Torosaurus* and *Triceratops*.

BAKKER, R.T. 1971a. Dinosaur physiology and the origin of mammals. *Evolution* 25:636-658.
The author suggests that dinosaurs probably combined large body size with high body temperatures, large hatchling size, high levels of activity and an avian-type air sac system for loss of excess heat. The explanation for the survival of Mesozoic mammals is that they managed to exploit nocturnal niches unavailable to dinosaurs.

BAKKER, R.T. 1971b. Ecology of the brontosaurs. *Nature, Lond*. 229:172-174.
The author compares the ecology of sauropods with those of large, extant terrestrial mammals, and suggest; that sauropods (which are usually accorded the status of infraorder, not order as stated by the author), were better adapted to a terrestrial habitat than the aquatic one traditionally attributed to them. See Coombs, 1975.

BAKKER, R.T. 1972. Anatomical and ecological evidence of endothermy in dinosaurs. *Nature, Lond.* 238:81-85.
Predator/prey ratios of fossil communities are used to show that dinosaurs appear to have been metabolically more like endothermic mammals than ectothermic reptiles. More recently, use of this line of evidence to infer endothermy in fossil communities has come under criticism, see for example, Farlow, 1980,1983; Tracy, 1976.

BAKKER, R.T. 1974. Dinosaur bio-energetics - a reply to Bennet and Dalzell, and Feduccia. *Evolution* 28:497-503.
Bakker's response to Bennett and Dalzell (1973) and Feduccia (1973). He again argues that predator/prey ratios from fossil collections can be used to accurately predict endothermy, and that this evidence for dinosaurs is supported by bone histology data that shows dinosaur bone as similarly vascularised to those of known endotherms (primarily mammals). He also questions the interpretation of limb movement as figured by Bennett and Dalzell.

BAKKER, R.T. 1975a. Dinosaur renaissance. *Sci. Amer*. 232(4):58-78.
The author proposes a reclassification of land vertebrates, combining the class Aves together with the two dinosaur orders in one group, ranked as a subclass. The argument depends partly on whether the assumed dinosaurian origin of *Archaeopteryx* can be accepted. See Bakker and Galton, 1974; Hecht and Tarsitano, 1982; Tarsitano and Hecht, 1980.

BAKKER, R.T. 1975b. Experimental and fossil evidence for the evolution of tetrapod bioenergetics. In: D.M. Gates and R.B. Schmerl (eds.), *Perspectives of biophysical ecology*, p. 365-399, Springer, New York.

BAKKER, R.T. 1978. Dinosaur feeding behaviour and the origin of flowering plants. *Nature, Lond*. 274:661-663.
Sauropod and stegosaur dinosaurs of the Jurassic appear to have co-evolved with the conifer dominated forests of that period. Large conifers would have been browsed upon by sauropods assuming a tripodal position (utilising the tail as a balance). The decline of these two dinosaur groups was followed by the appearance of low browsing ornithischian dinosaurs, (ceratopsians, ankylosaurs, hadrosaurs), with the consequent radiation of low level angiosperm vegetation. The author's treatment of the Sauropoda as an unequivocally terrestrial group can be disputed. See for example. Coombs, 1975; Krassilov, 1981; Kurzanov and Bannikov, 1983; McGowan, 1979.

BAKKER, R.T. 1980. Dinosaur heresy - dinosaur renaissance: Why we need endothermic archosaurs for a comprehensive theory of bioenergetic evolution. In: R.D.K. Thomas and E.G. Olson (eds.), *A cold look at the warm-blooded dinosaurs*, p. 351-462, Westview Press, Boulder.
In by far his most detailed analysis of the question of dinosaur endothermy, the author considers a wide range of evidence including skeletal morphology, body size, habitats, competition, bone histology and predator/prey ratios. See Farlow, 1983.

BAKKER, R.T., and P.M. GALTON, 1974. Dinosaur monophyly and a new class of vertebrates. *Nature, Lond.* 248:168-172.
A prelude to Bakker's later views regarding avian re-classification. See Bakker, 1975a.

BARSBOLD, R. 1974. Saurornithoididae, a new family of small theropod dinosaurs from Central Asia and North America. *Palaeontol. Pol.* 30:5-22.
The family Saurornithoididae is created to include the genera *Saurornithoides* and *Stenonychosaurus,* which are characterised by possessing bulbous structures; 'parasphenoid capsules' on the braincase wall (as in the Ornithomimidae) and having the second digit modified as a weapon (as in the Dromeosauridae). See Osmolska et al, 1972.

BARSBOLD, R. 1976. A new Late Cretaceous family of small theropods (Oviraptoridae n. fam.) in Mongolia. *Dokl. Akad. Nauk S.S.S.R. (Earth Sciences Section).* 226: 221-223.
New finds of the small theropod *Oviraptor philoceratops* in Mongolia provide for the creation of the new family Oviraptoridae. The toothless jaws of oviraptorids were capable of powerful compressive forces and it is therefore unlikely that dinosaur eggs constituted the diet of these animals, as was originally believed when the genus was named in 1924. (*Oviraptor philoceratops* = ceratopsian egg stealer).

BARSBOLD, R. 1977a. Kinesis and structural peculiarities of the jaw apparatus of *Oviraptor* (Theropoda, Saurischia). *Sovmestnaya Sov.-Mong. Paleontol. Eksped., Tr.,* No. 4:34-47. (In Russian with English summary).
An expanded discussion of the unusual jaw structure of oviraptors (see Barsbold, 1976), which were unusual among theropods due to the extreme facial reduction and several other features including the reduced palatine and paired vomers. In contrast, the post-cranial skeleton is typically theropod.

BARSBOLD, R. 1977b. On the evolution of carnivorous dinosaurs. *Sovmestnaya Sov.-Mong. Paleontol. Eksped., Tr.,* No. 4:48-56. (In Russian with English summary).

BARSBOLD, R. 1979. Opisthopubic pelvis in the carnivorous dinosaurs. *Nature, Lond.* 279: 792-793.
The pelves of segnosaurids (see Barsbold and Perle, 1980) are compared with those of other carnivorous dinosaurs. The similarity between the segnosaurid-type pelvis (termed opisthopubic) and the pelves of primitive ornithischians is noted.

BARSBOLD, R. 1981. Toothless predatory dinosaurs of Mongolia. *Sovmestnaya Sov.-Mong. Paleontol. Eksped., Tr.,* No. 15:28-39. (In Russian with English summary).

BARSBOLD, R., and A. PERLE, 1979. Modification of the saurischian pelvis and the parallel development of carnivorous dinosaurs. In: Fauna Mezozoya i Kaynozoya Mongolii [Barsbold, R. (ed.), *et. al.*], p. 39-44, 122, 148. *Sovmestnaya Sov.-Mong. Paleontol. Eksped., Tr.,* No. 8. (In Russian with English summary).

BARSBOLD, R., and A. PERLE, 1980. Segnosauria, a new infraorder of carnivorous dinosaurs. *Acta Palaeontol. Pol.* 25:187-195.

Description of a most unusual type of theropod excavated from Upper Cretaceous deposits in the Gobi Desert. *Erlikosaurus andrewsi* Perle gen. et sp. n. is described and compared to existing material previously assigned to the genus *Segnosaurus* (Perle, 1979). Also reported is a new specimen designated as the 'dinosaur from Khara Khutul', also a segnosaurid, though generically indeterminate. Although segnosaurids were theropods, they differ from all other known theropod groups and hence must be accommodated within a new infraorder. Segnosaurids were medium to large sized theropods with comparatively small skulls. Subsequent to this paper, they were identified as the same group as the therizinosaurs (see discussion in Rozhdestvensky, 1970). The cervical vertebrae of segnosaurs were elongated and large; the forelimbs were short with a tridactyl manus; the hindlimbs were more massive with a short, tetradactyl pes. The anterior portion of the jaws was edentulous, forming a horny 'beak', a characteristic of the herbivorous ornithischians (see for example, Ostrom, 1966b). The most important osteological feature of segnosaurids is, however, the structure of the pelvis. Described as 'opisthopubic' by the authors (see Barsbold, 1979), it displays a deep and broad anterior wing of the ilium and a short posterior wing, unlike the hitherto recognised saurischian pelves (see Colbert, 1964b). Unlike other saurischian pelves, where the pubis is orientated anteroventrally, the pubis of segnosaurids lies parallel to the ischium. The existence of this type of pelvis makes it more conceivable that *Archaeopteryx* may have had a posteroventrally directed pubis (see Ostrom, 1973). As in other groups of Mongolian theropods, segnosaurids have deviated from the typical theropod trends of bipedalism and offensive predatory habits, and the authors speculated that segnosaurids were amphibious, feeding perhaps, on fish.

BARTHOLOMAI, A. 1966. Fossil footprints (location, descriptions) in Queensland (reptiles, amphibians, dinosaurs), *Aust. Nat. Hist.* 15(5):147-150.

BARTHOLOMAI, A., and R.E. MOLNAR, 1981. *Muttaburrasaurus,* a new iguanodontid (Ornithischia: Ornithopoda) dinosaur from the Lower Cretaceous of Queensland. *Mem. Qd Mus.* 20:319-349.

BAUR, M.E., and R.R. FRIEDL, 1980. Application of size-metabolism allometry to therapsids and dinosaurs. In: R.D.K. Thomas and E.G. Olson (eds.), *A cold look at the warm-blooded dinosaurs*, p. 253-286, Westview Press, Boulder.

BEER, G. de, 1964, *Archaeopteryx.* In: A.L. Thompson (ed.), *A new dictionary of birds*, p. 58-62, Nelson, London.

BEER, G. de, 1975. *The flying and flightless birds*, Oxford University Press, London, 16 p.

BELAND, P., and D.A. RUSSELL, 1978. Palaeoecology of dinosaur Provincial Park, (Cretaceous), Alberta, interpreted from the distribution of articulated vertebrate remains. *Can. J. Earth Sci.* 15:1012-1024.

BELAND, P., and D.A. RUSSELL, 1979. Ectothermy in dinosaurs: Paleoecological evidence from Dinosaur Provincial Park, Alberta. *Can. J. Earth Sci.* 16(2):250-255.

Energy flow models for Dinosaur Provincial Park indicate that tyrannosaurids were 3 to 4 times more abundant than should have been the case had they been endothermic. The fossil sample may not reflect the true relative abundances of dinosaurs or alternatively, large dinosaurs may have been ectothermic.

BELAND, P., and D.A. RUSSELL, 1980. Dinosaur metabolism and predator/prey ratios in the fossil record. In: R.D.K. Thomas and E.G. Olson (eds.), *A cold look at the warm-blooded dinosaurs*, p. 85-102, Westview Press, Boulder.

BELEN'KII, G.A., and A.K. ROZHDESTVENSKY, 1963. The first discovery of a large dinosaur (hadrosaurus, Reptilia) skeleton in the U.S.S.R. *Paleontol. Zhur.*1:141-143.

BENES, J, and Z. BURIAN, (illustrator), 1979. *Prehistoric animals and plants*, Hamlyn, 311 p.
A handbook sized work containing over 130 excellent plates by Zdenek Burian.
See also Augusta and Burian, 1960,1961; Spinar and Burian, 1972; Zaruba and Burian, 1983.

BENNETT, A.F. 1974. A final word. *Evolution* 28:503.
A short comment in response to Bakker 1974, in which the author notes that Bakker has attempted to make a strong connection between erect gait in dinosaurs and high levels of food consumption, when alternative reasons are more plausible, notably the fact that a large body may necessitate an erect gait so as to minimise strain on the limbs.

BENNETT, A.F., and B. DALZELL, 1973. Dinosaur physiology: a critique. *Evolution* 27: 170-174.
The authors present this paper as a challenge to Bakker (1971a), noting that many of his arguments contain contradictions and factual errors, including his assumed connection between fully erect posture and homeothermy, his biomechanical analysis of erect gaits in mammals and birds, and the inferred gait of dinosaurs based on those data. Comparative diagrams of limb movement in mammals and dinosaurs are given.

BENTON, M.J. 1979a. Ecological replacement among Late Palaeozoic and Mesozoic tetrapods. *Palaeogeogr., Palaeoclimatol., Palaeoecol.* 26:127-150.

BENTON, M.J. 1979b. Ectothermy and the success of dinosaurs. *Evolution* 33:983-997.
A review of the evidence for and against dinosaur endothermy. The conclusion reached is that dinosaurs (with the possible exception of small theropods) could have been ectothermic. See Ostrom, 1980.

BENTON, M.J. 1983. Dinosaur success in the Triassic: a noncompetitive model. *Quart. Rev. Biol.* 58:29-51.
A discussion of faunal replacements in the Triassic, involving changes in the world flora. The author concludes that large synapsids or rhynchosaurs will not be found associated with large dinosaurs and will always be found in geologically older deposits than those containing ecologically important dinosaurs. Rhynchosaurs will be found associated with *Dicoidium* (seed fern) floras, dinosaurs with conifer floras. See Charig, 1984.

BERMAN, D.S., and S.L. JAIN, 1982. The braincase of a small sauropod dinosaur (Reptilia: Saurischia) from the Upper Cretaceous Lameta Group, Central India, with review of Lameta Group localities. *Ann. Carnegie Mus.* 51(21):405-422.

BERMAN, D.S., and J.S. McINTOSH, 1978. Skull and relationships of the Upper Jurassic sauropod *Apatosaurus* (Reptilia, Saurischia). *Bull. Carnegie Mus.* 8:5-35.

BIDAR, A., L. DEMAY and G. THOMEL, 1972a. *Compsognathus corallestris*, nouvelle espece de dinosaurien theropode du Portlandien de Canjuers (Sud-est de la France). *Ann. Mus. Hist. Nat., Nice* 1(1):1-34.

BIDAR, A., L. DEMAY and G. THOMEL, 1972b. Sur la presence du Dinosaurien *Compsognathus* dans le Portlandien de Canjuers (Var.). *C. R. Hebd. Seances Acad. Sci. Ser. D Sci. Nat.* 275(21):2327-2329.

BLUMBERG, B.S., and L. SOKOLOFF, 1961. Coalescence of caudal vertebrae in the giant dinosaur *Diplodocus*. *Arthritis and Rheumatism* 4(6):592-601.

BOCK, W.J. 1969. The origin and radiation of birds. *Ann. N.Y. Acad. Sci.* 167:147-155.

BONAPARTE, J.F. 1975a. The family Ornithosuchidae (Archosauria: Thecodontia). *Prob. Actuels Paleont. (Evol. Vertr.) C.N.R.S. Collog. Internat.* 1973 :485-502.

BONAPARTE, J.F. 1975b. Nevos materiales de *Lagosuchus talampayensis* Romer (Thecodontia-Pseudosuchia) y su significado en el origen de los Saurischia; Chanarense inferior, Triasico Medio de Argentina. *Acta Geol. Lilloana* 13(1):1-85.

BONAPARTE, J.F. 1976. *Pisanosaurus mertii* Casamiguela and the origin of the Ornithischia. *J. Paleontol.* 50:808-820.

BONAPARTE, J.F. 1978. *Coloradia brevis*, new genus new species (Saurischia, Prosauropoda), a plateosaurid dinosaur of the Los Colorados Formation, Upper Triassic of La Rioja, Argentina. *Ameghiniana* 15(3/4):327-365.(In Spanish with English summary).

BONAPARTE, J.F., J.A. SALFITY, G. BOSSI, and J.E. POWELL, 1977. Discovery of Cretaceous dinosaurs and birds from the Lecho Formation, El Brete, southern Salta Province, Argentina. *Acta. Geol. Lilloana* 14:5-18.

BONAPARTE, J., and M. VINCE, 1979. El hallazgo del primer nido de dinosaurios triasicos, (Saurischia, Prosauropoda), Triasico superior de Patagonia, Argentina. *Ameghiniana* 16:173-182.

BOND, G. 1972. Milestones in Rhodesian palaeontology (1901-1971). *Trans. Geol. Soc. S. Afr.* 75(2):149-158.

BOND, G., and K. BROMLEY, 1970. Sediments with the remains of dinosaurs near Gokwe, Rhodesia. *Palaeogeogr., Palaeoclimatol., Palaeoecol.* 8(4):313-327.

BORSUK-BIALYNICKA, M. 1977. A new camarasaurid sauropod *Opisthocoelicaudia skarzynskii gen. n., sp. n.* from the Upper Cretaceous of Mongolia. *Palaeontol. Pol.* 37:5-64.
This new Gobi sauropod was straight-backed, carried the tail horizontally and the neck low. The possibility of the animal assuming a tripodal stance (with the tail acting as a balance) is considered by the author. The features of the skeleton neither confirm nor exclude either aquatic or fully terrestrial habits. See Coombs, 1975; Kurzanov and Bannikov, 1983; Nowinski, 1971.

BOSSI, G.E., and J.F. BONAPARTE, 1978. On the presence of prosauropod dinosaur in the Quebrada del Barro Formation, austral border of the Marayes-el Carrizol Basin (Upper Triassic of San Juan province). *Acta. Geol. Lilloana* 15(l):41-48.

BOUVIER, M, 1977. Dinosaur Haversian bone and endothermy. *Evolution* 31:449-450.
The author considers the histological evidence used by Bakker (1972) with respect to dinosaur endothermy, and notes that Haversian bone is found among ectotherms as well as endotherms.

BRAMBILLA, G. 1972. Primi dati morfometrici sulle lacune osee di vertebrati fossili: *Kritosaurus notabilis* (Lambe). *Atti Soc. Ital. Sci. Nat. Mus. Civ. Stor. Nat., Milano* 113:313-327.

BRAMWELL, C.D. 1971. Flying ability of *Archaeopteryx*. *Nature, Lond*. 231:128.
The author notes that the previous weight of *Archaeopteryx* given as 500 gm was probably nearer to 200 gm, and also accepts the increased wing area given by Yalden (1971). He also points out that *Archaeopteryx* had a significantly-sized tail that would have helped to slow the landing speed and make it capable of a more controlled decent.

BRAMWELL, C.D., and G.R. WHITFIELD, 1970. Flying ability of the largest aerial vertebrate. *Nature, Lond*. 225:660.
Many authorities have assumed that *Pteranodon* was primarily a glider and that it would have found taking off and landing difficult. The authors, however, calculate *Pteranodon's* aerial speed at only 15 or 17 mph., which would not have presented this very large pterosaur with any such difficulties. See Brower and Veinus, 1981.

BRAMWELL, C.D., and G.R. WHITFIELD, 1974a. Biomechanics of *Pteranodon*. *Phil. Trans. Roy. Soc. Lond. B* 267:503-581.

BRAMWELL, C.D., and G.R. WHITFIELD, 1974b. D.M.S. Watson's notes on pterosaurs. *Phil. Trans. Roy. Soc. Lond. B, Biol. Sci*. 267:587-589.

BRETT-SURMAN, M.K. 1975. *The appendicular anatomy of hadrosaurian dinosaurs*. Thesis, Univ. Calif., Los Angeles.

BRETT-SURMAN, M.K. 1979. Phylogeny and palaeobiogeography of hadrosaurian dinosaurs. *Nature, Lond*. 277:560-562.
The remains of hadrosaurs have traditionally been found on all northern continent (Laurasian) landmasses, as well as South America. The author notes that the identification of hadrosaur genera was previously very difficult, but subsequently far more accurate with the use of certain pelvic diagnostic elements (many previously named hadrosaur species have since been identified as examples of con-specificity, ie. male/female, adult/juvenile). A re-evaluation of existing hadrosaur fossils was possible in this study, and it provided strong evidence for an extensive land connection between the North and South American landmasses from 85-100 million years ago, during which time the hadrosaurs reached their peak of diversity.

BRINKMAN, D. 1981. The origin of the crocodiloid tarsi and the interrelationships of thecodontian archosaurs. *Breviora* 464:1-23.

BRODKORB, P. 1971. Origin and evolution of birds. In: D.S. Earner and J.R. King (eds.), *Avian biology*, Vol. 1, p. 19-55, Academic Press, New York.

BROWER, J.C., and J. VEINUS, 1981. Allometry in pterosaurs. *Univ. Kans. Paleontol. Contrib. Pap*. 105:1-32.
The relationship between size and shape of 15 taxa of pterosaurs is studied, including *Dimorphodon macronyx, Sordes pilosus, Rhamphorynchus spp., Pterodactylus spp*., and *Pteranodon ingens*, ranging in weight from 4 g. to an estimated 75 kg. (the estimate for *Quetzalcoatlus*). Tail length variation is interpreted in terms of different stability during flight. Pterosaurs show lower wing loading than most flyers of similar mass, but they still fall in the range calculated for birds and/or bats. Larger species of pterosaurs were evidently slow flyers and would have been highly manoeuvrable.

BUDYKO, M.I. 1978. Thermal regime of dinosaurs. *Zh. Obshch. Biol*. 39:179-188.
The heat balance of some dinosaurs is calculated, and the conclusion reached is that in the warm climate of the Mesozoic, large dinosaurs could not have been endothermic. Analysis of trophic …

levels of large herbivorous species provides a similar conclusion. The ectothermy of dinosaurs was a factor causing their extinction during the Late Mesozoic. (In Russian with English summary).

BUFFETAUT, E., and R. INGAVAT, 1982. Phytosaur remains (Reptilia, Thecodontia) from the upper Triassic of northeastern Thailand. *Geobios (Lyon)* 15(1):7-18.

BURGHARDT, G.M. 1977. Of iguanas and dinosaurs: social behaviour and communication in neotenate reptiles. *Amer. Zool.* 17:177-190.

CAMPBELL, J.G. 1966. A dinosaur bone lesion resembling avian osteopetrosis and some remarks on the mode of development of the lesion. *J. Roy. Microsc. Soc.* 85:163-174.

CAREY, D.J. 1972. Flying ability of *Archaeopteryx. Nature, Lond.* 239:535.

CARPENTER, K. 1982. Baby dinosaurs from the Late Cretaceous Lance and Hell Creek formations and a description of a new species of theropod. *Univ. Wyoming Contribs Geol.* 20(2):123-134.

Published accounts describing young dinosaurs indicate that such remains are rare in the fossil record. However, screen-washing in the Lance and Hell Creek formations produced teeth and cranial remains of young dinosaurs belonging to at least 11 taxa, including theropods, ceratopsians, hadrosaurs and ankylosaurs. Their abundance suggests that they are not as rare as had previously been believed. Two factors controlling the preservation of young dinosaurs and dinosaur egg shells are soil drainage and soil pH.

CARROLL, R.L. 1976. Eosuchians and the origin of archosaurs. in: C.S. Churcher (ed.), *Essays on palaeontology in honour of Loris Shano Russell*, p. 58-79, R. Ontario Mus. Sci. Misc. Publ., Toronto.

CASAMIGUELA, R.M. 1964. Sobre un dinosaurio hadrosaurido de la Argentina. *Ameghiniana* 3:285-312.

CASAMIGUELA, R.M. 1967. Un dinosaurio ornithisquio Triasico *Pisanosaurus merti*; Ornithopoda) de la formacion Ischigualasto, Argentina. *Ameghiniana* 5:47-60.

CASANOVAS, C., LOURDES and J.V. SANTAFE LLOPIS, 1974. Dos neuvos yacimientos de icnitas de Dinosaurios. *Acta Geol. Hisp.* 9(3):88-91.

CASE, T.J. 1978. Speculations on the growth rate and reproduction of some dinosaurs. *Paleobiology* 4:320-328.

CASIER, E. 1960. *Les Iguanodons de Benissart*. Brussells, Inst. Royal Sci. Nat. Belg. 134 p.

Changing dinosaurs-but not in midstream, 1971. *Nature, Lond.* 229:153.

In this short review, the editor of Nature comments on the views of Bakker (1971b) regarding the changing views of sauropods as non-aquatic animals, based on the evidence of tooth wear (suggesting the consumption of land plants), limb and foot construction, shape of the vertebral column, and the nature of the sediments that their fossils are found.

CHAPMAN, R.E., P.M. GALTON, J.J. SEPKOSKI and W.P. WALL, 1981. A morphometric study of the cranium of the pachycephalosaurid dinosaur *Stegoceras*. *J. Paleontol.* 55(3):608-618.

CHARIG, A.J. 1972. The evolution of the archosaur pelvis and hind limb: an explanation in functional terms. In: K.A. Joysey and T.S. Kemp (eds.), *Studies in vertebrate evolution: essays presented to Dr. F.R. Parrington, FRS*, p. 121-155, Winchester Press, New York.

CHARIG, A.J. 1973. Jurassic and Cretaceous dinosaurs. In: A. Hallam (ed.), *Atlas of paleobiogeography*, p. 339-352, Amsterdam-London-New York.

CHARIG, A.J. 1976. "Dinosaur monophyly and a new class of vertebrates": a critical review. In: A. d'A. Bellairs and C.B. Cox (eds.), Morphology and biology of reptiles. *Linn. Soc. Lond., Symp.* 3: p. 65-104, Academic Press, London.

CHARIG, A.J. 1979. *A new look at the dinosaurs*, Heinemann, London, 160 p.
A popular work aimed primarily at younger readers. Burian aficionados will recognise a number of the commissioned illustrations within that have been copied directly from Burian paintings, but curiously inversed in mirror image from the originals.

CHARIG, A.J. 1984. Competition between Therapsids and Archosaurs during the Triassic Period: a review and synthesis of current theories. In: *Symp. Zool. Soc. Lond.*, No. 52: (597-628).
The author expresses the opinion that the Triassic faunal replacement of therapsids by archosaurs was a competitive one involving two sympatric lineages occupying the same broad adaptive zone. It is concluded that the improved locomotor abilities and larger body sizes were primary factors in the dominance of the archosaurs. See Benton, 1983.

CHARIG, A.J., J. ATTRIDGE and A.W. CROMPTON, 1965. On the origin of the sauropods and the classification of the Saurischia. *Proc. Linn. Soc. Lond.* 176:197-221.

CHARIG, A.J., and O.A. REIG, 1970. The classification of the Proterosuchia. *Biol. J. Linn. Soc.* 2:125-171.

CHARIG, A.J., and H.D. SUES, 1976. Suborder Proterosuchia Broom 1906b. In: 0. Kuhn (ed.), *Handbuch der Palaoherpetologie* 13, p. 11-39, Gustav Fischer, Stuttgard.

CHATTERJEE, S. 1978. A primitive parasuchid (phytosaur) reptile from the Upper Triassic Maleri Formation of India. *Palaeontology* 21:83-127.

CHENG, C-C., TANG, YING-JUN, CHIU, CHANSIANG and H-K. YEH, 1973. Notes on the Upper Cretaceous-Lower Tertiary of the Nanhsiung Basin, N. Kwangtung. *Vertebr. Palasiat.* 11(1):18-30. (In Chinese with English summary).

CHURCHER, C.S. 1976. Royal Ontario Museum Life Sciences Miscellaneous Publications. Athlon. *Essays on palaeontology in honour of Loris Shano Russell*, Royal Ontario Museum, Toronto, 286 p.

CLOUDSLEY-THOMPSON, J.L. 1968. Hot blood or cold? Thermoregulation in terrestrial poikilotherms. *Sci. Progr.* 56(224):499-509.
The concept that no fundamental dichotomy exists between ectothermic and endothermic animals is discussed. Dinosaurs are described as having evolved a state of homeothermic 'warm-bloodedness'. The end of the Cretaceous included seasonal variations during which large animals that could not hibernate would have perished. See Russell, L.S., 1965.

CLOUDSLEY-THOMPSON, J.L., and D.K. BUTT, 1977. Thermal balance in the tortoise and it's relevance to dinosaur extinction. *Brit. J. Herpetology* 5:641-647.

COLBERT, E.H. 1961. *Dinosaurs, their discovery and their world*, E.P. Dutton, New York, 300 p.
One of the earliest general accounts of dinosaur hunting world-wide by the former doyen of North American palaeontologists. Well illustrated with reconstructions.

COLBERT, E.H. 1962. The weight of dinosaurs. *Amer. Mus. Novitates* 2076:1-16.
The author uses models and comparisons with living archosaurian reptiles in order to estimate the size and weight of some well known dinosaur genera.

COLBERT, E.H. 1963. Fossils of the Connecticut Valley. The age of dinosaurs begins. *Bull. Connecticut Geol. Nat. Hist. Survey* 96:1-31.

COLBERT, E.H. 1964a. Dinosaurs of the Arctic (Spitsbergen). New find extends Cretaceous tropics. *Nat. Hist*. 73(4):21-23.

COLBERT, E.H. 1964b. Relationships of the saurischian dinosaurs. *Amer. Mus. Novitates* 2118: 1-23.

COLBERT, E.H. 1964c. The Triassic dinosaur genera *Podokesaurus* and *Coelophysis*. *Amer. Mus. Novitates* 2168:1-12.

COLBERT, E.H. 1966. A gliding reptile from the Triassic of New Jersey. *Amer. Mus. Novitates* 2246:1-22.

COLBERT, E.H. 1968. *Men and dinosaurs*, Evans Bros, London, 283 p.
A popular account of the history of dinosaur discovery and discoverers up until the 1960's, with the emphasis on expedition-type field work, particularly in North America, East Africa and Central Asia. The early finds in the Gobi are discussed, but the author did not have access to the first results of the Polish-Mongolian expeditions when this volume was produced.

COLBERT, E.H. 1969. A Jurassic pterosaur from Cuba. *Amer. Mus. Novitates*. 2370:1-26.

COLBERT, E.H. 1970. A saurischian dinosaur from the Triassic of Brazil. *Amer. Mus. Novitates* 2405:1-39.

COLBERT, E.H. 1983. *Dinosaurs: an illustrated history*, Hammond, Maplewood, N.J., 224 p.
A general account of dinosaur evolution and ecology from a chronological as opposed to a taxonomic viewpoint. The question of endothermy is discussed in chapter seven. A number of classic paintings by noted American paleo-artist Charles Knight are reproduced within.

COLBERT, E.H., and D. MERRILEES, 1967. Cretaceous dinosaur footprints from Western Australia. *J. Roy. Soc. W. Aust*. 50:21-25.

COLBERT, E.H., and D.A. RUSSELL, 1969. The small Cretaceous dinosaur *Dromaeosaurus*. *Amer. Mus. Novitates* 2380:1-49.
Osteological description of the small and active theropod that partly inspired the dinosaur endothermy arguments of Robert Bakker.

COOMBS, W.P. 1972. The bony eyelid of *Euoplocephalus* (Reptilia, Ornithischia). *J. Paleontol*. 46:637-650.
The author describes the unusual (and unique) bony eyelid coverings of a large Canadian ankylosaur. Russian palaeontologists had earlier speculated that some Mongolian ankylosaurs may have been capable of burrowing into the sand (appendix: Maleev, 1956), which would explain why these armoured animals possessed such extreme optical protection.

COOMBS, W.P. 1975. Sauropod habits and habitats. *Palaeogeogr., Palaeoclimatol., Palaeoecol.* 17:1-33.
An analysis of sauropod skeletal adaptations. Some features, such as the long neck, and the nares, could be cited as evidence for either terrestrial or aquatic existence. Others point to primarily terrestrial behaviour. The possibility that sauropods possessed proboscises is also discussed.

COOMBS, W.P. 1978a. The families of the Ornithischian dinosaur order Ankylosauria. *Palaeontology* (Lond.) 21(1):143-170.

COOMBS, W.P. 1978b. Forelimb muscles of the Ankylosauria (Reptilia, Ornithischia). *J. Paleontol.* 52:642-657.

COOMBS, W.P. 1978c. Theoretical aspects of cursorial adaptations in dinosaurs. *Quart. Rev. Biol.* 53:393-418.
The running potential of dinosaurs is evaluated by analysing limb structure. Sauropods and stegosaurs were graviportal; ankylosaurs and large ceratopsians were mediportal; large ornithopods were subcursorial; large theropods were subcursorial to cursorial; small ceratopsians and small bipedal ornithischians and theropods were highly cursorial. See Thulborn, 1982.

COOMBS, W.P. 1979. Osteology and myology of the hindlimb in the Ankylosauria (Reptilia, Ornithischia). *J. Paleontol.* 53(3):666-684.
A study of ankylosaur pelvic structure suggests that this group is primitive in some respects, but other factors indicate a possible relationship to the Pachycephalosauria (but see Maryanska and Osmolska, 1974). Some hindlimb muscles of Ankylosaurs were used to swing the heavy tail club. Ankylosaurs in general were probably very sluggish animals.

COOMBS, W.P. 1980a. Juvenile ceratopsians from Mongolia-the smallest known dinosaur specimens. *Nature, Lond.* 283:380-381.
In this paper, the author describes some of the material collected by the American Museum Gobi expeditions of the 1920s. This included tiny skulls of Psittacosaurus (an early ancestral ceratopsian from the Gobi) just 1.6 and 1.1 inches long (making them some of the smallest dinosaurs ever found – the adults were about 6.6 ft in length). The teeth of the hatchlings were already somewhat abraded from feeding on woody herbage.

COOMBS, W.P. 1980b. Swimming ability of carnivorous Dinosaurs. *Science* 207:1198-1200.
Dinosaur tracks at Rocky Hill, Connecticut, were made by a large carnivorous dinosaur that was in a swimming position. The traditional view that sauropods sought refuge in deep water to evade such predators as these thus seems unlikely.

COOMBS, W.P. 1982. Juvenile specimens of the ornithischian dinosaur, *Psittacosaurus mongoliensis*. *Palaeontology (Lond.)* 25(1):89-108.

COOMBS, W.P., and R.E. MOLNAR, 1981. Sauropoda (Reptilia, Saurischia) from the Cretaceous of Queensland. *Mem. Qd Mus.* 20:351-373.

COOPER, M.R. 1981. The prosauropod dinosaur *Massospondylus carinatus* from Zimbabwe: Its biology, mode of life and phylogenetic significance. *Occas. Pap. Natl. Mus. Monum. Rhod. Ser. B Nat. Sci.* 6(101:689-840.

COOPER, M.R. 1984. A reassessment of *Vulcanodon karibaensis* (Dinosauria:Saurischia) and the origin of the Sauropoda. *Palaeontol. Afr.* 25:203-231.

COX, C.B. 1976. Mysteries of early dinosaur evolution. *Nature, Lond.* 246:314.

COX, C.B. 1980. Trimming the pterosaur's wings. *Nature, Lond.* 284:400-402.
The author briefly reviews the changing views on pterosaurs, once regarded as typical endothermic flying reptiles, but subsequently confirmed as endothermic, particularly following the discovery of a hairy pterosaur (Sharov, 1971). He also notes that the work of Kevin Padian and Peter Wellnhofer has shown a far more manoeuvrable pterosaur wing structure that was previously thought, because the hindlimb was not necessarily attached to the wing membrane, nor was there necessarily another membrane attached from the hindlimb to the tail.

CRACRAFT, J. 1977. Special review. John Ostrom's studies on *Archaeopteryx*, the origin of birds and the evolution of avian flight. *Wilson Bull.* 89:488-492.

CROMPTON, A.W., and A.J. CHARIG, 1962. A new ornithischian from the Upper Triassic of South Africa. *Nature, Lond.* 196:1074-1077.

CRUICKSHANK, A.R.I. 1972. The proterosuchian thecodonts. In: K.A. Joysey and T.S. Kemp (eds.), *Studies in vertebrate evolution*, p. 89-119, Oliver and Boyd, Edinburgh.

CRUICKSHANK, A.R.I. 1975. The affinities of *Proterochampsa barrioneuvoi* Reig, *Palaeontol. Afr.* 18:133-135.

CURREY, J.D. 1962. The histology of the bone of a prosauropod dinosaur. *Palaeontology* 5: 283-246.

CURREY, P., and K. PADIAN, 1983. A new pterosaur record from the Judith River (Oldman) Formation of Alberta. *J. Paleontol.* 57:599-600.

CURRIE, P.J., and D.A. RUSSELL, 1982. A giant pterosaur (Reptilia: Archosauria) from the Judith River (Oldman) Formation of Alberta, Canada. *Can. J. Earth Sci.* 19(4):894-897.

CURRIE, P.J., and W.A.S. SARJEANT, 1979. Lower Cretaceous dinosaur footprints from the Peace River Canyon, British Columbia, Canada. *Palaeogeogr., Palaeoclimatol., Palaeoecol.* 28:103-115.
A rich assemblage of dinosaur footprints are known from the Peace River Valley. They included trackways of a new type of dinosaur that was named *Amblydactylus kortmeyeri* from the prints alone, which were probably made by a hadrosaur. Study of the trackways by Currie and the late Bill Sarjeant (a dinosaur footprint specialist) shows that they included those of juvenile and adult animals travelling together, and not surprisingly, suggest gregarious behaviour in this species.

CYS, J.M. 1967. The inability of dinosaurs to hibernate as a possible key factor in their extinction. *J. Paleontol.* 41:266.
In this paper, endothermy is described as an unnecessary factor with regard to dinosaur extinction. The main cause may have been the inability of dinosaurs to hibernate during periods of prolonged low temperature. See Russell, L.S.,1967.

DASHZEVEG, D. 1963. Dinosaur eggs. *Priroda* 9:100.

DAVITASHVILI, L.Sh. 1961. *Teoriya Polovogo Otbora. Izdatel'stvo Akademii Nauk SSSR*, (Academy of Sciences Press), Moscow, 538 p.
This book is the earliest and most comprehensive review of the concept of sexual selection with respect to extinct reptiles. The author discusses the many unusual external morphological structures found in extinct reptiles (including the horns, frills and head crests of various ornithischian dinosaurs) and speculates on their possible functions as weapons and display structure used in competition for territories or mates. See Farlow and Dodson, 1975; ...

Hopson, 1975a; Molnar, 1977/78; Spassov, 1979.

DAWLEY, R.M., J.M. ZAWISKIE and J.W. COSGRIFF, 1979. A rauisuchid thecodont from the Upper Triassic Popo Agie Formation of Wyoming. *J. Paleontol.* 53:1428-1431.

DEBENATH, A., J-P. RAYNAL and F.M-Z. SBIHI-ALAOUI, 1979. 1st. excavation at a paleontological site with dinosaurians, in the basin of Taguelft (atlas of Beni-Mellal, province of Azilal, Morocco): Results and prospects. *C. R. Hebd. Seances Acad. Sci. Ser. D Sci. Nat.* 289(13):899-902.

DE BUISONJE, P.H. 1980a. *Santanadactylus brasilensis*, new genus new species, a long-necked, large pterosaur from the Aptian of Brazil:1. *Proc. K. Ned. Akad. Wet. Ser. B Palaeontol. Geol. Phys. Chem.* 83(2):145-157.

DE BUISONJE, P.H. 1980b. *Santanadactylus brasilensis*, a long-necked, large pterosaur from the Aptian of Brazil:2. *Proc. K. Ned. Akad. Wet. Ser. B Palaeontol. Geol. Phys. Chem.* 83(2):158-172.

DEMATHIEU, G., and H. HAUBOLD, 1978. On the problem of the dinosaur's origin according to the data of the ichnology of the Triassic. *Geobios (Lyon)* 11(3):409-412. (In French with English summary).

The authors attempt to reconstruct the biotypes of the earliest archosaurs of the Triassic period, based on the remains of their track-ways and on fragmentary fossils. Such evidence suggests that both saurischian dinosaurs and pseudosuchian thecodonts probably appeared as separate groups as early as the Lower Triassic.

DESMOND, A.J. 1975. *The hot blooded dinosaurs*. Blond and Briggs, London, 238 p.

This work gives an excellent historical review of the way attitudes towards dinosaurs and other archosaurs have altered since their discovery, while at the same time popularising Bakker's theories concerning dinosaur physiology and possible endothermy. Despite the title, early birds, pterosaurs and pseudosuchian thecodonts, as well as dinosaurs are discussed. Some of the author's arguments are presented teleologically and the reasons for the existence of different morphological features (such as the high tibia/fibula ratio in struthiomimids) are given somewhat prematurely, (in the example above, by comparing struthiomimids directly with modern birds and mammals). This aspect of the text soon attracted criticism (Halstead, 1976; Hopson, 1976). In chapter six, *Archaeopteryx* is discussed, and the author appears to accept Ostrom's theory regarding *Archaeopteryx* as a feathered coelurosaur that utilised its forearms as insect traps, leaping progressively higher until flight was achieved (Ostrom, 1974b). Generally, this hypothesis has failed to find acceptance. Pterosaurs are discussed in chapter seven, and the evidence for their endothermy is presented convincingly, with less of the speculation evident in other chapters.

DMITRIYEV, G.A. 1960. New dinosaur finds in Buriatia. *Paleontol. Zhur.* 1:148. (In Russian).

DODSON, P. 1971. Sedimentology and taphonomy of the Oldman Formation (Campanian), Dinosaur Provincial Park, Alberta, Canada. *Palaeogeogr., Palaeoclimatol., Palaeoecol.* 10(l): 21-74.

The sediments of the Oldman Formation in Alberta have always yielded particularly rich assemblages of dinosaur bones. Annual growth rings in tree limb remains found in these strata suggest the climate was seasonal and warm. The preservation of dinosaur bones appear to be the result of animals dying in water channels during regular events rather than catastrophic ones. The author identifies the remains of ceratopsians as coming from swampy lowland habitats, where the remains of hadrosaurs are also to be found. He suggests that these two types of dinosaur, as well as some of the carnosaurs, may have spent part of their daily lives in and around water, and that ...

such dinosaurs did not breed in upland areas (at least in these localities), but in drier areas between freshwater streams.

DODSON, P. 1974. Dinosaurs as dinosaurs. *Evolution* 28:494-497.
A response to Feduccia (1973), in which the author offers some support to the arguments marshalled by Bakker, and questions Feduccia's claims that dinosaur limb joints were mechanically inferior to those of mammals (although he does agree that the joint surfaces were less complex). Dodson also notes that climatic pressures first selected for endothermy among the therapsids (mammal-like reptiles) and possibly among the advanced thecodonts as well. The fossil record suggests that dinosaurs attained physiological refinement before the mammals (expressed as bipedality and erect gait), which is why the latter group avoided competition with the dinosaurs by maintaining small body size and (most likely) nocturnal habits throughout the Mesozoic.

DODSON, P. 1975. Taxonomic implications of relative growth in lambeosaurine hadrosaurs. *Syst. Zool.* 24:37-54.

DODSON, P. 1976. Quantitative aspects of relative growth and sexual dimorphism in *Protoceratops*. *J. Paleontol.* 50:929-940.
Comprehensive ontogenetic collections of dinosaur skulls and/or skeletons are comparatively rare, examples of two exceptions being the small protoceratopsid *Protoceratops andrewsi* and the giant theropod *Tarbosaurus bataar* (both from Upper Cretaceous formations, Mongolia).
In this study a total of 24 skulls of *P. andrewsi* were subjected to biometric analysis in order to determine evidence of sexual dimorphism. Among the 40 variables considered, ones that appear to show intersexual variation include frill width, nasal height and skull height. It is noted that the changes in myology that result from ontogenetic changes in the frill do not appear to result in improved mastication. See Farlow and Dodson, 1975; Kurzanov, 1972.

DODSON, P. 1980. Comparative osteology of the American ornithopods *Camptosaurus* and *Tenontosaurus*. Mem. *Soc. Geol. France* (N.S.), 139:81-85.

DODSON, P., A.K. BEHRENSMEYER, R.T. BAKKER and J.S. McINTOSH, 1980. Taphonomy and paleoecology of the dinosaur beds of the Jurassic Morrison Formation. *Paleobiology* 6(2): 208-232.

DONG ZHI-MING, 1973. Dinosaurs from Wuerho. *Mem. Inst. Vert. Paleont. and Paleaoant.* 11:45-52.

DUTUIT, J-M. 1972. Decouverte dun Dinosaure ornithischien dans le Trias superieur de l' Atlas occidental marocain. *C. R. Hebd. Seances Acad. Sci. Ser. D. Sci. Nat.* 275(25):2841-2844.

EATON, T.H. 1960. A new armoured dinosaur from the Cretaceous of Kansas. Univ. Kansas Paleont. *Contrib. Vertebr.* 8:1-24.

EATON, T.H. 1963. Caterpillar versus dinosaur? *J. Res. Lepidoptera* 1(2):114-116.

EDWARDS, M.B., R. EDWARDS and E.H, COLBERT, 1978. Carnosaurian footprints in the Lower Cretaceous of Eastern Spitsbergen. *J. Paleontol.* 52:940-941.

ELLENBERGER, F., and L. GINSBURG, 1966. Le gisement de dinosauriens triassiques de Maphutseng (Basuboland) et l'origine des sauropodes. *C. R. Hebd. Seances Acad. Sci. Ser D* 262:444-447.

ERBEN, H.K., J. HOEFS and K.H. WEDEPOHL, 1979. Paleobiological and isotope studies of eggshells from a declining dinosaur species (*Hypselosaurus priscus*). *Paleobiology* 5(4):380-414.

ERICKSON, B.R. 1966. Mounted skeleton of *Triceratops prorosus* in the Science Museum. *Sci. Mus. St. Paul, Minnesota, Sci. Publ.* (n.s.) 1:1-16.

EWER, R.F. 1965. The anatomy of the thecodont reptile *Euparkia capensis* Broom. *Phil. Trans. Roy. Soc. Lond. B*, 248:379-435.

FARLOW, J.O. 1976a. A consideration of the trophic dynamics of a late Cretaceous large-dinosaur community (Oldman Formation). *Ecology* 57:841-857.

The author uses a large collection of dinosaur fossils from the Oldman Formation (deposited along the margin of an inland sea covering much of western North America) to estimate trophic level energy flows from predator/prey ratios in the dinosaur community. The results show that there would have been insufficient numbers of herbivorous dinosaurs to meet the energy needs of endothermic carnivores, but there were more than enough if the carnivores were ectothermic in metabolism. However, he also notes that there are other factors to be taken into consideration, and that the results are not conclusive.

FARLOW, J.O. 1976b. Speculations about the diet and foraging behaviour of large carnivorous dinosaurs. *Amer. Midl. Nat.* 95:186-190.

As in young crocodilians and monitor lizards, juvenile carnosaurs probably consumed large invertebrates and small vertebrates as well as carrion. Adults may have been group foragers, hunting in loosely integrated packs, and feeding on giant herbivorous dinosaurs.

FARLOW, J.O. 1980. Predator/prey biomass ratios, community food webs, and dinosaur physiology. In: R.D.K. Thomas and B.C. Olson (eds.), *A cold look at the warm-blooded dinosaurs*, p. 55-83, Westview Press, Boulder.

The author cautions against using predator/prey ratios *per se* to make assumptions about the physiology of fossil vertebrates, in particular dinosaurs (Bakker, 1972), noting that there may be a convergence of ectothermic and endothermic metabolic rates when animals attain a certain size, (MacNab and Auffenberg, 1976). Other factors that may influence predator/prey ratios in dinosaur fossil communities are biases of preservation and collecting, a qualitatively restricted range of prey availability for the predator, and/or a high mortality among juvenile predators. The possibility that predators were cannibalistic in habits (Tracy, 1976) should also be noted.

FARLOW, J.O. 1981. Estimates of dinosaur speeds from a new trackway site in Texas. *Nature, Lond.* 294:747-748.

Using the methods of estimating dinosaur speeds from trackways developed by Alexander (1976), the author estimates the speed of several (unidentified) species of dinosaurs from tracks made in limestone of the Glen Rose Formation. Some of the speeds he obtains are much faster than previous estimates from other sites, reaching to 42 km/hr., which is almost comparable to the speed of a running ostrich.

FARLOW, J.O. 1983. Dragons and dinosaurs. *Paleobiology* 9(3):207-210.

This article discusses the results of Auffenberg's (appendix, 1981) major field study on the trophic food budget of the Komodo Dragon, a top-level physiologically-ectothermic carnivore. He notes that Bakker (1980) had questioned the low predator/prey ratios that resulted from this study (which suggested that the giant monitor was food-limited), but believes that a similar and valid situation could well have occurred with extinct, ectothermic reptilian carnivores such as large dinosaurs. He believes that predator/prey ratios *per se* cannot be used on their own to infer physiological states such as endothermy.

FARLOW, J.O., and P. DODSON, 1975. The behavioural significance of frill and horn morphology in ceratopsian dinosaurs. *Evolution* 29:353-361.

Ceratopsian dinosaurs exhibit a remarkable array of horn and frill morphology. The authors propose that the morphology of frills was determined by their functionality as display structures in addition to jaw mechanics. The evolution and development of these structures can be at least partly explained in terms of species specific courtship and agonistic behaviour as observed in extant species of horned ungulates and horned lizards. See Davitashvili, 1961; Hopson, 1975a; Molnar, 1977/78; Spassov, 1979.

FARLOW, J.O., C.V. THOMPSON and D.E. ROSNER, 1976. Plates of the dinosaur *Stegosaurus*: forced convection heat loss fins? *Science* 192:1123-1125.

The large dermal plates along the back of *Stegosaurus* may have served an important thermoregulatory function, acting as forced heat convection fins. If this was so, the most effective arrangement of the plates would have been a staggered or interrupted pattern as opposed to the paired arrangement figured by some authors (eg. Halstead, 1975). Other evidence cited included the existence of what appears to be vascular blood channels in plates viewed under X-rays.
See Wheeler, 1978.

FEDER, M.E. 1981. A cold look at physiology. *Paleobiology* 7:144-148.

A review of papers presented at the 1978 AAAS Symposium (Thomas and Olson, 1980). The author remarks on the failure of contributors to standardise the definitions and concepts used when discussing the question of dinosaur metabolism. The property that enabled dinosaurs to become a successful 'group' was variously given as: 1) constancy of body temperature; 2) thermal constancy at a high body temperature (homeothermy); 3) thermal constancy (though not necessarily at a high body temperature); 4) a high rate of internal heat production (tachymetabolism); 5) a high rate of oxygen consumption, and 6) sustained levels of activity.

FEDUCCIA, A. 1973. Dinosaurs as reptiles. *Evolution* 27:166-169.

The author questions some of the previous assertions and the definitions of Bakker and Ostrom (including terms such as poikilotherm, homoiotherm, homeotherm, endotherm, heterotherm, thigmotherm). Bakker (and to a lesser extent, Ostrom) attempts to equate homeothermy with endothermy, which Feduccia challenges. He notes that for much of the Mesozoic, climatic fluctuations were few and insignificant, whereby the end of the Cretaceous saw major climatic variation (due in part to the trans-Antarctic oceanic flow that resulted from the break-up the southern continents), and that the dinosaurs may thus have died out due to not possessing a physiologically endothermic metabolism, which would have shielded them from such changes.

FEDUCCIA, A. 1974. Endothermy, dinosaurs and *Archaeopteryx*. *Evolution* 28:503-504.

A reply to Bakker, 1974; Dodson, 1974; Ostrom, 1974d, in which the author notes that erect gait should not alone be considered a direct correlate of endothermy because there is no physiological connection between the two factors. He also questions Ostrom's arguments that avian feathers developed as an insulatory mechanism for effective endothermy (because Ostrom had assumed that *Archaeopteryx* had no particular skeletal adaptations for flight).

FEDUCCIA, A., and H.B. TORDOFF, 1979. Feathers of *Archaeopteryx*: asymmetric vanes indicate aerodynamic function. *Science* 203:1021-1022.

Modern flying birds, (eg. *Crex*), possess asymmetric primary and secondary wing feathers with the rachis lying close to the leading edge (in contact with the air flow), while modern flightless birds, (eg. *Struthio* and *Rhea*) exhibit either reduced asymmetry or near symmetry of the primaries. The feathers of *Archaeopteryx* in comparison, exhibit an asymmetry that appears to be close to that of modern flying birds, and the authors conclude that it was at least capable of gliding.
See Yalden, 1970.

FERNANDEZ GALIANO, D. 1960. Yacimientos de dinosaurios en Galve (Teruel). *Bol. R. Soc. Espanola Hist. Nat. Geol.* 58(l):95-96.

FERRUSQUIA-VILLAFRANCA, I., S.P. APPLEGATE and L. ESPINOSA-ARRUBARRENA, 1978. Rocas volcanosedimentarios Mesozoicas y huellas de dinosaurios en la region suroccidental pacifica de Mexico. *Rev. Inst. Geol. Univ. Nac. Auton. Mexico* 2:150-162.

FISHER, D.W. 1981. The world of *Coelophysis*: A New York, USA, dinosaur of 200 million years ago. *N.Y. State Mus. Sci. Serv. Circ.* 49:1-22.

FLANDERS, S.E. 1962. Did the caterpillar exterminate the giant reptile? *J. Res. Lepidoptera* 1 (l):85-88.

FLANNERY, T.F., and T.H. RICH, 1981. Dinosaur digging in Victoria. Aust. Nat. Hist. 20: 195-198.

FOLINSBEE, R.E., P. FRITZ, H.R. KROUSE and A.R. ROBBLEE, 1970. Carbon-13 and oxygen-18 in dinosaur, crocodile and bird eggshells indicate environmental conditions. *Science* 168:1353-1356.

FREEMAN, E.F. 1975. The isolation and ecological implications of the microvertebrate fauna of a Lower Cretaceous lignite bed. *Proc. Geol. Assoc.* 86(3):307-312.

GALTON, P.M. 1969. The pelvic musculature of the dinosaur *Hypsilophodon* (Reptilia: Ornithischia). *Postilla* 131:1-64.

GALTON, P.M. 1970a. Ornithischian dinosaurs and the origin of birds. *Evolution* 24:448-462.

Until the 1970s, birds were generally accepted as having been derived from a 'fifth' thecodont line, quite separate from the Saurischia, Ornithischia, Crocodilia and Pterosauria, which constituted the first four lines. Any similarities between birds and dinosaurs were thought to be the result of parallelism and convergence (appendix, Heilmann, 1916,1926). In this paper, the author attempted to show that similarities between some ornithischian dinosaurs and *Archaeopteryx* indicated shared ancestry. A key factor in the author's argument involved the orientation of the post pubic process (the assumed homologue of the pubis in saurischians), which in both *Archaeopteryx* and ornithischians has shifted posteroventrally to lie parallel with the ischium. This contrasts with the pubis in saurischians, which is orientated anteroventrally. The pelvis of *Archaeopteryx* as preserved in the Berlin specimen, may, however, have been dislocated from an original ventral or even anteroventral position (Ostrom, 1973), and the author, like Ostrom, later supported a saurischian origin for birds (Bakker and Galton, 1974).

GALTON, P.M. 1970b. Pachycephalosaurids - dinosaurian battering rams. *Discovery, New Haven* 6(l):23-32.

The thickly boned skulls of the enigmatic pachycephalosaurids (recently elevated to the rank of Suborder, see Maryanska and Osmolska, 1974) have often eluded explanation, and in this paper, the author combines osteological evidence with ethological analogies in an attempt to offer one. Some ornithischians, notably hadrosaurs, possessed series of ossified tendons arranged in a network along the sides of the neural spines, and the assumption is that this enabled the animal to assume a horizontal posture of the backbone when mobile (Galton, 1970c). Smaller ornithischians, like pachycephalosaurids, may have been built similarly (although comparable post-cranial evidence is lacking). Such a posture would have enabled the animals to use the skulls as battering rams during intraspecific combat much as do modern ungulates. The theory is supported by the position of the occipital condyle which is directly behind the apex of the dome of the skull if the neck is held horizontally (thus minimising the possibility of neck dislocation). The ethological …

significance of such behaviour is that ornithopods may have lived in loosely integrated, gregarious herds. See Farlow and Dodson, 1975; Galton, 1971d; Molnar, 1977/78.

GALTON, P.M. 1970c. The posture of hadrosaurian dinosaurs. *J. Paleontol.* 44:464-473.
Traditionally, hadrosaurs have been restored and mounted in more or less upright positions. But in such a stance, the head of the femur would bear heavily against the lightly constructed pubic peduncle and even the pubis itself, instead of the acetabulum and the acetabular bar. The structure of the ilium in some hadrosaur species indicates that the sacrum was held horizontally, and this is supported by the straightness of the posterior dorsal, sacral and anterior caudal vertebrae. The author also examines the manus and hindlimbs of *Anatosaurus* and concludes that the correct position of a mobile animal was bipedal, with the backbone held virtually horizontal and the tail well clear of the ground.

GALTON, P.M. 1971a. *Hypsilophodon*, the cursorial non-arboreal dinosaur. *Nature, Lond.* 231:159-161.
Until this paper, it was generally assumed that the small ornithopod dinosaur *Hypsilophodon*, was an arboreal animal. However, a re-examination of the fossil material led the author to conclude that this dinosaur was far more likely to have been a creature of cursorial habits (it is described as being more highly adapted to running than any other post-Triassic ornithopod), and it did not exhibit any specific adaptations for arboreal habits.

GALTON, P.M. 1971b. Manus movements of the coelurosaurian dinosaur *Syntarsus* and opposability of the Theropod hallux. *Arnoldia* 5(15):1-18.

GALTON, P.M. 1971c. The mode of life of *Hypsilophodon,* the supposedly arboreal ornithopod dinosaur. *Lethaia* 4:453-465.

GALTON, P.M. 1971d. A primitive domeheaded dinosaur (Ornithischia: Pachycephalosauridae) from the Lower Cretaceous of England and the function of the dome of pachycephalosaurids. *J. Paleontol.* 45:40-47.
A description of a skull cap assigned to the new genus *Yeverlandia*, thought to represent a primitive pachycephalosaurid from the Lower Cretaceous Wealden, England (all other pachycephalosaurids are Upper Cretaceous in age). The possibility that pachycephalosaurids utilised their skulls in intraspecific battering combats is also discussed. See Galton, 1970 b.

GALTON, P.M. 1971e. The prosauropod dinosaur *Ammosaurus*, the crocodile *Protosuchus*, and their bearing on the age of the Navajo Sandstone of northeastern Arizona. *J. Paleontol.* 45: 781-795.

GALTON, P.M. 1972. Classification and evolution of Ornithopod dinosaurs. *Nature, Lond.* 239:464-466.
The author discusses the origin of the Ornithischia, and presents arguments for the re-classification of the hypsilophodonts (see Galton, 1971a). Because of the cursorial nature of these small dinosaurs, he places them nearer to the fabrosaurs, psittacosaurs and ceratopsians. Other diagnostic features of hypsilophodonts include inset maxillary and dentary teeth, no canines, and cheeks present (for the chewing of vegetable matter).

GALTON, P.M. 1973a. The cheeks of ornithischian dinosaurs. *Lethaia* 6:67-89.

GALTON, P.M. 1973b. A femur of a small theropod dinosaur from the Lower Cretaceous of England. *J. Paleontol.* 47(5):996-997.

GALTON, P.M. 1973c. On the anatomy and relationships of *Efraasia diagnostica* (Huene) n. gen., a prosauropod dinosaur (Reptilia: Saurischia) from the Upper Triassic of Germany. *Palaontol. Z.* 47:229-255.

GALTON, P.M. 1973d. Rediscription of the skull and mandible of *Parkosaurus* from the Late Cretaceous with comments on the family Hypsilophodontidae (Ornithischia). *Life Sci. Contr., R. Ont. Mus.* 89:1-21.

GALTON, P.M. 1974a. Notes on *Thescelosaurus*, a conservative ornithopod dinosaur from the Upper Cretaceous of North America, with comments on ornithopod classification. *J. Paleontol.* 48:1048-1067.

GALTON, P.M. 1974b. The ornithischian dinosaur *Hypsilophodon* from the Wealden of the Isle of Wight. *Bull. Br. Mus. Nat. Hist. (Geol.)*. 25:1-152.

GALTON, P.M. 1975. English hypsilophodontid dinosaurs (Reptilia: Ornithischia). *Palaeontology* 18(4):741-752.

GALTON, P.M. 1976a. The dinosaur *Vectisaurus valdensis* (Ornithischia: Iguanodontidae) from the Lower Cretaceous of England. *J. Paleontol.* 50(5):976-984.

GALTON, P.M. 1976b. *Iliosuchus*, a Jurassic dinosaur from Oxfordshire and Utah. *Palaeontology (Lond.)* 19(3):587-589.

GALTON, P.M. 1976c. Prosauropod dinosaurs (Reptilia: Saurischia) of North America. *Postilla* 169:1-98.

GALTON, P.M. 1977. On *Staurikosaurus pricei*, an early saurischian dinosaur from the Triassic of Brazil, with notes on the Herrerasauridae and Poposauridae. *Palaontol. Z.* 51:234-245.

GALTON, P.M. 1978. Fabrosauridae, the basal family of ornithischian dinosaurs (Reptilia: Ornithopoda). *Palaeontol. Z.* 52(1/2):138-159.

GALTON, P.M. 1980. Armored dinosaurs (Ornithischia: Ankylosauria) from the Middle and Upper Jurassic of England (UK). *Geobios (Lyon)* 13(6):825-838.

GALTON, P.M. 1981a. *Dryosaurus*, a hypsilophodontid dinosaur from the Upper Jurassic of North America and Africa: Postcranial skeleton. *Palaeontol. Z.* 55(3/4):271-312.

GALTON, P.M. 1981b. A juvenile stegosaurian dinosaur, *Astrodon pusillus*, from the Upper Jurassic of Portugal, with comments on Upper Jurassic and Lower Cretaceous; biogeography. *J. Vertebr. Paleontol.* 1(3/4):245-256.

GALTON, P.M. 1981c. A rhamphorhynchoid pterosaur from the Upper Jurassic of North America. *J. Paleontol.* 55(5):1117-1122.
This find, from the proliferous Como Bluff site, Wyoming, is notable as the first record of a rhamphorhynchoid pterosaur from North America, and only the second from the New World.

GALTON, P.M. 1982a. *Elaphrosaurus*, an ornithomimid dinosaur from the Upper Jurassic of North America and Africa. *Palaeontol. Z.* 56(3/4):265-276.

GALTON, P.M. 1982b. Juveniles of the stegosaurian dinosaur *Stegosaurus* from the Upper Jurassic of North America. *J. Vertebr. Paleontol.* 2(1):47-62.
Partial skeletons of two juvenile *Stegosaurus* are described. In contrast to the adults, dermal plates appear to be absent though tail spines are present. The bones are similar to those of juvenile individuals of the East African stegosaur *Kentrosaurus* (skeletons of which seem to exhibit sexual dimorphism in the sacrum).

GALTON, P.M., and H.A. CLUVIER, 1976. *Anchisaurus capensis* (Broom) and a revision of the Anchisauridae (Reptilia, Saurischia). *Ann. S. Afr. Mus*. 69:121-159.

GALTON, P.M., and W.P. COOMBS, 1981. *Paranthodon africanus*, a stegosaurian dinosaur from the Lower Cretaceous of South Africa. *Geobios (Lyon)* 14(3):299-310.

GALTON, P.M., and J.A. JENSEN, 1973a. Skeleton of a hypsilophodontid dinosaur (*Nanosaurus* (?) *rex*) from the Upper Jurassic of Utah. *Brigham Young Univ., Geol. Stud.* 20:137-157.

GALTON, P.M., and J.A. JENSEN, 1973b. Small bones of the hypsilophodontid dinosaur *Dryosaurus altus* from the Upper Jurassic of Colorado. *Great Basin Nat.* 33(2):129-132.

GALTON, P.M., and H.P. POWELL, 1980. The ornithischian dinosaur *Camptosaurus prestwichii* new combination from the Upper Jurassic of England, U.K. *Palaeontology (Lond.)* 23(2):411-444.

GALTON, P.M., and H.P. POWELL, 1983. Stegosaurian dinosaurs from the Bathonian (Middle Jurassic) of England, (U.K.) the earliest record of the family Stegosauridae. *Geobios (Lyon)* 16(2):219-230.

GALTON, P.M., and P. TAQUET, 1982.*Valdosaurus*, a hypsilophodontid dinosaur from the Lower Cretaceous of Europe and Africa. *Geobios (Lyon)* 15(2):147-160.

GARTNER, S., and J.P. MacGUIRK, 1979. Terminal Cretaceous extinction: Scenario for a catastrophe. *Science* 206:1272-1276.
A model is proposed to explain the mass biotic extinctions that mark the Cretaceous/Tertiary boundary. It includes an isolation of the Arctic Ocean in the Late Cretaceous, due to a combination of tectonics and shelf-sea regression. Eventually, this body of water lost its salinity. Rifting between Greenland and Norway caused intrusion of salt water into the Arctic Ocean while at the same time, Arctic water spilled into the North Atlantic. This mixing may have lowered world sea temperatures by 10 degrees C. The subsequent climatic disturbance may have produced a long drought, general cooling, pronounced seasonality and a change in composition of world flora, which together, may have caused a major decline and eventual demise of dinosaur communities.

GIBSON, M.A. 1967. The histology of two samples of fossilised bone. *Can. J. Zool.* 45(4):582.

GINGERICH, P.O. 1973. Skull of *Hesperornis* and early evolution of birds. *Nature, Lond.* 243: 70-73.
A re-evaluation of a skull of *Hesperornis* collected in 1871 by O.C. Marsh provides further evidence in favour of a saurischian origin for birds (see Bakker, 1975a; Bakker and Galton, 1974; Ostrom, 1973,1974a,19755,1975c,1976a). *Hesperornis*, together with *Ichthyornis*, represented the intermediary stages between *Archaeopteryx* and modern birds. Modern birds exhibit cranial 'kinesis', that is, they are able to raise or lower, to some degree, the upper bill relative to the braincase. Unlike modern birds, the skull of *Hesperornis* (which, incidentally, retains thecodont teeth), does not show true cranial kinesis (although some anteroposterior movement of the maxillae relative to the rest of the skull is possible). The skull does, however, show articulation between the splenial and angular bones of the mandible, conditions also found in the theropods *Deinonychus* …

and *Dromaeosaurus*. This could have permitted medial rotation of the posterior part of the mandible, thus allowing the dentary teeth to disengage from prey during mandible protrusion.

GINSBERG, L. 1964. Decouvertr d'un scelidosaurian (Dinosaure ornithischien) dans le Trias Superieur du Basutoland. *Compt. Rendu. Acad. Sci. Paris* 258:2366-2368.

GLUT, D.F. 1972. *The dinosaur dictionary*, Citadel Press, New Jersey, 218 p.
In this general reference work, the author has gone to considerable effort to include relevant information and illustrations of all well known dinosaur genera. General external morphology, age and distribution are provided for each entry, and instances of any con-specificity are noted. At the beginning is a concise (but now very outdated) summary of dinosaur classification.

GLUT, D.F. 1982. *The new dinosaur dictionary*, Citadel Press, New Jersey, 288 p.
A more comprehensive and updated version of the original 1972 edition. Well illustrated.

GOULD, S.J. 1978. Were dinosaurs dumb? *New Sci.* 79(1113):266-267.
This short essay forms a chapter in one of the author's natural history monographs (appendix, Gould, 1980:ch.25). The main discussion concerns the size of dinosaur brains relative to other reptiles, and the fact that most dinosaurs possessed brains no smaller than what one would expect when the ratio of brain to body size is calculated. See Hopson, 1977a,1980a; Jerison, 1969.

GOW, C.E. 1975. The morphology and relationships of *Youngina capensis* Broom and *Prolacerta broomi* Parrington. *Palaeontol. Afr.* 18:89-131.

GREENBERG, N. 1980. Physiological and behavioural thermoregulation in living reptiles. In: R.D.K. Thomas and E.G. Olson (eds.), *A cold look at the warm-blooded dinosaurs*, p. 141-166, Westview Press, Boulder.

GREGORY, J.T. 1962. The genera of phytosaurs. *Amer. J. Sci.* 260:652-690.

Guide to the palaeontological exhibition of the USSR Academy of Sciences 'Animal World of the Past Epochs', 1979, 49 p. (In Japanese).

HAAS, G. 1963. A proposed reconstruction of the jaw musculature of *Diplodocus*. *Ann. Carnegie Mus.* 36:139-157.

HALSTEAD, L.B. 1975. *The evolution and ecology of the dinosaurs*, Peter Lowe, London, 116 p.
A popular account of dinosaurs and other Mesozoic reptiles. On p.63, *Stegosaurus* is curiously figured with the unlikely arrangement of symmetrically paired plates (see Farlow et al, 1976), and on p.80, *Deinocheirus* is prematurely described as an active, carnosaur-like predator (see Rozhdestvensky, 1970). The author suggests that adult dinosaurs were warm-blooded as a consequence of their large mass and that their metabolic rates were low. Juvenile dinosaurs may have had higher metabolic rates which slowed as they grew.

HALSTEAD, L.B. 1976. Dinosaur teleology. *Nature, Lond.* 260:559-560.
A critical review of 'The hot blooded dinosaurs' (Desmond, 1975). The author concludes that the evidence for dinosaur endothermy, as presented by Desmond, is inconclusive, noting that dinosaurs could have been passive homeotherms by virtue of their large size (though such an alternative would not explain homeothermy in small theropods like coelurosaurs, see Benton, 1979b).

HALSTEAD, L.B., and J.R. MERCER, 1968. Histology of dinosaur bone. In: 16th. Symp. Vert. Palaeont. and Compar. Anat., Reading. Reading, England, 2p.

HASS, G. 1969. On the jaw muscles of ankylosaurs. *Amer. Mus. Novitates* 2399:1-11.

HEATON, M.J. 1972. The palatal structure of some Canadian Hadrosauridae (Reptilia, Ornithischia). *Can. J. Earth Sci.* 9:185-205.

HECHT, M.K., and S. TARSITANO, 1982. The paleobiology and phylogenetic position of *Archaeopteryx. Geobios, Memoire* special 6:141-149.

Several archosaur groups have been advocated as being the origin of *Archaeopteryx*, including the Crocodilia (Walker, 1972), the Saurischia (Bakker and Galton, 1974; Ostrom, 1973, 1974a, 1975b,1975c,1976a; Thulborn, 1975), and the Thecodontia (Tarsitano and Hecht, 1980; appendix, Heilmann, 1926). In this paper, the authors restate their earlier (1980) position in considering *Archaeopteryx* as a derivative of the pseudosuchian Thecodontia. They note that characters listed in support of a crocodilian origin for *Archaeopteryx* tend to be primitive for the Archosauria in any case. In addition, clavicles are absent in the Crocodilia. Some characters listed in support of a saurischian origin are also primitive, for example, the presence of clavicles in some theropods. Also noted is the apparent loss of the fourth digit in theropods, whereas embryological studies indicate that birds still retain the fourth digit. The similarity between the furcula of *Archaeopteryx* and that of the thecodont *Longisquama* (see Sharov, 1970) is mentioned. The insect net hypothesis proposed to explain the feathered forearms of *Archaeopteryx* (Ostrom, 1974b) is considered, but rejected on the grounds that adduction of the forearms would cause air pressure to expel prey from between the wings (Feduccia and Tordoff, 1979). The cursorial hypothesis of the evolution of avian flight is also rejected by the authors, primarily because *Archaeopteryx* lacked a M. supracoracoideus pulley system (which acts as a humeral abductor, raising the wing in modern birds), as well as possessing a ventrally directed glenoid fossa, features which would have greatly limited wing elevation. The probable ecology of *Archaeopteryx* is briefly discussed, and in contrast to previous authors who have speculated on an arboreal pro-avis stage inhabiting dense or open woodland (see for example, Yalden, 1970), the authors suggest that *Archaeopteryx* was a scavenger on the beaches of the ancient Solnhofen Sea. The scattered offshore coral islands enabled the weakly flying and gliding *Archaeopteryx* to attain a considerable aerial range. Flight itself was initiated either from high trees or cliffs, and was maintained by thermal up-currents arising from the warm sea. Thus foraging was achieved at relatively little musculature effort.

HEINTZ, N. 1963. Dinosaur footprints and polar wandering. *Arbok Norsk. Polarinst*. 1962:35-43.

HELLER, F. 1960. Der dritter *Archaeopteryx* - Fund aus den Solnhofer Plattenkalken des obern Malm Frankens. *J. fur Ornithologie* 101:7-28.

HEPTONSTALL, W.B. 1970. Quantitative assessment of the flight of *Archaeopteryx. Nature,* Lond. 228:185-186.

The author provides an anatomical comparison between *Archaeopteryx* and the pigeon *Columbia livia*. The lengths of many of the bones are similar though the head, neck and tail of *Archaeopteryx* appear to have been heavier. The body weight is calculated at 500 g. as opposed to the 200 g. suggested by Bramwell (1971), though the wing loading appears to have been quite high. See Yalden, 1970, 1984.

HEPTONSTALL, W.B. 1971. Flying ability of *Archaeopteryx. Nature, Lond.* 231:128.

The author's response to Bramwell (1971), and Yalden (1971), in which he defends his original estimate of the weight of Archaeopterx as 500 gm. This was based on a comparison with the pigeon *Columbia livia*. He agrees with Yalden's inference on *Archaeopteryx* mainly using its aerial abilities to travel from tree to tree, but suggests that landing could have been less well controlled than was suggested by Yalden.

HOHNKE, L.A. 1973. Haemodynamics in the Sauropoda. *Nature, Lond.* 244:309-310.
Because of their large body length and very long necks, large sauropods must have had specific adaptations to cope with the blood pressures required to supply blood to the cranium when the neck was held in an upright position. The author compares the haemodynamic data of the giraffe to calculated pressures in two large sauropods, *Apatosaurus* and *Brachiosaurus,* and estimates their mean systemic arterial pressure at 216 and 568 mm Hg, respectively. Sauropods solved the problem associated with supplying the brain from the heart via great distances/heights under very high pressures, possibly by having a very high aortic pressure and reflexogenic control over cerebral perfusion pressures.

HOOIJER, D.A. 1968. A Cretaceous dinosaur from the Syrian Arab Republic. *Proc. Kon. Ned. Akad. Wetensch. Ser. B. Physi. Sci.* 71(2):150-152.

HOPSON, J.A. 1975a. The evolution of cranial display structures in hadrosaurian dinosaurs. *Paleobiology* 1:21-43.
The author reviews earlier theories advanced to explain the function of the various cranial crests of the Hadrosauridae. These largely fell into six categories, as follows: 1) an air storage reservoir (snorkel) during submergence (effectively disputed by Ostrom and Davitashvili); 2) an attachment site for a proboscis (this theory is based on an erroneous interpretation); 3) a water trap during submerged feeding (disputed by Ostrom); 4) an area of increased olfactory sensitivity; 5) a visual sexual display structure, and 6) a vocal resonating chamber. (Points 1,3, and 6 applicable only to lambeosaurine hadrosaurs). The author presents a hypothesis that incorporates points 5 and 6 above. He notes, in evidence, that hadrosaurs possessed well developed optic and auditory systems; that variation in crests appears to be species specific and sexually dimorphic; that the degree of crest distinctiveness correlates well with species diversity, and that crest size increases with time. (Note however, that this last observation is disputed by Molnar (1977/78) who cites Rozhdestvensky in questioning the age that Hopson assigns to the sauroloph *Tsintasaurus* in this analysis). The possibility of the crests serving a thermoregulatory function to cool the brain (Wheeler, 1978) is not considered. See Davitashvili, 1961; Maryanska and Osmolska, 1979,1981a; Weishampel, 1981a,1981b.

HOPSON, J.A. 1975b. On the generic separation of the ornithischian dinosaurs *Lycorhinus* and *Heterodontosaurus* from the Stormberg Series (Upper Triassic) of South Africa. *S. Afr. J. Sci.* 10:302-305.

HOPSON, J.A. 1976. Hot- cold-, or lukewarm-blooded dinosaurs? Review of The hot-blooded dinosaurs: a revolution in paleontology by J.A. Desmond. *Paleobiology* 2:271-275.
A review of Desmond (1975). The author admits that certain dinosaurs (such as the coelurosaurs and some bipedal ornithopods) may have possessed endothermic levels of metabolism, but sauropods, stegosaurs and ankylosaurs probably did not. The review concludes with the acknowledgement that dinosaurs were not ‘typical’ representatives of the Reptilia, but should be treated as a unique group.

HOPSON, J.A. 1977a. Brain size and behaviour of dinosaurs. *J. Paleontol.* 51(2, Suppl.):15.

HOPSON, J.A. 1977b. Relative brain size and behaviour in archosaurian reptiles. *Ann. Rev. Ecol. Syst.* 8:429-448.
An evaluation of the brain sizes of extinct archosaurs can give an indication of the animals' possible behavioural repertoires. Endocasts of the cranial cavities are known for representatives of all archosaurian orders, if one takes into consideration that brain size varies allometrically with body size, a comparison between the measured brain size of an extinct archosaur can be made against the expected brain size for typical reptiles (the standard, in this case, being extant crocodilians). The brain sizes of sauropods, ankylosaurs, stegosaurs and ceratopsians all lie…

below the expected standard. Those of ornithopods lie across it, while those of carnosaurs and coelurosaurs lie above it. See Hopson, 1977a,1980a; Jerison, 1969.

HOPSON, J.A. 1980a. Relative brain size in dinosaurs, implications for dinosaurian endothermy. In: R.D.K. Thomas and E.G. Olson (eds.), *A cold look at the warm-blooded dinosaurs*, p. 287-310, Westview Press, Boulder.

In a restatement of earlier (1977b) views, the author concludes that the majority of dinosaurs were not capable of mammalian-type metabolic activity levels as maintained by Bakker. High degrees of encephalisation are, however, found in large bipedal ornithopods such as hadrosaurs and iguanodonts, and in the Theropoda. The majority of ornithopods do not possess defensive structures, so encephalisation in this group is associated with highly developed senses and the capability of fast movement (see Galton, 1970c). Further, the assessment of the cranial crests of hadrosaurs as display structures (Hopson, 1975a) implies a complex social behaviour for which a high degree of encephalisation is a prerequisite. With regard to the Theropoda, the high degree of encephalisation as found in the coelurosaurs is associated with the implications of predaceous habits, such as increased agility, highly developed vision (in order to pursue small, mobile prey), the evolution of a grasping manus, and, in some cases, the apparent development of binocular vision (Russell, D.A., 1969).

HOPSON, J.A. 1980b. Tooth function and replacement in early Mesozoic ornithischian dinosaurs: implications for aestivation. *Lethaia* 13(1):93-105.

HORNER, J.R. 1979. Upper Cretaceous dinosaurs from the Bearpaw Shale (marine) of south-central Montana with a checklist of Upper Cretaceous dinosaur remains from marine sediments in North America. *J. Paleontol*. 53(3):566-577.

Four dinosaur specimens from the marine Bearpaw Shale are assigned to the genus *Hadrosaurus* (previously *Kritosaurus*), *Lambeosaurus*, and *Panoplosaurus*. A new checklist of dinosaur fossils from these marginal-marine sediments reveals that there was an abundance of non-crested hadrosaurs and armoured nodosaurs in such areas, and that about half of the hadrosaur population from marine sediments were young or juvenile individuals.

HORNER, J.R. 1982. Evidence of colonial nesting and "site fidelity" among ornithischian dinosaurs. *Nature, Lond*. 297:675-676.

The author relates the discovery of seven hadrosaur nests in addition to the one previously described (Horner and Makela, 1979). One of the new nests contained very young hadrosaurs (.5 m. long) and the remaining six contained only eggshells. It is suggested that all 8 nests hosted conspecific hadrosaurs, and originally formed part of a much larger colonial nesting site. The author proposes that while some adults foraged for food to bring back to the nests, others remained to ward off potential predators. Fossil varanids, similar to modern species known to pillage crocodile and turtle nests, are also known from this vicinity (Horner, 1984). Another nesting site, belonging to hypsilophodontid-like ornithopods, was also uncovered in the same area. The young of this species, however, appear to have been more precocious than the hadrosaurs, as their remains were only to be found outside of the nests proper.

HORNER, J.R. 1984. The nesting behaviour of dinosaurs. *Sci. Amer*. 250(4):92-99.

A popular article describing the discoveries of dinosaur communal nesting areas at the Willow Creek and Egg Mountain sites in Montana. Three different kinds of egg were found associated with the large circular nests (each containing 20- 25 eggs), belonging to hypsilophodonts (eggs of 12 cm length) and hadrosaurs (eggs of 20 cm length). The nests are only about the length of an adult parent apart from each other. The remains of egg-eating lizards and the small carnivorous theropod *Troodon* were also found at the same site, suggesting that these might have fed on the eggs and young hatchlings, respectively. The closeness of the nests infers that the nests were more easily guarded with the presence of many parental adults in the same area.

HORNER, J.R., and J.R. MAKELA, 1979. Nest of juveniles provides evidence of family structure among dinosaurs. *Nature, Lond.* 282:296-298,

The most commonly accepted explanation for the traditional paucity of fossil juvenile dinosaurs is that the adults gave birth in upland areas that were prone to erosion. In this paper, the authors describe the discovery of a rudimentary ornithischian nest containing the remains of 11 young hadrosaurs averaging 1 in. in length. The nest, 2 m. in diameter and .75 m. deep at its concave centre, was situated at the apex of a mound that was considerably higher than the surrounding topography. Remains of 4 other young hadrosaurs were found outside the nest. Tooth wear on the animals' dental batteries indicate that they had been feeding, and the fact that 11 individuals were in the nest together implies altricial behaviour on behalf on the parent/parents who presumably brought suitable food to the nest. Apart from the relatively large pes of the juveniles, comparison of other skeletal elements with those of adult hadrosaurs indicates that little ontogenetic change occurred in this species. See Horner, 1982,1984.

HOTTON, N. 1963. *Dinosaurs*, Pyramid Press, New York, 192 p.

HOTTON, N. 1980. An alternative to dinosaur endothermy: the happy wanderers. In: R.D.K. Thomas and E.G. Olson (eds.), *A cold look at the warm-blooded dinosaurs*, p. 311-350, Westview Press, Boulder.

The author proposes that most dinosaurs, herbivorous and carnivorous alike, would have found it difficult to locate sufficient quantities of food to sustain even modest rates of ectothermic metabolism. This, combined with a supposedly low temperature fluctuation toleration, meant that dinosaurs may have employed seasonal migration as a food/temperature coping strategy, much as do modern birds. There is evidence that at least one genus, *Plateosaurus*, a comparatively small Triassic prosauropod, undertook long (annual?) treks (appendix, Von Heune, 1928). Dinosaur migration may have begun as a random process during daily forays, increasing during the spring when increased daylight, higher temperatures and increased primary productivity could have expanded the northern range. The returning migration south was probably cued by a reversal of these factors. The author calculates the average daily distance required to be covered to account for a migration of thirty degrees latitude at between 19 and 27 km. Such distances would, however, seem to be beyond the capabilities of dinosaurs such as sauropods, given that excessive daily movement would have caused heat dissipation problems (MacGowan, 1979), and that even an ectothermic metabolism would have dictated continual feeding for the greater part of the day.

HOWGATE, M.E. 1984. The teeth of *Archaeopteryx* and a reinterpretation of the Eichstatt specimen. Zool. J. Linn. Soc. 82:159-175.

The best preserved and most complete fossil of *Archaeopteryx* unearthed to date is that of the Eichstatt specimen uncovered near the village of Workerzell in 1951. Because the fossil lacked any feather impressions it was originally diagnosed as a juvenile specimen of the theropod *Compsognathus* (see Ostrom, 1975a) until it was correctly recognised as another *Archaeopteryx* specimen by Mayr (1973). In this paper, the author distinguishes the Eichstatt specimen from all other specimens referred to *A. lithographica* to at least the specific level. It is assigned, by the author, to the new species *A.recurva*. The differences between *A.recurva* and *A. lithographica* are as follows: 1) teeth more gracile and recurved; 2) body size one third smaller; 3) distal pes elements comparatively longer, and 4) pubic symphysis shorter. Other differences, also noted, may serve to establish a new genus for *A. recurva*. These are: 5) pubis almost vertical as opposed to strongly opisthopubic as in *A. lithographica* (Ostrom believes that this orientation is correct and that the other specimens have been altered during preservation; see for example, Ostrom, 1973, while other authorities, notably Tarsitano and Hecht, 1980; Hecht and Tarsitano, 1982; Walker, 1980, accept the Berlin and London specimens as being correctly orientated), and finally, 6) *A. recurva* lacks an ossified furcula. The author considers that *A. recurva* was probably an evolutionary precursor to *A. lithographica* and was probably more cursorial. The teeth were stouter than in other *Archaeopteryx* specimens, and were distally recurved (hence the specific name) and...

it seems likely that *A.recurva* was not adapted to an insectivorous diet (the other specimens of *Archaeopteryx* are thought to have been largely insectivorous). Finally, Walker's 1972 proposal that birds lie phylogenetically closest to crocodiles (see also Martin et al, 1980; Whetstone and Martin, 1979) is rejected (as it has been by most authorities) and the author suggests that the ancestor of *Archaeopteryx* was either a pseudosuchian thecodont or a theropod.

HU, C.C. 1973. A new hadrosaur from the Cretaceous of Chucheng, Shantung. *Acta Geol. Sinica* 2:179-206.

HUGHES, B. 1963. The earliest archosaurian reptiles. *S. Afr. J. Sci.* 59:221-241.

JAIN, S.L., T.S. KUTTY, T. ROY-CHOWDHURY and S. CHATTERJEE, 1974. The sauropod dinosaur from the Lower Jurassic Kota formation of India. *Proc. Roy. Soc. Lond. B. Biol. Sci.* 188(1091):221-228.

JASTROW, R. 1984. The dinosaur massacre. *Omega Science Digest* March 5/ April, 1984:22-26.

JAWOROWSKI, Z., and J. PENSKO, 1967. Unusually radioactive fossil bones from Mongolia. *Nature, Lond.* 214:161-163.

The authors have examined fossil bone from Cretaceous dinosaurs and Palaeocene mammals collected during the Polish-Mongolian Expeditions to the Gobi between 1963 and 1965, and found them to be high in levels of radioactivity. The levels were 7 times higher in the Cretaceous fossils (collected from the celebrated Nemegt Valley deposits) than from the Palaeocene ones. Levels were highest in bones containing greater amounts of organic matter. It is assumed that natural uranium from percolating ground waters had been infused into the fossil bone, possibly from very distant sources of the nuclide.

JENNY, J., A.L. MARREC and M. MONBARON, 1981. Footprints of Middle Jurassic dinosaurs from the Central High Atlas (Morocco): New occurrences and stratigraphic data. *Geobios (Lyon)* 14(3):427-432. (In French with English summary).

JENSEN, J.A., and J.H. OSTROM, 1977. A second Jurassic pterosaur from North America. *J. Paleontol.* 51(4):867-870.

JEPSEN, G.L. 1964. Riddles of the terrible lizards. *Amer. Sci.* 52(2):227-246.

JERISON, H.J. 1968. Brain evolution and *Archaeopteryx*. *Nature, Lond.* 219:1381-1382.

This paper looks at the brain endocast from one of the well preserved *Archaeopteryx* specimens in the collections of the British Museum. Using an estimated body size of 500 gm (which some authors would dispute and suggest was nearer to 200 gm: see for example Bramwell, 1971; Yalden, 1971), the author finds the brain size exactly intermediate between the brain sizes of reptiles and birds. Using the 200 gm. estimate would therefore place the fossil far higher on the scale of relative brain size.

JERISON, H.J. 1969. Brain evolution and dinosaur brains. *Amer. Nat.* 103:575-588.

JOHNSTON, P.A. 1979. Growth rings in dinosaur teeth. *Nature, Lond.* 278:635-636.

Growth rings in teeth are normally characteristic of ectothermic animals, because such animals cannot maintain constant levels of activity during adverse times such as unusually dry or cold periods. The author examined the teeth of several types of dinosaur, including tyrannosaurs, ceratopsians, and hadrosaurs, and found clear evidence of growth rings in all of them. The rings were very similar to those found in extant (ectothermic) crocodiles, and far more obvious than those found in extinct and recent (endothermic) mammals.

KARASZEWSKI, W. 1975. Footprints of pentadactyl dinosaurs in the Lower Jurassic of Poland. *Bull. Acad. Pol. Sci. Ser. Sci. Terre* 23(2):133-136.

KAYE, J.M. 1973. The oldest record of hadrosaurian dinosaurs in North America. *J. Paleontol.* 47(l):91-93.

KERMACK, D. 1984. New sauropod material from South Wales. *Zool. J. Linn. Soc.* 82:101-117.

KEROURIO, P. 1981. The distribution of dinosaurian multilayered eggshells in the continental Maastrichtian of southern France. *Geobios (Lyon)* 14(4):533-536. (In French with English summary).

KIELAN-JAWOROWSKA, Z. 1967. Les resultats des expeditions paleontologiques polono-mongoles (1963-1965) dans le desert da Gobi et en Mongolie Occidentala. *Intern. Cent. Natl. Rech. Sci. Colloq.* 163:419-425.

KIELAN-JAWOROWSKA, Z. 1969a. Fossils from the Gobi Desert. *Sci. J. Lond.* 5A:32-38.
A summary of Kielan-Jaworowska, 1969b. The author notes that skeletons of top trophic level carnivorous dinosaurs outnumber those of herbivorous ones in the Nemegt deposits in the Gobi. One explanation could be that such deposits were lain down during floods which were more hazardous to terrestrial carnivores than to semi-aquatic herbivores. According to a study by Efremov and Novojilov (see Rozhdestvensky, 1960), the Nemegt area constituted the delta of a giant river which was subject to periodic flooding.

KIELAN-JAWOROWSKA, Z. 1969b. *Hunting for dinosaurs*, MIT Press, Cambridge, 177 pp.
Following the successful palaeontological ventures of the Russian Academy of Sciences to the Gobi Desert (1946-1949) and the associated discovery of the unusually fossiliferous Nemegt Valley deposits (Rozhdestvensky, 1960; appendix, Efremov, 1956), a series of joint Polish/Mongolian expeditions to the same area was organised. This book, a translation of the Polish original, is a popular account of the first series (1963-1965) of these ventures by the leader of the Polish side. By modern standards, the equipment used was basic (excepting the multi-wheel driven vehicles). All supplies had to be stocked four months in advance after being sent from Poland. Nevertheless, many excellently preserved Cretaceous dinosaur remains were recovered, including examples of giant tyrannosaurids (*Tarbosaurus*), ornithomimids, hadrosaurs (*Saurolophus*), pachycephalosaurids, protoceratopsids, ankylosaurids, and an atlantosaurid (the first complete sauropod skeleton from this part of the world). Also of note was the discovery of the forelimbs of a previously unknown and gigantic theropod (now assigned to the Deinocheiridae, see Osmolska and Roniewicz, 1969). In addition to the dinosaurian material, remains of a number of crania belonging to late Cretaceous mammals were recovered. See Kielan-Jaworowska, 1967, 1969, 1975: Kielan-Jaworowska and Dovchin, 1969.

KIELAN-JAWOROWSKA, Z. 1975. Late Cretaceous mammals and dinosaurs from the Gobi Desert. *Amer. Sci.* 63:150-159.
A summary of the results of the joint Polish/Mongolian expeditions to the Gobi (1963-1965 and 1967-1972). The author notes that although the known dinosaurs of Asia superficially appear similar to North American representatives (eg. *Tarbosaurus bataar vs Tyrannosaurus rex*, *Saurolophus angustirostris vs. S. osborni*), a more detailed comparative study would probably expose greater differences between the two assemblages. Until relatively recently, it has been assumed that during the Late Cretaceous, a trans-Bering land bridge connected Eastern Asia with Western North America, permitting faunal movement between the continents (Colbert, 1968: ch.8; Rozhdestvensky, 1965), but this now appears doubtful.

KIELAN-JAWOROWSKA, Z., and R. BARSBOLD, 1972. Narrative of the Polish-Mongolian Palaeontological Expeditions 1967-1972. *Palaeontol. Pol.* 27:5-13.

A summary of the preparation, field work and results of the second series of joint Polish/Mongolian ventures to the Gobi. See Kielan-Jaworowska, 1975.

KIELAN-JAWOROWSKA, Z., and N. DOVCHIN, 1969. Narrative of the Polish-Mongolian Palaeontological Expeditions 1963-1965. *Palaeontol. Pol.* 19:7-32.

A summary of the preparation, field work and results of the first series of joint Polish/Mongolian ventures to the Gobi. See Kielan-Jaworowska, 1969b.

KITCHING, J.W. 1979. Preliminary report on a clutch of six dinosaurian eggs from the Upper Triassic Elliot Formation, Northern Orange Free State. *Palaeontol. Africana* 22:41-45.

KLEBANOVA, I.M. 1963. Site of Cretaceous dinosaurs in the Ala Shan Desert (Maortu). *Vertebr. Palasiat.* 7(1):58. (In Russian).

KNOWLES, P.C. 1980. Dinosaur tracks. *Geo* 1:64-65.

KOCH, N.C. 1967. Disappearance of the dinosaurs. *J. Paleontol.* 41:970-972.

KOOL, R. 1981. The walking speed of dinosaurs from the Peace River Canyon, British Columbia, Canada. *Can. J. Earth Sci.* 18:823-825.

KRASSILOV, V.A. 1981. Changes of Mesozoic vegetation and the extinction of dinosaurs. *Palaeogeogr., Palaeoclimatol., Palaeoecol.* 34:207-224.

The author considers the fossil evidence provided by Mesozoic vegetation and combines this with assumed dinosaur feeding habits to provide an ecological explanation for dinosaur radiation and decline. The rationale of workers who assign dinosaurs such as sauropods to a fully terrestrial niche (sensu Bakker) without considering the fossil plant evidence, is questioned by the author. During the Mesozoic, the most common forms of habitats were cycadophyte-conifer shrublands and fern-horsetail marshes, and it is suggested that sauropods fed on dicksoniaceous ferns within extensive marshlands. The posteriorly positioned nares would have permitted uninterrupted feeding at times of flood or high water levels. Finds of mired sauropods, and the fact that some species appear to have held the neck in a lowered position (Borsuk-Bialynicka, 1977), support this view, as does the possession of weak dentition (Coombs, 1975), seemingly unsuitable for conifer branchlet removal. (for an analysis of possible sauropod stomach contents, see Stokes, 1964). The strong beaks of ceratopsians have previously been considered as suited to plucking cycads or palm material (Ostrom, 1966b), but the author notes that such plants were uncommon at the time. Alternatively, cycadeoid bennettites, averaging .5 m. in height, were a common and productive element of the Mesozoic flora. Ankylosaurids too, were probably shrubland dwellers, browsing up to 1 m. above ground level, as were ornithopods. Although Ostrom (1964b) gives a detailed analysis of hadrosaurs as terrestrial animals, the author notes that the stomach contents of a mummified hadrosaur studied by Krausel, 1922 (appendix) and cited by Ostrom in evidence, was most likely secondary infilling. (Krausel originally described the content as peat-like, containing abundant fruits and seeds). Krassilov suggests that hadrosaur morphology (including the duck-like feeding bills) and their frequent fossilisation both suggest a semi-aquatic mode of life. The feeding behaviour of various dinosaurs appears to correlate well with the world-wide vegetational changes that occurred from Mid Triassic to Late Cretaceous times. The elimination of Mesozoic fern-marshes, gymnosperms and cycadophyte shrubs coincided with the decline of dinosaur communities.

KREBS, B. 1963. Bau und Funkion des Tarsus eines Pseudosuchiers aus der Trias des Monte San Giorgio (Kanton Tessin, Schweirz). *Palaeontol. Z.* 37:88-95.

KUHN, 0. (ed.). 1976. *Handbuch der Palaeoherpetologie. Teil 13, Encyclopedia of Paleoherpetology*. Part 13. Thecodontia, Gustav Fischer Verlag, 137 p.

KURTEN, B. 1968. *The age of the Dinosaurs*, McGraw-Hill, New York, 255 p.
A pocket sized handbook that provides a popular account of the rise and dominance of the Mesozoic reptiles.

KURZANOV, S.M. 1972. Sexual dimorphism in protoceratopsians. *Palaeontol. J.* 6:91-97.
Seven specimens (and one cast) of the skull of the small protoceratopsid *Protoceratops andrewsi* are examined for evidence of sexual dimorphism. Using cranial angles as opposed to linear dimensions (see Dodson, 1976), the author lists several features that appear to indicate sex, including presence or absence of a nasal horn, angle of elevation of the frill crest, angle of expansion of the frill, and angle of the facial portion of the skull. It is suggested that the comparatively extended frill of males could have been an advantageous feature in the attraction of potential mates as well as the repulsion of competing males. See Davitashvili, 1961; Farlow and Dodson, 1975.

KURZANOV, S.M. 1976. Structure of the braincase of the carnosaur *Itemirus gen. nov.* and some questions of cranial anatomy of dinosaurs. *Paleontol. Zhur.* 3:127-137. (In Russian).
This Gobi carnosaur was actually the size of a dromaeosaur, and is known only from a short and high-domed braincase found at the Dzhara Kuduk locality. The inner ear structure suggests poor hearing but, as in dromaeosaurs, an exceptional sense of balance. *Itemirus* may have been close to the shared ancestry of carnosaurs and the much smaller dromaeosaurs.

KURZANOV, S.M. 1981. Unusual theropods from the Upper Cretaceous sequence of Mongolia. *Tr. Sovmestn. Sov.-Mong. Paleont. Exsped.* 15:36-45. (In Russian).

KURZANOV, S.M., and A.F. BANNIKOV, 1983. A new sauropod from the Upper Cretaceous of Mongolia. *Paleontol. J.* 17 (2):91-97.
Partial cranial remains of a new sauropod *Quaesitosaurus orientalis gen. et sp. nov.*, are described. The large cavity present in the middle ear indicates a sensitive auditory apparatus. An aquatic mode of life is indicated by several features of the skull, including the small adductor muscles, the weak teeth, the broad jaw scoop and the lengthened facial portion (all appear to be adaptations for feeding on soft, most probably aqueous vegetation). The authors, however, caution against treating the Sauropoda as a homogeneous group, and suggest that different ecological modes (including non-aquatic) were probably adopted within the group. See Bakker, 1971b; Borsuk-Bialynicka, 1977; Coombs, 1975; Krassilov, 1981; Nowinski, 1971.

KURZANOV, S.M., and T.A. TUMANOVA, 1978. Endocranium structure of some Mongolian ankylosaurs. *Paleontol. Zh.* 3:90-96.
The authors describe the internal cranial structure of the Gobi ankylosaurs *Talarurus plicatospineus*, and *Amtosaurus* gen. nov., as compared with other Gobi genera *Pinacosaurus*, *Saichania*, and *Tarchia*. Major differences between the endocranium morphology of these five ankylosaurs, and several other dinosaur species, are noted. (In Russian).

LAMBERT, D. 1982. *Dinosaurs*, Kingfisher Books, London, 95 p.

LANGSTON, W. 1960a. A hadrosaurian ichnite. *Nat. Hist. Pap., Nat. Mus. Can.* 4:1-9.

LANGSTON, W. 1960b. The vertebrate fauna of the Selme Formation of Alabama, Pt. 6: The dinosaurs. *Fieldiana Geol. Mem.* 3:313-361.

LANGSTON, W. 1975. The ceratopsian dinosaurs and associated lower vertebrates from the St. nary River Formation (Maestrichtian) at Scabby Butte, Southern Alberta. *Can. J. Earth Sci.* 12:1576-1608.

LANGSTON, W. 1981. Pterosaurs. *Sci. Amer.* 244(2):92-102.
A popular article outlining the then recent pterosaur theories and discoveries, including those of the hairy pterosaur *Sordes pilosus* (Sharov, 1971), and the giant *Quetzalcoatlus* (Lawson, 1975). Structural comparative diagrams of the wings of pterosaurs, birds, bats and human arm are given, as are various possible explanations of how pterosaurs took off, landed and fed. Some basic wing loading data are also given; large pterosaurs were slow and un-agile fliers, depending on warm air currents to maintain them in the air for long periods like an albatross, whilst small pterosaurs may have been more active but still slower than birds of comparable size.

LAPPARENT, A.F. de. 1960. Les dinosauriens du "Continental intercalaire" du Sahara central. *Mem. Soc. geol. Fr.* (n.s.) 39(88 A):1-57.

LAPPARENT, A.F. de. 1962. Footprints of dinosaurs in the Lower Cretaceous of Vestspitsbergen-Svalbard. *Arbok Norsk. Polarinst.* 1960:14-21.

LAPPARENT, A.F. de. 1967. Le dinosaures de France. *Science (Paris)* 51:5-19.

LAPPARENT, A.F. de., and M. DAVOUDZADEH, 1972. Jurassic dinosaur footprints of the Kerman area, central Iran. *Rept. geol. Surv. Iran* 26:5-22.

LAWSON, D.A. 1975. Pterosaur from the latest Cretaceous of West Texas: discovery of the largest flying creature. *Science* 187:947-948.
The remains of three partial skeletons of the largest aerial creature yet known, the pterosaur *Quetzalcoatlus,* are described. Unlike other pterosaur remains, these remains were located in sandstone and siltstone deposits that were some 400 km. from the nearest sea at the time of deposition. Fossilised stomach contents indicate that some pterosaurs fed on fish, but most authors believe that *Quetzalcoatlus* was a scavenger on dinosaur carrion. The author's estimate of the wing span as between 15.5 and 21 m. have since been recalculated as between 11 and 12 m. See Brower and Veinus, 1981; Langston, 1981.

LAWSON, D.A. 1976. *Tyrannosaurus and Torosaurus*, Maestrichtian dinosaurs from Trans-pecos, Texas. *J. Paleontol.* 50(1):158-164.

LAWTON, R. 1977. Taphonomy of the dinosaur quarry. Dinosaur National Monument. Univ. Wyoming Contrib. Geol. 15:119-126.

LEONARDI, G. 1979a. new archosaurian trackways from the Rio do Peixe Basin, Paraibo, Brazil. *Ann. Univ. Ferrara (N.S.), Sci. Geol. Paleont.* 5:239-250.

LEONARDI, G. 1979b. Preliminary note on 6 ornithischian dinosaur trackways of the basin of the Rio de Peixe in Sousa, Paraiba, Brazil. *An. Acad. Bras. Cienc.* 51(3):501-516. (In Portugese).

LEONARDO, G. 1980. Ornithischian trackways of the Corda Formation (Jurassic), Goias, Brazil. *Actas 2nd Congr. Argent. Paleont. Bioestrat,, Buenos Aires* 1978, 1:215-222.

LEONARDO, G. 1981. Ichnological data on the rarity of young in North East Brazil dinosaurian populations. *An. Acad. Bras. Cienc.* 53:345-346.

LLOMPART, C. 1979. Deposits of dinosaur footprints in the Prepyrenees (Spain) Upper Cretaceous. *Acta Geol. Hisp.* 14:333-336, (In Spanish with English summary).

LUCA, A.P. 1984. Postcranial remains of Fabrosauridae (Reptilia: Ornithischia) from the Stromberg of southern Africa. *Palaeontol. Afr.* 25:151-180.

LUPTON, C., D. GABRIEL and R.M. WEST, 1980. Paleobiology and depositional setting of Late Cretaceous vertebrate locality, Hell Creek Formation, McCone County, Montana, USA. *Contrib. Geol. Univ. Wyo.* 18(2):117-126.

McGOWAN, C. 1979. Selection pressure for high body temperatures: implications for dinosaurs. *Paleobiology* 5:285-295,

A discussion of the thermal regimes that may have been adopted by different types of dinosaurs. It is suggested that enhanced muscle power has been a prime factor in the evolutionary selection for high body temperatures in extant animals, and an understanding of this is necessary for a discussion of dinosaur physiology. The lightly built theropods, with their elongated tibia and tarsometatarsus, were probably capable of high levels of activity, thus producing large quantities of muscle-derived heat (though such activity was probably not achieved at high basal metabolic levels). The very smallest theropods, on the other hand, may have had to achieve endothermy proper, and the author suggests that, like *Archaeopteryx,* they may have been insulated by feathers, though supporting evidence for this is lacking. (This argument also partly depends on whether the phylogenetic position of *Archaeopteryx* between the Saurischia and Aves is accepted, see for example, Hecht and Tarsitano, 1982; Tarsitano and Hecht, 1980).The explanation of sauropods as highly active and mobile terrestrial animals (sensu Bakker, 1971b) is rejected (see also, Krassilov, 1981), and the evidence cited by Bakker is reinterpreted. Due to their large body sizes and small surface to volume ratios, the author suggests that heat dissipation in sauropods would have been a problem, with the consequence that excessive muscular activity would have been restricted. In this way, inertial homeothermy, at a relatively low body temperature, was achieved.

McINTOSH, J.S., and D.S. HERMAN, 1975. Descriptions of the palate and lower jaw of the sauropod dinosaur *Diplodocus* (Reptilia: Saurischia) with remarks on the nature of the skull of *Apatosaurus*. *J. Paleontol.* 49(1):187-199.

McNAB, B.K., and W. AUFFENBERG, 1976. The effect of large body size on the temperature regulation of the Komodo dragon, *Varanus komodoensis*. *Comp. Biochem. Physiol. A. Comp. Physiol.* 55(4):345-350.

The authors describe a field study of the body temperature variation of *V. komodoensis*. It is concluded that temperature differentials in reptiles and mammals appear to converge when body weight exceeds 100 kg. This is due to large reptiles having lower conductances than expected, and thus behaving more like large mammals than typical reptiles. The large body sizes of herbivorous dinosaurs was an attempt to gain thermal constancy, while the associated increases in sizes of carnivorous dinosaurs permitted predation on larger herbivores. The authors support the view that dinosaur body temperatures were achieved without the increased levels of metabolism suggested by Bakker (1971a,1972).

MADERSON, P.P.A. 1972. On how an archosaurian scale might have given rise to an avian feather. *Amer. Nat.* 106:424-428.

A morphological model for the development of bird feathers from archosaurian scales is proposed. The primitive thecodont *Longisquama* possessed overlapping, elongated scales over much of the body (Sharov, 1970) and the author considers that a similar archosaur may have been the avian ancestor. It is proposed that specialised proto-feathers grew directly from the tips of the scales of proto-avian archosaurs. Once the proto-feathers assumed a primary functional importance, the scales themselves regressed and disappeared, while the germinal and early maturative regions of the proto-feathers sunk into follicles. Eventually, controlled movements of the individual units was permitted by the development of follicular muscles. See Regal, 1975; Rautian, 1978.

MADSEN, J.H. 1974. A new theropod dinosaur from the Upper Jurassic of Utah. *J. Paleontol.* 48 (1):27-31.

MADSEN, J.H. 1976. *Allosaurus fragilis*: a revised osteology. *Utah. Geol. Min. Surv. Bull.* 109: 1-163.

MALEEV, E.A. 1974. Giant carnosaurs of the family Tyrannosauridae. *Mesozoic and Cenozoic faunas and Biostratigraphy of Mongolia. Trans.* 1:132-191. (In Russian).

A discussion of the genus *Tarbosaurus*, remains of which are common in Upper Cretaceous Gobi strata. Originally, *Tarbosaurus* was named as two distinct species by Maleev in 1955 (*bataar*, the type species, and *efremovii*), with a smaller but very similar animal being named as *Gorgosaurus* (a genus also known from Canada). Today, the genus *Gorgosaurus* is no longer used for any of the Gobi specimens, which are provisionally placed within the genus *Tarbosaurus*. A suggestion for a new genus, *Maleevosaurus,* has more recently also been proposed.

MARTIN, L.D., J.D. STEWART and K.N. WHETSTONE, 1980. The origin of birds: Structure of the tarsus and teeth. *Auk* 97(l):86-93.

The similarity between the dentition of birds and crocodiles is cited as evidence in support of a common pseudosuchian origin for the two groups (Walker, 1972). The teeth of *Archaeopteryx* are serrated and the bases are constricted with expanded roots. Juvenile crocodilians exhibit similar tooth construction, especially in the posterior region of the jaw. In comparison, theropod teeth are serrated, straight rooted, and do not show constriction. The hypothesis favouring such a common origin for the Aves and the Crocodilia is, however, not supported by other lines of evidence, nor by other authorities.

MARX, J.L. 1978. Warm-blooded dinosaurs: evidence pro and con. *Science* 199:1424-1426.

A brief but informative summary of the arguments marshalled by both the protagonists and opponents of dinosaur endothermy.

MARYANSKA, T. 1970. Uppermost Cretaceous remains of armoured dinosaurs from Nemegt Basin, Gobi Desert. *Palaeontol. Pol.* 21:23-32.

MARYANSKA, T. 1971. New data on the skull of *Pinacosaurus grangeri* (Ankylosauria). *Palaeontol. Pol.* 25:45-56.

MARYANSKA, T. 1977. Ankylosauridae (Dinosauria) from Mongolia. *Palaeontol. Pal.* 37: 85-151.

The most comprehensive review of the Asiatic ankylosaurs since that provided by Maleev, 1956 (appendix). New genera retrieved during the joint Polish/Mongolian expeditions are described and a revised diagnosis of all known Mongolian species is given. The Asiatic genera show far greater…

diversification than those of North America, but appear to be less advanced. However, they do exhibit characteristics unknown in North American genera, including the completely ventral orientation of the occipital condyle, and the very strong ventral armoury. Several sequential evolutionary changes are evident in the Asiatic genera. These include: 1) a tendency toward greater massiveness of the skull; 2) stronger ossification of the orbit region, and 3) stronger ossification of the palate (the trend toward larger body size, previously suggested by some authors, is not apparent). A comparison of Asiatic ankylosaurs with those of North America indicates that unspecialised Asiatic forms probably migrated to North America at an early stage in the group's phylogeny. The phylogeny of the Ankylosauria is considered and a phylogenetic tree for ornithischians is proposed. A common origin of the Stegosauria and the Ankylosauria is supported by several lines of evidence, including the shared condition of primary quadrupedalism. Finally, the life habits of ankylosaurs are discussed. The presence of extensive armour, the structure of the pectoral girdle and limbs all indicate an inability to perform rapid movements, and ankylosaurs are considered the slowest and clumsiest of the ornithischians (see Coombs, 1979). Olfaction was well developed and was probably utilised in food, mate and enemy detection (carnosaurs of the genus *Tarbosaurus* are common in the same strata). The well developed hyoid apparatus indicates the existence of a long, mobile tongue, similar to that found in recent Squamata. In addition to vegetable matter, the diet may have been supplemented with insects and their larvae, as suggested by Nopcsa, 1928 (appendix), as well as carrion. Several features of the body armour and the presence of a bony eyelid (Coombs, 1972) lend support to Maleev's suggestion that some species possessed the ability to dig themselves into sandy soil using anteroposterior body movements.

MARYANSKA, T., and H. OSMOLSKA, 1974. Pachycephalosauria, a new suborder of ornithischian dinosaurs. *Palaeontol. Pol.* 30:45-102.

Until this paper, only three definite genera of pachycephalosaurids were recognised. The systematic position of the group had previously been variously given as lying within: 1) the Stegosauria; 2) the Ceratopsia; 3) the Ankylosauria, and 4) the Ornithopoda. After consideration of new Mongolian specimens, the authors establish the new suborder Pachycephalosauria. Representatives are unique among the dinosaurs in possessing a pubis almost excluded from the acetabulum (a condition also shared with the Crocodilia). Wide variation in the dentition within the group indicates various diets, inluding leaves, fruits, seeds and insects. The large orbits and optic nerves indicate a high degree of visual perception and the extensive nasal cavities suggest good olfactory abilities. The extremely thickly-domed skull was held horizontally and was suitable for use as a battering ram, but as opposed to Galton (1970b,1971d), who considers this aspect of behaviour to be linked to sexual selection, the authors consider it to be linked to defense, citing the apparent slow gait (this also differs from Galton's analysis) and lack of body armour. Phylogenetically, pachycephalosaurids may have arisen from the Hypsilophodontidae in the early Triassic, an origin possibly also shared with the Ceratopsia, the two groups separating during the Jurassic.

MARYANSKA, T., and H. OSMOLSKA, 1975. Protoceratopsidae (Dinosauria) of Asia. *Palaeontol. Pal.* 33:133-182.

In one of the few comprehensive studies of the Protoceratopsidae, the authors describe new material from the Cretaceous formations of Mongolia, and consider aspects of the post-embryonic ontogeny of several protoceratopsid genera. Following the discussion of systematics, the authors provide a list of osteological characters that can be regarded as ancestral or advanced for the family, in order to be able to gauge the relative phylogenetic position of any given protoceratopsid. These are as follows: 1) frill: short (primitive), long (advanced); 2) horn core: lacking or incipient (primitive), well developed (advanced); 3) snout: long (primitive), short (advanced); 4) premaxillary teeth: present (primitive), absent (advanced); 5) frontoparietal depression: absent (primitive), present (advanced); 6) mandible: shallow (primitive), deep (advanced); 7) long limb…

bones: slender (primitive), massive (advanced), hindlimb long (primitive), short (advanced), forelimb short (primitive), long advanced), and 8) ungual phalanges: claw-like (primitive), hoof-like (advanced). It is suggested that the Protoceratopsidae can be derived directly from primitive Triassic hypsilophodonts, as opposed to the previously favoured psittacosaurid origin. Contrary to what has generally been accepted (see for example, Ostrom, 1966b), the genus *Protoceratops* is described as a specialised form, and not ancestral to any of the known ceratopsids. It is instead suggested that an appropriate ancestor might be located within earlier protoceratopsid forms, near to, for example, *Microceratops.* Probably before Campanian time (Late Cretaceous), protoceratopsids migrated from Asia to North America, where, together with the Ceratopsidae, they constituted a significant part of the dinosaur assemblage until the end of the Cretaceous. The apparent lack of ceratopsids in Cretaceous formations in Mongolia (not withstanding a possible ceratopsid horn core collected during the Russian expeditions of 1946-1949) is probably related to the harsh environments of Central Asia during that time. The authors here consider the deposition of the Nemegt formation, which is indicative of a fluvial and highly productive environment, (see Rozhdestvensky, 1960), to be exceptional. See Dodson, 1976; Kurzanov, 1972.

MARYANSKA, T., and OSMOLSKA, H, 1979. Aspects of hadrosaurian cranial anatomy. *Lethaia* 12:265-273.

A study of the cranial anatomy of several representatives of the Hadrosauridae leads the authors to propose that the frontal-nasal and premaxillar-nasal fontanellae were responsible for the variability of crest shape encountered within this family. The cartilaginous diverticulum nasi in the circumnarial depression of *Saurolophus angustirostris* is analogous to a similar structure found in the modern tapir, and it is proposed that this structure functioned in respiration, air-conditioning and/or thermoregulation. See Hopson, 1975a; Maryanska and Osmolska, 1981a; Weishampel, 1981a,1981b; Wheeler, 1978.

MARYANSKA, T., and H. OSMOLSKA, 1981a. Cranial anatomy of *Saurolophus angustirostris* with comments on Asiatic Hadrosauridae (Dinosauria). *Palaeontol. Pol.* 42:5-24.

The authors comment on ontogenetic changes in the skull of *Saurolophus angustirostris* and propose that the enlarged respiratory surface within the crest in this species functioned as a thermoregulatory device. The delicacy of the narial structures in hadrosaurs was related to the weak or loose state of the skull bone junctions. See Maryanska and Osmolska, 1979.

MARYANSKA, T., and H. OSMOLSKA, 1981b. First lambeosaurine dinosaur from the Nemegt formation, Upper Cretaceous, Mongolia. *Acta Palaeontol. Pol.* 26(3/4):243-255.

MATSUBARA, S. 1980. Barite and carbonate-apatite constituting fossil dinosaur bone in sandstone from Berivotra, Madagascar, Malagasy Republic. *Bull. Natl. Sci. Mus. Ser. C (Geol. paleontol.)* 6(2):27-32.

MAY, J. 1977. *The Warm-blooded Dinosaurs*, Holiday House, N.Y., 48p.

MAYR, E. 1973. Bin neuer *Archaeopteryx* - Fund. *Paleont. Zeitschr.* 47:17-24.

A restudy of a fossil previously thought to be a juvenile *Compsognathus* is recognised as a 'new' *Archaeopteryx* find. See Ostrom, 1975a.

MILLER, M.F., and R.W.G. WYCKOFF, 1968. Proteins in dinosaur bones. *Proc. Nat. Acad. Sci. USA* 60(1):176-178.

MOLNAR, R. 1972. The skull of *Tyrannosaurus rex*. Ph.D. thesis, Univ. Calif., Los Angeles.

MOLNAR, R.E. 1974. A distinctive theropod dinosaur from the Upper Cretaceous of Baja California (Mexico). *J. Paleontol.* 48(5):1009-1017.

MOLNAR, R.E. 1977/78. Analogies in the evolution of combat and display structures in ornithopods and ungulates. *Evolutionary Theory* 3:165-190.

The cranial horns, frills, crests and caniniform teeth found variously within the Ornithopoda and their derivatives (the heterodontosaurs, hypsilophodonts, iguanodonts, psittacosaurs, hadrosaurs, pachycephalosaurs and ceratopsians) can be considered analogous to those of extant artiodactylid ungulates, and their development is here explained in terms of intraspecific combat and display functionality. The evolutionary sequence of development of such structures in ungulates and their ancestors is given as follows: 1) use of teeth and tail; 2) use of tail only; 3) use of caniniform teeth; 4) use of lateral display with head blows, and 5) use of frontal display with head blows. This situation was probably paralleled within the ornithopoda. See Davitashvili, 1961; Farlow and Dodson, 1975; Hopson, 1975a; Spassov, 1979.

MOLNAR, R.E. 1978. A new theropod dinosaur from the Upper Cretaceous of central Montana. *J. Paleontol.* 52(l):73-82.

MOLNAR, R.E., and R.A. THULBORN, 1980. 1st pterosaur from Australia. *Nature, Lond.* 288:361-363.

MONTEILLET, J., J.R. LAPPARTIENT and P. TAQUET, 1982. A giant pterosaur from the Late Cretaceous of Paki (Senegal). *C. R. Seances Acad. Sci. Ser. Ill Sci. Vie.* 295(3):167-172. (In French with English summary),

MOODY, R. 1977. *A Natural History of the Dinosaurs*. Hamlyn, London.

MORRIS, W.J. 1967. Baja California: Late Cretaceous dinosaurs. *Science* 155:1539-1541.

MORRIS, W.J. 1970. Hadrosaurian dinosaur bills – morphology and function. *Los Angeles Co. Mus. Contr. Sci.* 193:1-14.

MORRIS, W.J. 1971. A new view of duckbilled dinosaurs. *Fauna (California)* 1:26-30.

MORRIS, W.J. 1978. *Hycaprosaurus altispinus*? Brown from the Two Medicine Formation, Montana, a taxonomically indeterminate specimen. *J. Paleontol.* 52:200-205.

MORRIS, W.J. 1981. *Lambeosaurus laticaudus*?, new species of hadrosaurian dinosaur from the Upper Cretaceous of Baja California, Mexico. *J. Paleontol.* 55(2):453-462.

MULLER, A.H. 1968. *Lehrbuch der Palaozoologie.* Band III. Vertebraten, Tiel 2. Reptilien und Vogel. Gustav Fisher. - Berlag, Jena, East Germany, 657 p.

NESOV, L.A. 1984. Pterosaurs and birds of the Late Cretaceous in Soviet Central Asia. *Paleontol. Zhur.* 1:47-57.

NEWMAN, B.H. 1968. The Jurassic dinosaur *Scelidosaurus harrisoni*. *Palaeontology* 11:40-43.

NEWMAN, B.H. 1970. Stance and gait in the flesh-eating dinosaur *Tyrannosaurus*. *Biol. J. Linn. Soc.* 2:119-123.

Most vertebrate palaeontology texts have accepted without question the restoration of the…

carnosaur *Tyrannosaurus rex* as provided by the skeleton exhibited in the American Museum of Natural History, New York. The notable exception is the more likely restoration (dated 1938) provided in Augusta and Burian, 1960, Benes and Burian, 1979, and Spinar and Burian, 1972, the restoration in the last work having been modified so as to indicate a relatively rigid tail. The American Museum reconstruction is not complete, but comprises the bones from several individuals (despite the impression gained from many texts that the osteology of *T. rex* was well known, it was very poorly known compared to carnosaurs such as *Tarbosaurus*). The author reconsiders the osteology of *T. rex*, finding the American Museum restoration flawed in several respects. The skull should, in fact, be shown supported on a well developed cervical region, making a marked angle to the rest of the vertebral column, which was held almost horizontal, as opposed to the steep angle adopted by the American Museum restoration. This 'swan' neck arrangement permitted the skull to be carried horizontally, while the flexible neck allowed the head to reach the ground during feeding. The tail was not dragged along the ground, nor was it highly flexible. Its main function was to maintain a balanced equilibrium during bipedal locomotion (these conclusions are also supported by evidence derived from fossilised trackways made by theropods). An analysis of the hindlimb mechanics reveals that the bipedal gait was sinuous, resembling a bird-like waddle. The stride was small, and the feet were turned in (pigeon-toed). Traditionally, the comparatively small forelimbs of *T. rex* were considered too small to be of any use. They were, however, probably utilised in helping to raise the animal off its stomach when it had been resting, acting as 'brakes' to prevent the heavy body from sliding forward when the hindlimbs were extended during this manoeuvre. Skeletal restorations of *T. rex* in different body positions are given.

NORBERG, U.M. 1974. Structure, form, function - bats, birds and pterosaurs. *Zool. Revy* 35(2):64-68. (In Swedish with English summary).

NORMAN, D.B. 1980. The ornithischian dinosaur *Iguanodon bernissartensis* from the Lower Cretaceous of Bernissart (Belgium). *Inst. R. Sci. Nat. Belg. Mem.*

NORMAN, D.B. 1984. On the cranial morphology and evolution of ornithopod dinosaurs. In: *Symp. Zool. Soc. Lond.* No. 52:521-547, Academic Press, London.

NORMAN, D.B. 1985. *The Illustrated Encyclopedia of Dinosaurs*, Hodder and Stoughton, Sydney, 208 p.

The unofficial bible for the armchair palaeontologist, this text set new standards for popular reference works on dinosaurs. The text is authoritative and very detailed, while the large format presentation benefits from the life reconstructions of British artist John Sibbick (whose work can be seen in several UK museums including the British Museum of Natural History, London) and numerous skeletal drawings by Denise Blagden and David Nicholls. There are several illustrations to each page.

NOWICKI, Z., M. SARNECKA-KELLER, R. PAWLICKI, H. KUBLAK and A. KORBEL, 1972. Morphological and chemical analysis of the structure of the fossil dinosaur bone. *Anat. Anz.* 132 (1/2):10-23.

NOWINSKI, A. 1971. *Nemegtosaurus mongoliensis n. gen. n. sp.* (Sauropoda) from the Uppermost Cretaceous of Mongolia. *Palaeontol. Pol.* 25:57-84.

Description of one of only three known Gobi sauropods, this genus is known from a 55-cm-long skull and lower jaw. The orbits are large, the braincase small, and the maxilla bones flare outwards at the end of the snout. It has been provisionally placed in the family Dicraeosaurinae, being most similar to the East African genus *Dicraeosaurus* and the North American genus *Diplodocus*. See Borsuk-Bialynicka, 1977; Kurzanov and Bannikov, 1983.

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OBATA, I., and Y. KANIE, 1977. Upper Cretaceous dinosaur-bearing sediments in Majunga region, Northwestern Madagascar. *Bull. Natl. Sci. Mus. Ser. C (Geol. Paleontol.)* 3(3):161-174.

OLSHEVSKY, G. 1978. The archosaurian taxa. *Mesozoic Meanderings* 1:1-50.

OLSHEVSKY, G. 1979. Supplement 1. to ‘The archosaurian taxa’. *Mesozoic Meanderings* 1:51-54.

OLSHEVSKY, G. 1980. Supplement 2. to ‘The archosaurian taxa’. *Mesozoic Meanderings* 1:55-61.

OLSHEVSKY, G. 1982. The glory of the dinosaurs. *Omega Science Digest* Jan/Feb 1982:84-87.

OSMOLSKA, H. 1976. New light on the skull anatomy and systematic position of *Oviraptor*. *Nature, Lond.* 262:683-684.
The author examines new *Oviraptor* material, noting that the palate, mandible, and pterygoid structure all vary from those of other theropods. She proposes that the Oviraptors should be placed in the family Caenagnathidae. See Barsbold, 1976.

OSMOLSKA, H. 1979. Nasal salt glands in dinosaurs. *Acta Palaeontol. Pol.* 24(2):205-216.
The larger herbivorous dinosaurs usually exhibit enlarged external nostrils which accommodated large, functioning salt glands homologous with those found in extant reptiles and birds. This was probably an adaptation for the extrarenal excretion of excess monovalent ions, particularly K ions derived from the ingestion of vegetation, and Na ions accumulated by herbivores dwelling in saline environments.

OSMOLSKA, H. 1980. The Late Cretaceous vertebrate assemblages of the Gobi Desert, Mongolia. *Mem. Soc. Geol. France, N.S.* 139:145-150.

OSMOLSKA, H. 1981. Coossified tarsometatarsi in theropod dinosaurs and their bearing on the problem of bird origins. *Palaeontol. Pol.* 42:79-96.
The limb bones of two small theropods from Upper Cretaceous formations in Mongolia exhibit fused tarsometatarsi, which is cited as additional evidence for a theropod origin of birds. See, for example, Bakker, 1975a; Bakker and Galton, 1974; Gingerich, 1973; Ostrom, 1973,1974a,1975b, 1975c,1976a.

OSMOLSKA, H,, and E, RONIEWICZ, 1969. Deinocheiridae, a new family of theropod dinosaurs. *Palaeontol. Pol.* 21:5-22.
A description of the gigantic tridactyl forelimbs, shoulder girdle and ribs uncovered during the joint Polish/Mongolian expedition to the Gobi in 1965 (narrated in Kielan-Jaworowska, 1969b). Due to the size (240 cm. length) and morphology of the remains, the new family Deinocheiridae (lying within the superfamily Megalosauroidea and the infraorder Carnosauria) is erected. The structure of the manus and humerus strongly resembles that of *Ornithomimus* but the authors cannot determine whether this is due to convergence or phyletic relationships. It is suggested that the deinocheirids may constitute a link between the Carnosauria and the Coelurosauria. Although most subsequent authors have speculated on the probable carnosaurian-like habits of deinocheirids, Rozhdestvensky (1970) gives an interesting comparative review of the available evidence at that time, drawing an analogy between the ecology of deinocheirid-like dinosaurs and modern edentates. This interpretation is now recognized as being largely correct.

OSMOLSKA, H., E. RONIEWICZ and R. BARSBOLD, 1972. A new dinosaur *Gallimimus bullatus n. gen., n. sp.* (Ornithomimidae) from the Upper Cretaceous of Mongolia. *Palaeontol. Pol.* 27:103-143.
A detailed osteological description of the largest of the ornithomimids. The peculiar develop-...

-ment of the bulbous parasphenoid structure within the braincase is described (this condition is also encountered in at least the Saurornithoididae, see Barsbold, 1974). The range of collected material permitted some conclusions to be drawn concerning ontogenetic changes in *G. bullatus*. Post embryonic growth was accompanied by the following changes: 1) relative decrease in orbit size; 2) relative decrease in size of posterior skull region; 3) relative increase in snout size, and 4) increase in length of radius relative to the femur and tibia (probably, the forelimbs increased in relative size during growth). Points 1, 2 and 3 are in accordance with the growth processes noted for contemporary crocodiles. The head of *G. bullatus* was lightly constructed and the neck was highly mobile. The structure of the cervical neural arches is similar to those of the domestic chicken and other galliformes, and it is suggested that *G. bullatus* fed likewise on small, live prey swallowed whole, whilst the mobile neck and laterally directed eyes were ideal for ground-level prey detection. Although many authors have suggested that the manus of ornithomimids was suitable for prey manipulation, the forelimbs of *G. bullatus* appear to have most likely been used for raking or digging at the ground to expose potential prey. The hindlimbs infer high cursorial ability.

OSTROM, J.H. 1961. Cranial morphology of the hadrosaurian dinosaurs of North America. *Bull. Amer. Mus. Nat. Hist.* 122:39-186.

OSTROM, J.H. 1962. The cranial crests of hadrosaurs. *Postilla* 62:1-29.

OSTROM, J.H. 1963. *Parasaurolophus cyrtocristatus*, a crested hadrosaurian dinosaur from New Mexico. *Fieldiana, Geol.,* 14:143-168.

OSTROM, J.H. 1964a. A functional analysis of jaw mechanics in the dinosaur *Triceratops*. *Postilla* 88:1-35.

OSTROM J.H. 1964b. A reconsideration of the paleoecology of hardosaurian dinosaurs. *Amer. J. Sci.* 262:975-997.

The author gives a generalised review of hadrosaur osteology and speculates on the possible ecology of the group. Hadrosaurs are described as primarily terrestrial, occupying low-lying coastal plains in warm temperate to sub-tropical climates, dominated by conifers, willows, poplars and oaks. The large, laterally compressed tail and webbed manus that are characteristic of hadrosaurs (and clearly aquatic adaptations), are dismissed by the author as being functional only during swamp and river traverses, and/or in attaining refuge from predators (see however, Coombs, 1980b). The mummified stomach contents (consisting of fruits and leaves) of a hadrosaur described by Krausel, 1922 (appendix) is cited by the author as evidence for terrestrial feeding behaviour by hadrosaurs, but as Krassilov (1981) notes, this material was originally described as secondarily derived, that is, from a peat or swamp environment as opposed to a terrestrial one. In addition, considering the very high frequency of hadrosaur fossilisation in a number of different areas of the world, the author's interpretation of these animals as only infrequent water dwellers would appear to be difficult to reconcile.

OSTROM, J.H. 1966a. A dinosaur flies to Germany. *Discovery, New Haven* 2(l):23-26.

OSTROM, J.H. 1966b. Functional morphology and evolution of the ceratopsian dinosaurs. *Evolution* 20:290-308.

A functional study of the cranial osteology and myology of the North American Ceratopsia from the traditional diphyletic (short-frilled *vs*. long-frilled) viewpoint. The laterally compressed ceratopsian beak (composed of an upper edentulous rostral sutured to the premaxillaries and a lower edentulous predentary uniting the mandibles) is discussed and it is suggested that such a structure was more suited to a grasping or plucking function than a biting one.The diet may have comprised...

low level cycad or palm fronds, although Krassilov (1981) suggests such types were rare, and that cycadeoid bennettites were more likely candidates. Throughout successive evolutionary stages, the ceratopsian beak appears to have altered little (apart from varying in relative size), but tooth replacement seems to have occurred at a faster rate in advanced types than it did in ancestral types, a factor probably related to increased rates of wear. Compared to ancestral types, the teeth of advanced ceratopsids appear to have undergone a backward migration made possible by the lateral displacement of the coronoid process. The result of this modification was an increase in the maximum occlusal power due to the closer position of the functional teeth relative to the jaw fulcrum and jaw muscle attachment sites. The author proposes that the long-frilled ceratopsian lineage achieved increased dental shearing power by developing extensive cranial frills to provide enlarged jaw muscle attachment sites for the external adductor muscles, whereas the short-frilled lineage achieved a similar capability by developing a more efficient mandibular lever system, thus allowing a reduction in frill muscle volume. Note that in this analysis, the author has treated *Protoceratops* as ancestral to the larger, horned ceratopsians, but a recent study of the family Protoceratopsidae by Maryanska and Osmolska (1975) considers the genus as too specialised to occupy such a position.

OSTROM, J.H. 1966c. A study in dinosaur evolution. *Discovery, New Haven* 1(2):9-15.

OSTROM, J.H. 1967. Peabody paleontologists assist new dinosaur track park. *Discovery, New Haven* 2:21-24.

OSRTOM, J.H. 1968. *The Rocky Hill dinosaurs*. Guidebook 60 th Ann. New England Intercollegiate Geol. Conf., C-3:1-12.

OSTROM, J.H. 1969a. A new theropod dinosaur from the Lower Cretaceous of Montana. *Postilla* 128:1-17.

OSTROM, J.H. 1969b. Osteology of *Deinonychus antirrhopus*, an unusual theropod from the Lower Cretaceous of Montana. *Bull. Peabody Mus. Nat. Hist. Yale* 30:1-165.

A description of the relatively small (1 m. high) theropod that was unusual in possessing a long (10-13 cm.) sickle-like talon on the inner toe. The tridactyl manus of *D. antirrhopus* was long with large raptorial claws, and was capable of precise abduction-adduction as well as pronation-supination movements. Thus the forelimbs seem well suited for prey manipulation (grasping and holding). The large pedal talons may have been used to disembowel prey held by the forelimbs, and this is further supported by the structure of the caudal vertebrae which indicates that the tail acted as a balancing stabiliser during such activity. Although some texts figure *D. antirrhopus* as a highly cursorial animal, the available material (lacking femural remains) suggest that it was not as fleet-footed as many other theropods.

OSTROM, J.H. 1969c. Terrestrial vertebrates as indicators of Mesozoic climates. *Proc, N. Am. Paleontol. Conv., Chicago*:347-376.

OSTROM, J.H. 1970. *Archaeopteryx*: notice of a “new” specimen. *Science* 170:537-538.

This specimen of *Archaeopteryx,* the fourth to be recognised as such, was in fact the first *Archaeopteryx* fossil to be located (1855). However, since 1860, it had been displayed in the Teyler Stitching Museum in the Netherlands labelled as a pterosaur, until recognised as an *Archaeopteryx* by the author in 1970. Recognition of the Eichstatt specimen in 1973 (see Ostrom, 1975a) produced the ‘fifth’ specimen, while a solitary feather impression reported in 1861 is often included to make the total six.

OSTROM, J.H. 1972a. Carnivorous dinosaurs. In: *McGraw-Hill Yearbook of Science and Technology,* p. 176-179, McGraw-Hill, N,Y.

OSTROM, J.H. 1972b. Description of the *Archaeopteryx* specimen in the Teyler Museum, Haarlem. *Proc. Koninklijke Nederlandse Ak. van Wetenschappen, B.* 75:289-305.

OSTROM, J.H. 1972c. Were some dinosaurs gregarious? *Palaeogeogr., Palaeoclimatol., Palaeoecol.* 11:287-301.

A survey of footprints made by Triassic dinosaurs at the Mt. Tom site in Massachusetts reveals that an unusually high percentage (70) of the trackways are orientated in near-parallel directions. The different tracks appear not to have been independent events, and physical barriers that may have guided the trackmakers appear to be lacking. The evidence presented here, together with evidence from localities in Texas, strongly indicate gregarious habits in some dinosaurs.
See Thulborn and Wade, 1979;1984.

OSTROM, J.H. 1973. The ancestry of birds. *Nature, Lond.* 242:136.

A preliminary note in response to Walker's (1972) proposal for a common ancestor of birds and crocodiles. The author notes that the skeletal anatomy of *Archaeopteryx* varies little if at all with that of a coelurosaurian dinosaur. The elements that exhibit a strong coelurosaurian similarity are listed as: 1) the vertebral column; 2) the forelimb (the author's numbering of the digits as I, II and III, the same as in the Theropoda, would here be criticised by embryologists who identify them as II, III and IV, see Hecht and Tarsitano, 1982); 3) pectoral arch; 4) hindlimb, and 5) the pelvis (the author claims that the pubis of the Berlin specimen is dislocated and was originally directed ventrally and anteroventrally in an almost opisthopubic condition as in some theropods, an analysis also disputed by Tarsitano and Hecht). Finally, the author comments that although the coelurosaurian nature of *Archaeopteryx* has been known for some time, the possibility of a close phyletic relationship was ruled out primarily on the grounds that clavicles were not known within the Theropoda. However, clavicles have recently been identified in several theropod genera, including *Segisaurus, Oviraptor*, and possibly *Velociraptor*.

OSTROM, J.H, 1974a. *Archaeopteryx* and the origin of flight. *Quart. Rev. Biol.* 49:27-47.

The attainment of avian flight has traditionally been explained by one of two theories: 1) the arboreal theory, first proposed by Marsh, 1880 (appendix), and involving an early adaptation to arboreal habits followed by successive steps towards controlled descent from elevated positions, and 2) the cursorial theory, initially proposed by Williston, 1879 (appendix) and expanded by Nopcsa (appendix), involving a bipedal cursorial stage followed by developments toward leaping up from the ground during bipedal locomotion. In this paper, the author introduces a variation on the cursorial theory entitled the 'cursorial predator theory' (now commonly referred to as the 'insect net hypothesis'). The primary thesis is that *Archaeopteryx* was coelurosaurian-like in habits, with flight being attained as a result of predaceous behaviour. Successful pursual of insectivorous prey would have been enhanced by enlargement of pre-existing contour feathers on the forelimbs, with the limbs being utilised as a trapping device or net into which insects were corralled before being grasped by the beak or manus. The morphological similarity between the hand, metacarpus, forearm, humerus and pectoral arch of *Archaeopteryx* and those of several theropods, including *Ornitholestes* and *Velociraptor* is seen here to be a result of similar predatory functions, as opposed to being an example of parallelism and convergence. It is suggested that feathers existed in pre-*Archaeopteryx* forms and arose in connection with the need for heat loss control [although the author later (1980) indicates that they may have functioned as heat shields to minimise heat gain], and thus a state of endothermy preceded the attainment of flight (see Regal, 1975) with the later development of a fully formed wing being a result of preadaptation, sensu Simpson, 1953 (appendix). The cursorial predator theory has been criticised by Feduccia (1980) and Hecht and Tarsitano (1982), primarily because the aerodynamic nature of the feathers of *Archaeopteryx* would cause air pressure to expel any prey during forearm adduction. It should, however, be noted that Rautian (1978) describes an Upper Jurassic feather that apparently lacked barbules and was therefore less aerodynamically efficient than those of *Archaeopteryx*.

OSTROM, J.H. 1974b. The pectoral girdle and forelimbs of *Deinonychus* (Reptilia: Saurischia): a correction. *Postilla* 165:1-11.

OSTROM, J.H. 1974c. Reply to "Dinosaurs as reptiles". *Evolution* 28:491-493.
In this response to Feduccia (1973), Ostrom suggests that there is more than pure chance that all living ectotherms have a sprawling gait whereas all vertebrates with an upright gait are endothermic. He also draws correlations between the assumed endothermy of the first 'birds' and small theropods. He assumes here that endothermy had been achieved well before any flight abilities, due to the presence of well developed plumage.

OSTROM, J.H. 1975a. *Archaeopteryx. Discovery, New Haven* ll (l):14-23.
A resume of the fascinating history surrounding the discovery of the various *Archaeopteryx* fossils recovered from the Solnhofen limestones in Central Bavaria.

OSTROM, J.H. 1975b. On the origin of *Archaeopteryx* and the ancestry of birds. *Centre Nat. Recherche Scient*. 218:519-532.

OSTROM, J.H. 1975c. The origin of birds. *Ann. Rev. Earth Planet. Sci*. 3:55-77.

OSTROM, J.H. 1976a. *Archaeopteryx* and the origin of birds. *Biol. J. Linn. Soc. Lond*. 8(2): 91-182.
One of the most comprehensive reviews of the osteology of *Archaeopteryx.* The author begins by giving a historical review of the various lines of evidence that have been advanced to support various hypotheses concerning the possible ancestry of the class Aves. This is followed by an analysis of aspects of the skeleton, including the manus and forelimb, the pectoral girdle, the hindlimb and pes, the pelvic girdle, the skull and jaws, the vertebral column and several other elements. In conclusion, the author finds no evidence for an ornithischian origin (see Galton, 1970a), while the concept that *Archaeopteryx* had descended from an unknown *Euparkia*-like pseudosuchian, converging or paralleling the coelurosaurs in certain skeletal similarities is also rejected. The evidence for a close theropod/avian relationship, however, appears to be convincing, and the author lists the following shared features in evidence: the tridactyl manus, metacarpus and carpus morphology, forelimb and pectoral girdle structure, four-toed pes, reversed hallux, metatarsal morphology, mesotarsal joint, hindlimb construction and pelvic form, among others. It is proposed that the phylogeny of avian ancestry was: 1) Pseudosuchia, 2) *Ornitholestes*-like coelurosaur, 3) *Archaeopteryx*, and 4) higher birds. See Hecht and Tarsitano, 1982; Tarsitano and Hecht, 1980; Thulborn, 1984.

OSTROM, J.H. 1976b. On a new specimen of the Lower Cretaceous theropod dinosaur *Deinonychus antirrhopus. Breviora* 439:1-20.

OSTROM, J.H. 1976c. Some hypothetical anatomical stages in the evolution of avian flight. In: S.L. Olsen (ed.). *Collected Papers in Avian Paleontology, Smithson. Contr. Paleob*. 27:1-21.
The osteology and myology (particularly of the wing) of *Archaeopteryx* is examined and compared to that of modern birds in order to construct an evolutionary sequence of the development of aerodynamic abilities in the class Aves. The author notes that although some authorities have indicated that *Archaeopteryx* itself may not be directly ancestral to modern carinates (Swinton, 1964; appendix, de Beer, 1954), the early ancestral lineage to birds most probably included an anatomical stage comparable to it, and it is thus reasonable to use *Archaeopteryx* as a model in this context. One of the critical components in the evolution of avian wing morphology involved changes in the coracoid that resulted in important myological alterations. In modern birds, the recovery stroke of the humerus is actioned primarily by the M. supracoracoideus. This muscle originates on the sternal carina, the sternum, the coracoid, and…

the coracoclavicular membrane, converging dorsally to the supracoracoideus tendon which then passes backward between the coracoid, clavicle and scapula to insert downwards on to the dorsal surface of the humerus. Consequently, the wing of modern birds is elevated not by a dorsal muscle as is the case in flying mammals (bats), but by a ventral one. However, in *Archaeopteryx*, the supracoracoideus is thought to have acted as a lateral humeral adductor, so the action of this muscle has been almost completely reversed. The changes from the wing condition of *Archaeopteryx* to that of modern carinates are the result of two main alterations in morphology: 1) an elongation of the coracoid dorsoventrally, and 2) the elevation of the site of origin of the M. biceps brachii by prolongation of the acrocoracoid. Coracoid elongation increased the range of dorsoventral humeral excursion which was probably related to changes in the sternum, the development of a keel, and enlargement of the main wing adductors, the M. pectoralis. The effect of the upward expansion of the biceps tubercle would have been initially to deflect the course of the supracoracoideus tendon, causing it to gradually and successively alter from being a humeral adductor to a forward extensor, to an anterodorsal extensor, and finally, to an abductor. Whereas this muscle therefore elevates the wing in modern birds (and also, incidentally, in the Pterosauria, see Padian, 1983), the recovery stroke in *Archaeopteryx* was probably powered by the relatively weak dorsal muscles such as the deltoids, the weight of the body and tail (see Hepstonall, 1970) most likely rendering a powerful recovery action largely unnecessary. The simple condition of the humerus in *Archaeopteryx* (lacking external and internal tuberosity, bicipital crest and ectepicondyle, all features involved in wing folding in modern carinates) indicates that *Archaeopteryx* was not capable of folding the forelimbs back against the trunk. A high degree of medial (but not lateral) hyperflexion of the manus was retained, a factor probably linked with prey catching and feeding, while the high level of forelimb extension and flexion were probably also involved in quadrupedal climbing habits. Here, the author recants somewhat from his earlier (1974a) position where *Archaeopteryx* is considered as non-arboreal (although he does so with the proviso that it acquired any climbing skills prior to its increased capacity for elevated forelimb extension and the acquisition of obligate bipedal posture).

OSTROM, J.H. 1978a. A new look at dinosaurs. *National Geographic* 154(2):152-185.
In this article the author attempts to popularize the concept of endothermy among dinosaurs, suggesting that they were comparable in physiology to modern mammals and birds. His analysis of the osteology of *Deinonychus* features prominently in the article, as does the assertion that erect gait is correlated with endothermy. The water colour paintings by Roy Anderson that accompany the article are only up to the general standard of National Geographic, and are unconvincing.

OSTROM. J.H. 1978b. The osteology of *Compsognathus longipes* Wagner. *Zitteliana, Abh. Bayerischen Staat. f. Palaont. Hist. Geol.* 4:73-118.

OSTROM, J.H. 1979. Bird flight. How did it begin? *Amer. Sci.* 67(l):46-56.
A brief and popularised summary of ideas first proposed by the author in his 1974a paper. The widespread interest but lack of general acceptance of the 'insect net hypothesis' is acknowledged.

OSTROM, J.H. 1980. The evidence for endothermy in dinosaurs. In: R.D.K. Thomas and E.G. Olson (eds.), *A cold look at the warm-blooded dinosaurs*, p. 15-54, Westview Press, Boulder.
In a balanced argument, the author begins by giving a helpful list of definitions that should be (but unfortunately are not always) used by participants in the debate on dinosaur endothermy, then goes on to review the relevant evidence which is categorised into five sections; anatomical, histological, ecological, zoogeographic and phylogenetic. In the conclusion, the author makes the observation that the only group of dinosaurs to which all the evidence for endothermy can apply is the Theropoda (a conclusion also reached by Benton, 1979b, among others), and in particular, the coelurosaurs. The high level of activity inferred for some dinosaurs may appear supportive of an endothermic condition, but high and/or sustained levels of activity do not require endothermy,...

and the relatively small brain capacities of most dinosaurs (excepting some ornithopods and most theropods, see Hopson, 1977a,1977b,1980a) would seem to exclude the possibility of such behaviour in any case. With regard to the use of predator/prey ratios in the debate, the author notes that such evidence may only be significant with respect to carnivores (although even in that context, it is not unambiguous, see Beland and Russell, 1979; Farlow, 1980). The histological evidence (primarily that of Ricqles) is also considered inconclusive, particularly since secondary Haversian bone has been found to be related to body size as well as the condition of tachymetabolism. Supportive biogeographical evidence is not relevant to the debate due to the relatively warmer and less seasonal climatic conditions prevalent during the Mesozoic. The most promising line of evidence in favour of endothermy may yet prove to be the erect posture and parasagittal limb movement characteristic of dinosaurs (though even here, it may be argued that large dinosaurs must have been obligatory in this respect anyway) and the large heart to brain vertical distances which imply the existence of a four-chambered heart (with fully separated systemic and pulmonary circulation). The author subscribes to the view that the majority of dinosaurs were ectothermic homeotherms, as originally suggested by Colbert et al, 1946 (appendix), maintaining this condition primarily by a combination of warm, largely nonseasonal environmental conditions and large body size.

OSTROM, J.H. 1981a. *Dinosaurs*, Carolina Biological Supply Co., 32 p.
A short monograph summarising recent views on dinosaur taxonomy, biology and extinction. The author cites the large heart to brain distances of many dinosaurs as the primary evidence for endothermy. The associated high systemic blood pressures compare with or even exceed those of birds and mammals, and the inference is that dinosaurs possessed a four-chambered double pump heart that could have made a tachymetabolic physiology possible (Seymour, 1976).

OSTROM, J.H. 1981b. *Procompsognathus*: Theropod or thecodont? *Palaeontogr. Abt. A Palaeozool. Stratigr*. 175(4-6):179-195.

OSTROM, J.H., and J.S. McINTOSH, 1966. *Marsh's Dinosaurs*, Yale University Press, New Haven.

PADIAN, K. 1979. The wings of pterosaurs: a new look. *Discovery, New Haven* 14:20-29.
In this preliminary paper, the author notes anomalies in some conclusions reached by early students of the Pterosauria. Instead of considering pterosaurs as ungainly and clumsy reptiles that succumbed to competition when birds arose, the author, after a re-evaluation of the evidence, comes to quite different conclusions involving pterosaur morphology, biology and ecology. The fifth toe of rhamphorhynchoid pterosaurs is a true digit, as opposed to being homologous with the calcar of bats (which fits into the uropetagium or interfemural wing membrane). Consequently, the wing membrane of pterosaurs, unlike those of bats, did not extend to incorporate the hindlimb (partly due to this factor, previous workers have excluded any terrestrial locomotor function for the hindlimbs). The weight of *Dimorphodon* is calculated at 1140 g. and when the wing outlines are reconstructed by excluding the hindlimbs from the membrane, a wing area of 2000 sq. cm. results. This fits well with what one would expect from an aerodynamic chart calculation for an animal of this size. Alternatively, if the hindlimbs are included within the wing membrane, an excessive wing area of 3050 sq. cm. is produced. See Padian, 1983b.

PADIAN, K. 1980. *Studies of the structure, evolution and flight of Pterosaurs*. Ph. D. Thesis, Yale Univ.

PADIAN, K. 1983a. Description and reconstruction of new material of *Dimorphodon macronyx* (Buckland) (Pterosauria: Rhamphorhynchoidea) in the Yale Peabody Museum. *Postilla* 189:1-44.

PADIAN, K. 1983b. A functional analysis of flying and walking in pterosaurs. *Paleobiology* 9:218-239.

Traditionally, pterosaurs have been reconstructed as ungainly flyers or gliders (Padian, 1979), while on the ground, they have often been portrayed as quadrupedal, the hindlimbs functioning primarily to hook on to the sides of cliffs or branches while the animal hung in bat-like fashion between flights, in this analysis, the author summarises the evidence that pterosaurs were active and accomplished fliers, as opposed to gliders, and that the hindlimbs were quite capable of functioning in bipedal locomotion. The bat-like similarity of pterosaurs is rejected, and instead, they are compared to advanced archosaurs, and to birds. As stated previously (Padian, 1979), the fifth toe of rhamphorhynchoid pterosaurs is not comparable to the calcar of bats. The calcar is a fused, unjointed medial element whereas the fifth toe is a jointed, highly mobile laterally located digit. It is thus unlikely that the wing membrane extended to the ankle of the hindlimb or that it stretched between the hindlimbs [although it does appear to have done so in *Sordes pilosus* (Sharov, 1971), which is not noted by the author]. There are no arboreal or cliff-hanging adaptations evident in the hindlimbs. However, a study of pterosaur pelves (which are seldom adequately preserved, and usually crushed) indicates that the puboischiadic plates of *Rhamphorhynchus* were joined medially, while the acetabulum points slightly ventrally. The natural position of the hindlimb probably involved the femur being directed between about horizontal and forty-five degrees lower, allowing the tibia to swing in a wide arc close to a parasagittal plane. Thus the hindlimb appears well developed for terrestrial, digitigrade and fully bipedal locomotion. Pterosaurs show a number of aerodynamic adaptations that appear to lie intermediate between those of birds and those of bats. The wing membrane was reinforced internally by a system of stiff, intercalated structural fibres that ran parallel to the wing finger, (these have the same general orientation as the feather shafts in the bird wing), and was consequently incapable of billowing like a glider. As in post-*Archaeopteryx* birds, (but unlike bats and gliders), pterosaurs possessed pneumatic foramina in many postcranial bones, presumably to help cool the blood when body temperature had risen due to muscular activity. Pterosaurs also exhibit an acrocoracoid process, a large deltopectoral crest, a broad, keeled sternum, and braced coracoids. As in birds, the acrocoracoid process appears to have reversed the action of the M. supracoracoideus tendon (see Ostrom, 1976c) which therefore acted as a humeral elevator in pterosaurs as well. With regard to the humerus, the axis of the glenoid fossa is horizontal (as in birds) and the forelimb was probably capable of the anteroventral stroke characteristic of birds. The forelimb does not show adaptations for quadrupedal locomotion as it was not capable of true parasagittal movement. This study suggests that a major re-evaluation of the palaeobiology of the Pterosauria is necessary. Considering that pterosaurs were most likely active flyers, capable of bipedal locomotion, and hair insulated (Sharov, 1971; Wellnhofer, 1977), they were as likely a candidate for true endothermy as any archosaur group.

PADIAN, K. 1984. Pterosaur remains from the Kayenta Formation (Early Jurassic?) of Arizona [USA]. *Palaeontology* (Lond.) 27(2):407-414.

PADIAN, K., and OLSEN, 1984. The fossil trackway *Pteraichnus saltwashensis*: Not pterosaurian, but crocodilian. *J. Paleontol.* 58(1):178-184.

PARKS, K.C. 1966. Speculations on the origin of feathers. *The Living Bird* 5:77-86.

PAWLICKI, R. 1975. Studies of the fossil dinosaur bone in the scanning electron microscope. *Z. mikrosk. anat. Porsch.* (Leipzig) 89:393-398.

PAWLICKI, R. 1977a. Histochemical reactions for mucopolysaccarides in the dinosaur bone. Studies on Epon and metacrylate-embedded semithin sections as well as on isolated osteocytes and ground sections of bone. *Acta Histochem.* 58:75-78.

PAWLICKI, R. 1977b. Topographical localisation of lipids in dinosaur bone by means of Sudan B black. *Acta Histochem.* 59:40-46.

PAWLICKI, R. 1978. Morphological differentiation of the fossil dinosaur bone cell. Light transmission, electron and scanning electron microscopic studies. *Acta Anatomica* 100:411-418.

PAWLICKI, R. 1983. Metabolic pathways of the fossil dinosaur bones: 1. Vascular communication system. *Folia Histochem. Cytochem.* 21(3/4):253-262.

PAWLICKI, R., A. KORBEL and H. KUBIAK, 1966. Cells, collagen fibrils and vessels in dinosaur bone. *Nature, Lond.* 211:655-657.
Collagen has been identified in mummified human remains, as well as in mastodon remains preserved in ice age permafrost conditions. In some cases, it is also possible to identify collagen in fossilized bones. In this paper, the authors sectioned the phalange bone of an Upper Cretaceous dinosaur from the southern Gobi (collected during the 1965 Polish-Mongolian Expedition). Osteocytes and collagenous material were both identified in the sections, leading them to speculate that the fibres and vessels were preserved due to a mummification process, possibly by becoming separated from the rest of the fossil by some barrier.

PENSO, J., and Z. JAWOROWSKI, 1967. Unusually radioactive fossil bones from Mongolia. *Nature, Lond.* 214:161-163.

PERLE, A. 1979. The Segnosauridae, a new family of theropods from the Late Cretaceous of Mongolia. In: Fauna mezozoya i kaynozoya Mongolii [Barsbold, R. (ed.), et. al.], p. 45-55, 123, 148-149. *Sovmestnaya Sov.-Mong. Paleontol. Eksped.*, Tr., No. 8.
The osteological description of *Segnosaurus galbiensis*, which, together with more recently located material, has now been placed in a new infraorder, the Segnosauria (see Barsbold and Perle, 1980). (In Russian with English summary).

PINNA, G. 1967. Lo scheleto di *Allosaurus fragilis* Marsh, dinosauro Giurassico, del Museo Civico di Storia Naturale di Milano. *Natura* (Milano) 58(2):145-149.

PINNA, G. 1969. Lo scheletre di *Camptosaurus browni* Gilmore, dinosaure Giurassico, del Museo Civico di Storia Naturale di Milano. *Natura* (Milano) 60(1):5-9.

PLEIJEL, C. 1975. New dinosaurian footprints from the Rhaeto-Liassic of Scania. *Fauna Flora* (Stockh) 70(3):116-120. (In Swedish with English summary).

PONOMARENKO, A.G. 1976. A new insect from the Cretaceous of Transbaikalia, a possible parasite of pterosaurs. *Paleontol. J.* 10(3):339-343.
A new apterous insect, *Saurophthirus longipes* n. gen. and n. sp., is described from a single fossil. The long legs and structure of the tarsi indicate that its host had a coat which was neither dense nor long. Similar long-legged parasites are today typical of bats, and considering that pterosaurs likewise possessed a furry coat (Sharov, 1970) and were likely endothermic (Wellnhofer, 1977), the author proposes the probable hosts of *S. longipes* as being pterosaurs.

POWELL, J.E. 1979. A dinosaur association and other evidence of Upper Cretaceous vertebrates from La Candelaria region, province of Salto, Argentina. *Ameghiniana* 16(1/2):191-204.

PRASAD, K.N., and K.K. VERMA, 1967. Occurrence of dinosaurian remains from the Lameta Beds of Umrer, Nagpur District. *Maharashtra. Curr. Sci.* (India) 36(20):547-548.

RAATH, M.A. 1969. A new coelurosaurian dinosaur from the Forest Sandstone of Rhodesia. *Arnoldia* 4(28):l-25.

RAATH, M.A. 1970. A new Upper Karroo dinosaur fossil locality on the lower Angara River, Sipolilo District, Rhodesia. *Arnoldia* 4(35):1-10.

RAATH, M.A. 1972a. First record of dinosaur footprints from Rhodesia. *Arnoldia* 5(27):l-5.

RAATH, M.A. 1972b. Fossil vertebrate studies in Rhodesia: a new dinosaur (Reptilia: Saurischia) from the Trias-Jurassic boundary. *Arnoldia* 5(30):l-37.

RAATH, M.A. 1974. Fossil vertebrate studies in Rhodesia: Further evidence of gastroliths in prosauropod dinosaurs. *Arnoldia* 7(5):l-7.

RAATH, M.A. 1980. The theropod dinosaur *Syntarsus* (Saurischia: Podokesauridae) discovered in South Africa. *S. Afr. J. Sci*. 76:375-376.

RAU, R. 1969. Uber den Flugel von *Archaeopteryx. Natur. und Museum* 99(1):l-8.

RAUTIAN, A.S. 1978. A unique bird feather from Jurassic lake deposits in the Karatau. *Paleontol. J.* 12:520-528.

On a palaeontological expedition to the Karatau range in Kazakhstan in 1971, the remains of a primitive bird feather were found by A.G. Sharov (whose other notable finds include *Longisquama insignis*, *Sordes pilosus*, and *Sharovipteryx mirabilis*). The specimen appears to be a primary feather from the left wing of a primitive bird capable of flight, but more importantly, occupying an evolutionary position that was probably pre-*Archaeopteryx*. In contrast to the feathers of all other known ancestral birds, (including *Archaeopteryx*), for which no major differences from the feathers of modern birds can be established, the Karatau feather has a number of features which make it exceptional and important to the questions surrounding the ancestry of birds. One is the number of barbs per unit length of the rachis. Modern birds have at least 15 barbs/cm., (*Archaeopteryx* has at least 22/cm.). The Karatau feather does not exceed 4/cm. The most notable feature, however, is the complete absence of any barbules, while the barbs themselves comprise a closed vane. It is relevant that the presence of barbules has been established on contour feathers of fossil birds whenever the conditions of fossilisation has made preservation possible (although some types of feathers of modern birds do lack barbules, in all cases the feathers concerned do not form closed vanes). The morphological features of the Karatau feather, particularly the absence of barbules, suggest that it belonged to a bird that was not capable of refined flight (in modern birds, the function of the barbules is to lock adjacent barbs together to resist air pressure during flight). The large size of the barbs was thus probably due to the necessity of each barb having to independently withstand such air pressure. The author suggests that the bird from which the feather is derived, here named *Praeornis sharovi*, (placed in a new subclass, the Praeornithes), did not fly great distances, but was primarily a ground dweller. A sharp short take-off incorporated a leap with a flapping of the wings, enabling it to seize air-borne prey or to escape predation by seeking refuge in the lower branches of trees. A study of the feather of *P. sharovi* provides further information on the possible evolutionary sequence that took place during the transition from a reptilian scale to an avian feather. The author divides the transition into five stages, with *P. sharovi* occupying the fourth stage, defined as the transition to flapping flight and the appearance of a split feather (the rami of the previous stage being converted to the axes of the barb, and the longitudinal rib into the rachis). *Archaeopteryx* and all subsequent birds occupy the final stage, which involved the cortical part of the barbs being divided up into barbules. See Maderson, 1972; Regal, 1975.

REGAL, P.J. 1975. The evolutionary origin of feathers. *Quart. Rev. Biol.* 50:35-66.
It is the opinion of the author that previous theories relating the origin of avian feathers to aerodynamic functions or to heat conservation are inadequate. It is noted that several genera of modern lizards that dwell in warm climates have tended to develop elongated body scales. Such scales most probably function as heat shields, and it is argued that the first feathers likewise arose as shields to solar radiation (see also Ostrom, 1980). At some stage, the elongated scales of primitive reptiles subdivided into finely branched structures to produce a contoured and flexible heat shield. The muscles associated with such scales allowed fine control over heat uptake and loss. In the first instance, avian flight was initiated by short glides that aided heat loss in a warm environment, but at some later stage, heat retention, rather than loss, became a problem. True flight and the full development of aerodynamic feather structure would therefore have taken place in conjunction with the attainment of endothermy. See Maderson, 1972; Ostrom, 1974a; Rautian, 1978.

REGAL, P.J., and C. CANS, 1980. The revolution in thermal physiology, implications for dinosaurs. In: R.D.K. Thomas and E.G. Olson (eds.), *A cold look at the warm-blooded dinosaurs*, p. 167-188, Westview Press, Boulder.

REID, R.E.H. 1978. Discrepancies in claims for endothermy in therapsids and dinosaurs. *Nature, Lond.* 276:757-758.
A critical review of evidence presented by Bakker in support of endothermy in therapsids and dinosaurs. It is noted that several notable authorities, including Feduccia, Thulborn, and Charig, remain unconvinced by many of Bakker's lines of reasoning. As noted previously (see Ostrom, 1980), most, if not all avenues of Bakker's arguments are open to alternative explanations without inferring conditions of endothermy.

REID, R.E.H. 1981. Lamellar-zone bone with zones and annuli in the pelvis of a sauropod dinosaur. *Nature, Lond.* 292:49-51.
The work of De Ricqles established two main types of compact bone in vertebrates, lamellar-zonal and fibro-lamellar. The former is associated with bones that grow slowly or only to small size, and is generally associated with ectothermic metabolism. The latter is a faster-growing bone type, and is generally associated with medium-to-large-sized endothermic animals. This study analysed the pelvic bone of a large sauropod, and found it to be lamellar-zonal in construction, which would appear to indicate an ectothermic metabolism. The author notes that there was, however, a general lack of systematic studies of dinosaur bone at that time.

REID, R.E.H. 1984a. The histology of dinosaurian bone, and its possible bearing on dinosaurian physiology. In: *Symp. Zool. Soc. Lond.,* No. 52, p. 629-663, Academic Press.

REID, R.E.H. 1984b. Primary bone and dinosaurian physiology. *Geol. Mag.* 121(6):589-598.

REIG, O.A. 1963. La presencia de dinosaurios saurisquios en los 'Estratos de Ischigualasto' (Mesotriasco superior) de las provincias de San Juan y La Rioja (Republica Argentina). *Ameghiniana* 3:3-20.

REIG, O.A. 1970. The proterosuchia and the archosaurs; an essay about the origin of a major taxon. *Bull. Mus. Comp. Zool., Harv.* 139:229-292.

REIG, O.A., and A.J. CHARIG, 1970. The classification of the Proterosuchia. *Biol. J. Linn. Soc.* 2:125-171.

RICH, P.V., and R. BERRA, 1979. Bird history - the first one hundred million years. *Aust. Nat. Hist.* 19(12):392-397.

RICH, V. 1979. Hunting Mongolian dinosaurs. *Nature, Lond.* 279:754.

A brief comment on the work of the joint Polish-Mongolian Gobi expeditions under the leadership of Zofia Kilean-Jaworowska. The author notes that the results of the field work were to be published in the *Palaeontologica Polonica* series that would eventually reach to some 20 thick volumes. She comments on the fact that the expeditions were far more successful than was originally hoped for, producing major finds of dinosaurs of all types (including several new taxonomic groups), numerous dinosaur eggs, fossil tortoises, and the first finds of well-preserved skulls of multituberculate mammals.

RICHMOND, N.D. 1965. Perhaps juvenile dinosaurs were always scarce. *J. Paleontol.* 39: 503-505.

Commenting on the traditionally noted infrequent finds of juvenile dinosaur specimens, the author suggests that large dinosaurs may have possessed a population structure similar to that found in some recent reptiles, fish and amphibians, which are characterized by extreme longevity of adults that reached full size, low rates of replacement and a population density close to the carrying capacity permitted by the environment. It is suggested that egg predation rates were high as was hatchling mortality, but the attainment of large size and/or armour would confer low rates of mortality on adults. However, it is now acknowledged that juvenile dinosaur remains are not as rare as was once believed, and Carpenter (1982) has found that screen washing may produce remains in some quantity.

RICQLES, A.J. de, 1968a. Quelques observations paleohistologiques sur le dinosaurien sauropode *Bothriospondylus*. *Ann. Univ. Madagascar* 6:157-209.

RICQLES, A.J. de, 1968b. Recherches paleohistologiques sur les os longs des tatrapodes: 1. Origine du tissue osseux plexiforme des dinosaurien sauropodes. *Ann. Paleont. (Vertebres)* 54:133-145.

RICQLES, A.J. de, 1969. L'histologie osseuse envisagee comme indicateur de la physiologie thermique chez les Tetrapodes fossiles. *C. R. Hebd. Seance Acad. Sci. Ser. D. Sci. Natur.* (Paris) 268(5):782-785.

RICQLES, A.J. de, 1971. Les performances d'*Archaeopteryx*. *La Recherche* 14:684.

RICQLES, A.J. de, 1972a. Les dinosaurs, "reptiles" a sang chaud. *La Recherche* 3(28):992-994.

RICQLES, A.J. de, 1972b. Vers une histoire de la physiologie thermique.
L'apparition de l'endothermie et le concept de reptile. *C. R. Acad. Sci., Ser. D* 275:1875-1878.

RICQLES, A.J. de, 1974. Evolution of endothermy: histological evidence. *Evolutionary Theory* 1:51-80.

Comparative histology of bone tissue in modern tetrapods can be interpreted in terms of the animals' physiology, morphology, adaptation and other characteristics. The taxonomic distribution of bone tissues can also give indications of gross relationships between bone histology and patterns of body growth and metabolism. In this paper, the author describes an extensive examination of bone histology in many fossil tetrapods, including stegocephalian amphibians, synapsids and archosaurs. The distribution of various bone tissue patterns in these groups indicate that an active form of metabolism (endothermy) may have existed among advanced therapsids (mammal-like reptiles) and many archosaurs, including dinosaurs, dating as far back as the Permian. Primary in the author's argument is the existence of densely vascularised Haversian bone in these groups. Haversian bone is characterised by large numbers of vascular channels that are secondary (reconstructed) in origin, and thought to be associated with the high rates of metabolism found…

in birds and mammals. However, it is now recognised that Haversian bone is absent from some small endotherms (mammals and birds) as well as being present in some undoubted ectotherms such as turtles and crocodilians. See Bouvier, 1977; Ostrom, 1980.

RICQLES, A.J. de, 1976. On the bone histology of fossil and living reptiles, with comments on its functional and evolutionary significance. In: A. d'A. Bellairs and C.B. Cox (eds.), *Morphology and biology of reptiles*, p. 121-150, Academic Press, London.

RICQLES, A.J. de, 1978a. Paleohistologic research on the long bones of tetrapods VII. Classification, functional significance and history of osseous tissue of tetrapods. 3. Evolution: Phylogenetic considerations. *Ann. Paleontol. Vertebr*. 64(1):85-lll. (In French).

RICQLES, A.J. de, 1978b. Paleohistologic studies on the long bones of tetrapods VII. Classification, functional significance and history of bony tissues of tetrapods. III. (conclusion). *Ann. Paleontol. Vertebr*. 64(2):153-184. (In French).

RICQLES, A.J. de, 1980. Tissue structure of dinosaur bone: functional significance and possible relation to dinosaur physiology. In: R.D.K. Thomas and E.G. Olson (eds.), *A cold look at the warm-blooded dinosaurs*, p. 103-139, Westview Press, Boulder.

In this presentation, the author restates previous evidence (summarised in Ricqles, 1974), but also acknowledges that the functional interpretation of bone histology varies among authorities. Nevertheless, dinosaur bone does appear to indicate rapid, continuous and sustained growth, as well as protracted individual longevity. It seems most likely that dinosaurs developed a thermal physiology that was unique and probably intermediate between 'typical' reptilian and mammalian metabolism.

RIXON, A.B. 1968. The development of the remains of a small *Scelidosaurus* from a Lias nodule. *Mus. J. Lond*. 67:315-321.

ROBINSON, P.L. 1962. Gliding lizards from the Upper Keuper of Great Britain. *Proc. Geol. Soc. Lond.* 1601:137-146.

ROMER, A.S. 1971a. The Chanares (Argentina) Triassic reptile fauna. X. Two new but incompletely known long-limbed pseudosuchians. *Breviora* 378.

ROMER, A.S. 1971b. The Chanares (Argentina) Triassic reptile fauna. XI. Two new long-snouted thecodonts, *Chanaresuchus* and *Gualosuchus*. *Breviora* 379.

ROMER, A.S. 1972a. The Chanares (Argentina) Triassic reptile fauna. XIII. An early ornithosuchid pseudosuchian, *Gracilisuchus stipanicorum*, gen. et sp. nov. *Breviora* 389.

ROMER, A.S. 1972b. The Chanares (Argentina) Triassic reptile fauna: XIV. *Lewisuchus admixtus*, gen. et sp. nov., A further thecodont from the Chanares beds. *Breviora* 390:1-13.

ROMER, A.S. 1972c. The Chanares (Argentina) Triassic reptile fauna, XV. Further remains of the thecodonts *Lagerpeton and Lagosuchus*. *Breviora* 394:1-7.

ROMER, A.S. 1972d. The Chanares (Argentina) Triassic reptile fauna, XVI. Thecodont classification. *Breviora* 395:1-24.

RONIEWICZ, E. 1969. Dinosaury z pustyni Gobi. *Wszechswiat* 5:120-123.

ROTH, J.J., and E.G. ROTH, 1980. The parietal-pineal complex among paleovertebrates, evidence for temperature regulation. In: R.D.K. Thomas and E.G. Olson (eds.), *A cold look at the warm-blooded dinosaurs*, p. 189-231, Westview Press, Boulder.

The epiphyseal complex of modern vertebrates, comprising a pineal body and a 'third' eye, functions as an environmental sensor. In this paper, the authors review the presence of part or parts of the epiphyseal complex in modern and fossil vertebrates with the intention of relating such conditions to thermoregulatory mechanisms and the acquisition of a homeothermic physiology. Among modern vertebrates, the presence of the entire epiphyseal complex occurs exclusively among ectotherms, whilst the absence of the complete complex or the presence of the pineal body only, occurs among both ectotherms and endotherms. Retention of the pineal body alone probably represents a trend toward a state of endothermy, such as is found in the mammal-like therapsids and the coelurosaurid dinosaurs. Most dinosaurs, however, like modern crocodilians, had lost the entire epiphyseal complex, and probably possessed a homeothermic metabolism coupled with a relatively low body temperature. Because of their size/ they were specialists in inertial environmental homeothermy.

ROZHDESTVENSKY, A.K. 1960. *Chasse aux dinosaures dans le Desert de Gobi*, (In the footsteps of Dinosaurs in the Gobi Desert), Fayard, Paris, 301 p.

Following the elaborate expeditions of the American Museum of Natural History to the Gobi Desert (1922-1930) under the leadership of R.C. Andrews (which were chiefly remembered for the location of large numbers of dinosaur eggs until recently thought to be derived from the genus *Protoceratops*), the Russian Academy of Sciences organised a series of extensive expeditions that were undertaken in 1946, 1948 and 1949. Although a large number of fossil localities were worked throughout Mongolia, the most important locality was the Nemegt Basin in the southern Gobi. This large, natural topographic depression, 180 km. from East to West and between 40 and 70 km. North to South, is flanked by rugged mountain ranges, and was at the time a most inaccessible area. Nevertheless, the material collected on this and many subsequent expeditions involving Russian, Polish and Mongolian palaeontologists have confirmed this location as the most productive and important late Cretaceous dinosaur locality. The author, one of the leading Russian reptile taxonomists, relates, in popular style, the preparation, field work, and results of the various expeditions. The bulk of material retrieved from the Nemegt deposits was derived from the famous 'dragon's tomb', (a locality accidentally discovered by one of the expeditions' truck drivers), and included ten complete skeletons of giant saurolophine hadrosaurs (*Saurolophus angustirostris*) and giant carnivorous theropods (*Tarbosaurus bataar*, one of the few dinosaurs for which good ontogenetic series are known), as well as hadrosaur dermal impressions (most likely from *Saurolophus*). In addition to this material was collected remains of ankylosaurs (including the genera *Talarurus* and *Syrmosaurus* [actually a junior synonym of *Pinacosaurus grangeri*]), isolated remnants of giant theropods, ornithomimids, and sauropods, as well as large numbers of *Protoceratops* and nests of eggs. According to a study conducted by the expeditions' leader, I. Efremov, and the chief geologist Novojilov, the reason for the extremely high fossil productivity of the Nemegt area is that in Upper Cretaceous times, the area lay at the mouth of a giant river whose waters created jungle-like conditions in and around the delta (there is some dispute now as to whether these conditions were limited in extent or if they were characteristic of the wider Gobi area during late Cretaceous times). Large numbers of herbivorous dinosaurs subsisted on the available plant growth, while many carnivorous species fed on the herbivores. Another narration of the expeditions can be found in Efremov, 1956 (appendix), while the results of these and subsequent expeditions can be found by reference to the following primary authors: Barsbold, Borsuk-Bialynicka, Kielan-Jaworowska, Kurzanov, Maleev, Maryanska, Nowinski, Osmolska, Rozhdestvensky, and Sochava, among others.

ROZHDESTVENSKY, A.K. 1964. New data on dinosaur sites in Kazakhstan and Soviet Central Asia. *Tashkent Univ. Nauchn. Trudy, Geologiya, vyp*. 234:227-241.

ROZHDESTVENSKY, A.K. 1965. Growth problems in some Asian dinosaurs and some problems of their taxonomy. *Paleontol. Zhur*. 3:95-109. (In Russian).

ROZHDESTVENSKY, A.K. 1970. Giant claws of enigmatic Mesozoic reptiles. *Paleontol. J.* 4:117-125.

Among the dinosaur remains collected by the Russian expeditions to the Gobi in 1948 (Rozhdestvensky, 1960), were gigantic claw phalanges, the largest of which is 60 cm. long (and by far the largest vertebrate claws known). These, which have been tentatively assigned to the family Therizinosauridae, are compared with the claws of *Deinocheirus* (Osmolska and Roniewicz, 1969), also from Mongolia, and with other claws from better known theropods. The author suggests that *Deinocheirus* was a descendant of ornithomimids (or possibly another coelurosaurid group) and therefore possessed a lightly constructed skull lacking teeth. The structure of the ulnar joint and the articulation of the humerus with the prehumeral bones allowed the manus to be inturned to some degree, a facility encountered in modern arboreal animals. Therefore, *Deinocheirus* may have followed a mode of life not unlike modern sloths, moving among the boughs of trees and feeding on fruits and leaves as well as the eggs and nestlings of birds and pterosaurs. In comparison, therizinosaurs probably adopted life habits analogous to modern anteaters, taking advantage of the Mid-Mesozoic flourishing of social insects and their associated community habits (although the concept of insectivorous dinosaurs may appear unlikely, there is evidence that another group, the Ankylosauridae, was at least partly insectivorous, see Maryanska, 1977). The laterally compressed claws of therizinosaurs, shaped like knife blades, would seem well adapted to breaking up ground (or insect mounds) or stripping bark from trees in search of insectivorous food. If the deinocheirids and the therizinosaurs were the Mesozoic analogues of modern edentates, they too would have been forest or savannah dwellers and the scarcity of their remains becomes apparent, because their habitats would have been at some distance from bodies of water. The strongest parts of the skeleton were the claws and they were capable of longer preservation. Most authors subsequently dismissed Rozhdestvensky's concepts, instead speculating on the possible carnosaurian-like habits of animals like *Deinocheirus,* but it should be remembered that the trend in the Carnosauria was for reduction of the forelimbs, and increase in cranial size (the cranium tending to be preserved). We now know from more complete remains that Rozhdestvensky was essentially correct in his analysis (see for example, appendix: Russell and Dong, 1993, who do not actually cite Rozhdestvensky's paper), and most authors now either place the therizinosaurs within the Segnosauria or assume that the two groups are synonymous (appendix: Farlow and Brett-Surman, 1997).

ROZHDESTVENSKY, A.K. 1971. Izuchenie dinozavrov Mongolii i ikh rol v raschlenenii kontinentalnogo Mezozoia. *Tr. Sovmestnoi Sov.-Mong. N. I. Geol. Zksp*. 3:21-32.

ROZHDESTVENSKY, A.K. 1974. A history of dinosaur fauna from Asia and other continents and some problems of paleogeography. *Sovmest. Sov.-Mong. Paleontol. Yeksled. Tr.*, No. 1:107-131. (In Russian).

ROZHDESTVENSKY, A.K. 1977. The study of dinosaurs in Asia. *J. Palaeontol. Soc. India* 20:102-119.

ROZHDESTVENSKY, A.K., and L.I. KHOZATSKIY, 1967. Late Cretaceous land vertebrates from Soviet Asia. In: *Stratigraphy and paleontology of the Mesozoic and Paleogene-Neogene continental deposits in Central Asia*, p. 82-92, Nauka Press. (In Russian).

ROZHDESTVENSKY, A.K., and L.P. TATARINOV, 1964. *Palaeontology, amphibians, reptiles and birds*, Moscow, 722 p. (In Russian).

RUSSELL, D.A. 1967. A census of dinosaur specimens collected in Western Canada. *Natl. Mus. Can., Nat. Hist. Pap.* 36:1-13.

RUSSELL, D.A. 1969. A new specimen of *Stenonychosaurus* from the Oldman Formation (Cretaceous) of Alberta. *Can. J. Earth Sci.* 6:595-612.

RUSSELL, D.A. 1970a. The dinosaurs of Central Asia. *Geog. J.* 81(6):208-215.

RUSSELL, D.A. 1970b. A skeletal reconstruction of *Leptoceratops gracilis* from the upper Edmonton Formation (Cretaceous) of Alberta. *Can. J. Earth Sci.* 181-184.

RUSSELL, D.A. 1970c. Tyrannosaurs from the Late Cretaceous of Western Canada. *Nat. Mus. Canada Publ. Paleontol.* 1:1-34.

RUSSELL, D.A. 1972a. Ostrich dinosaurs from the Late Cretaceous of Western Canada. *Can. J. Earth Sci.* 9:375-402.

RUSSELL, D.A. 1972b. A pterosaur from the Oldman formation (Cretaceous) of Alberta. *Can. J. Earth Sci.* 9(10):1338-1340.

RUSSELL, D.A. 1973. The environments of Canadian dinosaurs. *Can. Geog. J.* 87:4-11.

RUSSELL, D.A. 1979. The enigma of the extinction of the dinosaurs. *Rep. Ames Res. Center*: 1-14.

RUSSELL, D.A. 1981. Estimated speed of a giant bipedal dinosaur: a reply. *Nature, Lond.* 292:274.
The author replies to Thulborn (1981), and cautions against the re-interpretation of the Colorado ornithopod trackway, which was originally estimated by Barnum Brown to have represented a stride of 15 ft.

RUSSELL, D.A. 1982. The mass extinctions of the Late Mesozoic. *Sci. Amer.* 246(1):48-55.
The author relates the large (30 X normal) concentrations of iridium found in a marine formation in Italy, to the mass biotic extinctions that mark the end of the Cretaceous. Similar concentrations have also been reported from other parts of the world, including the Southern Hemisphere, and the author postulates that the collision of a very large asteroid with the Earth could have accounted for such a phenomenon. Such an impact would have injected large amounts of dust-size particles into the atmosphere, diminishing photosynthesis and eventually leading to large scale biotic extinctions. This scenario would not, however, explain the seemingly unaltered post-Cretaceous condition of many groups. See Allaby and Lovelock, 1983.

RUSSELL, D.A. 1984. The gradual decline of the dinosaurs. Fact or fallacy? *Nature, Lond.* 307:360-361.
The traditional view of dinosaur evolution often includes an inferred decline in diversity towards the end of the Cretaceous. The author shows that the fossil record of North American dinosaurs shows no indication of a decline in taxonomic diversity at that time, but rather, an increase throughout the Mesozoic.

RUSSELL, D.A., and P. BELAND, 1976. Running dinosaurs. *Nature, Lond.* 264:486.
The authors comment on the method of Alexander (1976) to estimate the speed of dinosaurs from fossil trackways. Using a trackway series in Colorado, they estimate the weight of the animal (which was most likely a very large hadrosaur) as 11 tonnes, the stride at 9.2 m., and the speed of movement at about 27 km.hr.

RUSSELL, D.A., P. BELAND and J.S. McINTOSH, 1980. Paleoecology of the dinosaurs of Tendaguru (Tanzania). *Mem. Soc. Geol. Fr., N. S.* 139:169-175.

RUSSELL, D.A., and T.P. CHAMNEY, 1967. Notes on the biostratigraphy of dinosaurian and microfossil faunas in the Edmonton (Cretaceous), Alberta. *Natl. Mus. Can. Nat. Hist. Pap.* 35: 1-22.

RUSSELL, D.A., and R. SEGUIN, 1982. Reconstructions of the small Cretaceous theropod *Stenonychosaurus inequalis* and a hypothetical dinosaurid. *Syllogeus* 37:1-39.

RUSSELL, D.A., and C. SINGH, 1978. The Cretaceous-Tertiary boundary in south-central Alberta: A reappraisal based on dinosaurian and microfloral extinctions. *Can. J. Earth Sci.* 15(2):284-292.

RUSSELL, D.A., and W. TUCKER, 1971. Supernovae and the extinction of the dinosaurs. *Nature, Lond.* 229:553-554.
The authors present the argument that an explosion of a supernova near to the earth could have triggered the Cretaceous extinctions that marked the end of the dinosaurs and many other vertebrates and invertebrates. They suggest that dinosaur extinction was rapid and sudden (this view would now be challenged by most authors, as there is ample evidence for a gradual diminishing of dinosaur variety towards the end of the Mesozoic), and that the large quantities of X-rays emitted by a supernova would have produced extensive lowering of temperatures and changed biotas which would have had a follow-on effect through the food pyramid.

RUSSELL, L.S. 1965. Body temperature of dinosaurs and its relationship to their extinctions. *J.Paleontol.* 39(3):497-501.
The author proposes that dinosaur extinction was due to a combination of physiology and climatic alterations. The hypothesis advanced includes several factors: 1) dinosaurs were probably homeothermic; 2) they lacked external insulation; 3) climatic changes toward the end of the Cretaceous included general cooling, a lowering of humidity and an accentuation of seasonality, and 4) an eventual point was reached when environmental temperatures dropped enough to inflict fatalities on animals unable to conserve body heat or hibernate. The tetrapods that survived the Cretaceous were either poikilothermic reptiles that were less vulnerable to cold and were capable of hibernation, or they were homeothermic and insulated against temperature declines (birds and mammals). See Cloudsley-Thompson,1968.

RUSSELL, L.S. 1966a. The changing environments of the dinosaurs in North America. *Advanc. Sci.* 23:197-204.

RUSSELL, L.S. 1966b. Dinosaur hunting in Western Canada. *Roy. Ontario Mus. Life Sci. Contr.* 70:1-37.

RUSSELL, L.S. 1967. Comment on the above (Cys, 1967). *J. Paleontol.* 41:267.

RUSSELL, L.S. 1973. Geological evidence on the extinction of some large terrestrial vertebrates. Can. J. Earth Sci. 10(2):140-145.

SAHNI, A., and O.K. MEHROTRA, 1974. Turonian terrestrial communities of India. *Geophytology* 4(1):102-105.

SANTA LUCA, A.P., A.W. CROMPTON and A.J. CHARIG, 1976. A complete skeleton of the Late Triassic ornithischian *Heterodontosaurus tucki. Nature, Lond.* 264:324-328.
The first complete ornithischian dinosaur found in Triassic strata was *Heterodontosaurus*, of which a post-cranial skeleton from South Africa is here described (this dinosaur today remains known only from finds in South Africa and North America). *Heterodontosaurus* appears to have been a cursorial herbivore with a highly manipulative manus. This particular skeleton reinforced the view that the heterodontids and fabrosaurids differed from each other in many important features, and that the two families had independent histories dating to at least the mid Triassic.

SANTAFE-LLOPIS, J.V., M.L. CASANOVAS-CLADELLAS, J.L. SANZ-GARCIA and CALZADABADIA, 1981. A new dinosaur deposit in the Lower Aptian of Morella (Castellon de la Plana) (Spain). *Acta Geol. Hisp.* 16(3):139-144.

SCHMIDT, H. 1969.*Stenopelix valdensis* H. v Meyer, Der kleine Dinosaurier des norddeutschen Wealden. *Palaeontol. Z.* 43(3/4):194-198.

SCHMIDT, W.J. 1967. Struktur des eischalen Kalkes von Dinosaurien. *Z. Zellforsch. und Mikroskop. Anat.* Bd. 82, H. 1, 3:136-155.

SCHWARZ, L., F. FEHSE, G. MULLER, F. ANDERSON and F. SIECK, 1961. Untersuchungen an dinosaurier eischalen von aix-en-provence und der Mongolei (Shabarak Usu). *Z. Wiss. Zool.,* Bd. 165, H. 3-4 3:344-379.

SCHWARZ, L., F. FEHSE and I. VALETON, 1962. Untersuchungen an dinosaurier-eischalen II (Iren Dabasu, Mongolei). *Z. Wiss. Zool*., Bd. 167, H. 1-2, 3:122-136.

SEYMOUR, R.S. 1976. Dinosaurs, endothermy and blood pressure. *Nature, Lond*. 262:207-208.
The author calculates the arterial blood pressures that would have been necessary to circulate blood from the heart to the brain in several types of dinosaurs. Large dinosaurs probably possessed four-chambered hearts capable of producing large differences in pulmonary and systemic pressures. Sauropods are particularly problematical; the specimen of *Brachiosaurus brancai* exhibited in the East Berlin Natural History Museum has a vertical blood column 6.5 m. above the heart, and considering that heart wall thickness increases with blood pressure stress, the conservative estimate for the weight of this heart is 1.6 tonnes. The potential disadvantage of high blood pressure (mechanical inefficiencies and high rates of oxygen consumption) would have been offset if sauropods favoured an aquatic mode of life where hydrostatic pressure would have negated internal blood pressure. Alternatively, they may have followed terrestrial habits and possessed extremely hypertrophied hearts, or they simply did not raise the neck in high positions (see Borsuk-Bialynicka, 1977).

SEYMOUR, R.S. 1979. Dinosaur eggs: gas conductance through the shell, water loss during incubation, and clutch size. *Paleobiology* 5(1):1-11.
Measurements of shell and shell pore geometry of fossil dinosaur eggs are used to estimate…

the amount of conductance of water vapor and respiratory gases by diffusion. The highly porous shells of three dinosaurs, *Protoceratops, Hypselosaurus* and a Gobi sauropod suggest that their nest conditions were high in humidity, low in oxygen concentration and high in carbon dioxide concentration. Conditions such as these would ideally be found within an incubation mound or beneath the ground. Due to the high risk of oxygen depletion and the danger of toxic levels of carbon dioxide accumulation, large sauropods probably limited clutch sizes to small numbers (there is evidence that at least one species of sauropod had divided the eggs into such groups).

SHAROV, A.G. 1970. An unusual reptile from the Lower Triassic of Fergana. *Paleontol. J.* 4(1):112-116.

A description of the small pseudosuchian thecodont *Longisquama insignis* n, gen. and sp. from Kirgizstan, certainly the most important thecodont find of recent times, and one that has added a new element in the debate on the origin of birds. The body of *L. insignis* was covered with elongate, overlapping scales which, along the dorsum, developed into lengthened spatula-like appendages that are two to three times longer than the head and trunk combined and forming a complex structure. While the structure of the shoulder and manus indicate an arboreal mode of life, the complex dorsal appendages appear to have functioned as a type of parachute for breaking the animal's fall as it leapt between branches. The scales of the forelimbs were originally thought to represent an early stage in the evolution of feathers and although the animal itself may not have been directly ancestral to birds, the stage of archosaur development that it represents was probably approximated by the true avian ancestor (Halstead, 1975; Maderson, 1972, among others). The overlapping scales may have also functioned as heat insulators, allowing *L. insignis* to attain a degree of endothermy (Tarsitano and Hecht, 1980). The presence of an *Archaeopteryx*-like furcula in *L. Insignis* and its absence in most known theropods (but see Ostrom, 1973), may add support in favour of a pseudosuchian origin of birds, or, conversely, it may represent another example of homoplasy (Hecht and Tarsitano, 1982). A much awaited detailed analysis of *L. insignis* should shed further light on these questions.

SHAROV, A.G. 1971. New flying reptiles from the Mesozoic deposits of Kazakhstan and Kirgizia. *Trudy Paleont. Inst. Akad. Nauk S.S.S.R.* 130:104-113.

This paper describes the single most important pterosaur find, the so called 'hairy pterosaur' *Sordes pilosus*, as well as the earliest known ancestor of the Pterosauria, the pseudosuchian thecodont *Podopteryx mirabilis*, (subsequently renamed *Sharovipteryx* because the name *Podopteryx* had previously been assigned to a fish) both from Central Asia. *S. pilosus* (= hairy devil) was uncovered in 1970, in Upper Jurassic lake deposits near Chimkent in Kazakhstan, and its discovery explains many hitherto unanswered questions concerning the biology of the Pterosauria. The impression of the flying membrane was perfectly preserved; it stretched interfemurally but was no longer attached to the tail as it was in *Sharovipteryx.* Most importantly, the clear impressions of fine fleece-like hair can be seen covering the body and wing membranes. It was thickest around the pelvis but extended down the legs to the ankles, underneath the wing membranes, between the knee and the elbow and interfemurally also. The inside of each elbow had a thick covering of fur as did the whole of the torso. It is now accepted that pterosaurs were not typically reptilian in biology; they were well insulated, endothermic and probably highly active (Padian, 1983b) flyers that equalled the aerial achievements of birds some 70 million years before the appearance of *Archaeopteryx. Podopteryx mirabilis* (= marvelous foot-wing), from Triassic rocks near Osh in Kirgizstan, was a possible gliding ancestor of the Pterosauria. The small body (100 mm. excluding the long tapered tail) supported a slender skull and hindlimbs more than twice the length of the fore. A membrane or parachute of skin stretched between the elbow and knee and more extensively between the femur and the tail. It was elastic and its surface area was primarily...

controlled by movements of the hindlimbs. Pterosaur evolution and the acquisition of powered flight proceeded by both the development of the anterior membrane which became attached to the long fourth finger, and the eventual degeneration of the interfemural membrane. (In Russian). See Ponomarenko, 1976; Wellnhofer, 1977.

SHOW-YUNG, H. 1963. The carnivorous dinosaurian remains from Fusin, Liaoning. *Vertebr. Palasiat*. 7(2):174-176. (In Chinese).

SHOW-YUNG, H. 1964. Carnosaurian remains from Alashan, Inner Mongolia. *Vertebr. Palasiat*, 8(l):42-63. (In Chinese).

SIGE, B, 1968. Dents de Micromammiferes et fragments de coquilles d'oeufs de Dinosauriens dans la faune de Vertebres du Cretace superieur de Laguna Umayo (Andes peruviennes). *C. R. Acad. Sci. Paris*, (D) 267:1495-1498.

SILL, W.D. 1974. The anatomy of *Saurosuchus galilei* and the relationships of the rauisuchid thecodonts. *Bull. Mus. Comp. Zool*. 146:317-362.

SILVA BARCENAS, A. 1975. Note regarding the remains of dinosaurs in Jurassic and Cretaceous area in the Mexican state of Durango. *Rev. Soc. Mex. Hist. Nat*. 34:289-292. (In Spanish).

SKOCZYLAS, R. 1980. Thermoregulatory strategies of fossil reptiles. *Przegl. Zool*. 24(l):15-46.
A discussion of the thermal physiology of fossil reptiles with new hypotheses concerning the evolution of endothermy and homeothermy. Topics covered include the evolution of the Therapsida, the development of mammalian homeothermy and Bakker's hypothesis of dinosaur endothermy. A change in vertebrate systematics is considered. (In Polish).

SMIT, J., and G. KLAVER, 1981. Sanidine spherules at the Cretaceous-Tertiary boundary indicate a large impact event. *Nature, Lond*, 292:47-49.

SMITH, B.J. (ed.), 1982. *Dinosaurs from China* (including catalogue to the exhibition in the National Museum of Victoria and the Australian Museum, Sydney), Council of the National Museum of Victoria, Melbourne, 51 p.

SOCHAVA, A.V. 1969. Dinosaur eggs from the Gobi Desert. *Paleontol. Zhur*. 4:76-88. (In Russian).

SOCHAVA, A.V. 1971a. New information on the structure of dinosaur eggshell. *Piroda* 3:103-104. (In Russian).

SOCHAVA, A.V. 1971b. Two types of eggshells in Senonian dinosaurs. *Paleontol. J.* 5(3): 353-361.
The microstructure of dinosaur eggshells is examined under a polarising microscope, and compared with the egg morphologies of modern birds and reptiles. Study samples came from Senonian deposits in the northern Gobi, Kazakhstan and the south of France (Provence). The eggs of living reptiles are divided (by structure and development) into two classes: 1) cleidoic, that is, supplied from the beginning with every essential substance (other than gases), and 2) noncleidoic, eggs which although supplied with essential substances and salts, must take up the greater part…

of water for development from the environment. The eggs of crocodiles and birds can be classed as cleidoic, whilst those of turtles (testudinates) occupy an intermediate position between the Squamata (which are characterised by noncleidoic eggs) and crocodiles and birds. Testudinate eggs exhibit segregation patterns which impart strength to the shell and increases resistance to desiccation while at the same time enabling the shell to stretch slightly in order to take up water. The complete liberation of the egg from this latter requirement permitted the development of the continuous calcareous shell characteristic of crocodiles, most dinosaurs and birds. The author distinguishes two types of dinosaur egg from this study: 1) ornithoid, with a structure similar to that of bird's eggs, and 2) testudoid, with a structure similar to that of turtle's eggs. Sochava suggested that the two types may represent the two orders of dinosaurs, the ornithoid belonging to the Ornithischia, the testudoid to the Saurischia. It is noted that the eggs found in close proximity to the ornithischian *Protoceratops* are definitely of the ornithoid type (some French authorities had always maintained that the eggs were, in fact, avian in origin). Sochava tried to explain the lack of relationship between *Protoceratops* and the ornithoid eggshell using ecological factors, because at the time this paper was published, it was believed that the ornithischian dinosaurs had been the group from which birds arose. We now know that saurischian theropods are the group related to birds, and that the eggs Sochava studied in fact belonged to the theropod *Oviraptor* (appendix: Norell *et al*, 1994). Hence her conclusions regarding microstructure were essentially correct, but her affinity groups would have to be reversed in line with the currently accepted saurischian-bird affinity. The ornithoid or bird-like shells would thus have to be assigned to the Saurischia.

SOCHAVA, A.V. 1972. The skeleton of an embryo in a dinosaur egg. *Paleontol. J.* 6:527-531.
Although preliminary workers on the dinosaur eggs collected in the Gobi desert by the American Museum of Natural History mentioned the possible existence of embryos, they were subsequently proven to be artifacts of preservation. This then, is the first verified recording of dinosaur embryonic remains. They were among egg shell remains collected in Upper Cretaceous deposits of Senonian strata in the eastern Gobi. Although Sochava described the egg concerned as 'ornithoid' in structure (see Sochava, 1971b) it differed from previously described dinosaur eggshell of that type. Because the sample was subject to recent weathering, most of the embryo has subsequently been lost. What remains are four subparallel tubular bones which must, by deduction, correspond to the metatarsals I-IV of the pes. The bones appear to be structurally similar to the metatarsal elements of the horned ornithischians *Leptoceratops* and *Protoceratops*, while the degree of ossification observable corresponds approximately to the stage reached in chick embryos during the final stage of incubation. It therefore appears that this embryonic horned dinosaur perished just prior to hatching, and that the egg was in fact not ornithoid in structure if the identification of the osteological elements is correct.

SPASSOV, N.B. 1979. Sexual selection and the evolution of horn-like structures of Ceratopsian dinosaurs. *Paleontol. Stratigr. Litol.* 11:37-48.
Following the work of Davitashvili (1961), the function of the large variety of horns, crests and frills that characterise the crania of many ornithischian dinosaurs have received consideration from various authors (for example, Farlow and Dodson, 1975; Hopson, 1975a; Molnar, 1977/78). In this paper, the author discusses the development of horns and neck frills in the Ceratopsia. Partly contrary to the views of Farlow and Dodson, and Molnar, the author considers that intraspecific ritual frontal fighting within some groups of ceratopsians evolved without the lateral fighting prerequisite sequence suggested by these authors. The initial development of the nasal horn in small, lightly built ceratopsians may have been a result of the combat advantage endowed by the horn due to its position. Later, as ceratopsians increased in size and weight, the develop-…

-ment of the supraorbital horns dominated that of the nasal due to the mechanical advantage provided by shifting the main thrusting force of the head towards the axis of the spinal column. The spectacular horn-like outgrowths of the North American genus *Styracosaurus* were probably actively used in ritual fighting during the mating season. Opposing animals would interlock the posteriorly directed spikes while crossing the nasal horns. Such fighting may have been preceded by ritualised display marches often encountered in the extant Cervidae. The cranial structures possessed by female ceratopsians were less developed than those of males, but they were still of use, for example, in the defense of egg laying sites. A reconstruction of two animals in combat is given.

SPASSOV, N.B. 1982. The bizarre dorsal plates of *Stegosaurus*: ethological approach. *Comptes Rendus de l'Academie Bulgare des Sciences* 35:367-370.

In a restatement of earlier views regarding the behavioral function of armour and various horny adornments of dinosaurs (Spassov, 1979), the author considers the possible intra-specific display functions of the large dermal plates of stegosaurs.

SPINAR, Z.V., and Z. BURIAN, (illustrator), 1972. *Life before man*, Thames and Hudson, London, 228 p.

A large collection of Zdenek Burian's faithful restorations of prehistoric fauna, flora and landscapes. Although some of the reptile reconstructions were completed in the 1930s, with few minor alterations they have remained standard works, having since been reproduced in many other publications. See Augusta and Burian, 1960,1961; Benes and Burian, 1979; Zaruba and Burian, 1983.

SPOTILA, J.R, 1980. Constraints of body size and environments on the temperature regulation of dinosaurs. In: R.D.K. Thomas and E.G. Olson (eds.), *A cold look at the warm-blooded dinosaurs*, p. 233-252, Westview Press, Boulder.

SPOTILA, J.R., P.W. LOMMEN, G.S. BAKKEN and D.M. GATES, 1973. A mathematical model for body temperatures of large reptiles: implications for dinosaur ecology. *Amer. Nat.* 107:391-404.

The authors use a geometrical model to approximate heat conductances through the bodies of large reptiles and compared these results with those measured from an extant archosaur, the American alligator. The calculations show that a large reptile with a body diameter of over 100 cm would have a fairly constantly high body temperature when exposed to warm, diurnally fluctuating environmental conditions, even if it had a low metabolic rate. Gigantism could have been a useful strategy employed by large dinosaurs to maintain a constant internal body temperature in stable, warm climates, without the need for an endothermic physiology and high metabolic rates.

STEEL, R. 1969. Ornithischia. In: 0. Kuhn (ed.), *Handbuch der Palaoherpetologie*, Part 15, Fischer, Stuttgart, 84 p.

STERNBERG, C.M. 1964. Function of the elongated narial tubes in the hooded hadrosaurs. *J. Paleontol*. 38:1003-1004.

STERNBERG, C.M. 1965. New restoration of hadrosaurian dinosaur. *Natl. Mus. Can. Nat. Hist. Pap*. 30, 5 p.

STERNBERG, C.M. 1970. Comments on dinosaurian preservation in the Cretaceous of Alberta and Wyoming. *Nat. Mus. Natur. Sci. (Ottawa) Publ. Palaeontol*. 4:2-9.

STOKES, W.L. 1964. Fossilised stomach contents of a sauropod dinosaur. *Science* 143:576-577.
A frequently overlooked reference that indicates some sauropods were omnivorous and were not particularly selective feeders. The fossil food fragments were found in close association with the stomach of a large sauropod and showed no sign of transport and deposition. It was composed of primarily vegetal fragments such as sections of twigs and branches averaging 2.5 cm. long and 1 cm. in diameter. No leaf material was evident in the sample, though minor but significant fragments of bone and teeth were found. The author suggests that the material may have been secondarily derived from an organically rich sediment or sapropel, and that sauropods were indiscriminate and effective harvesters of river and lake reservoirs. It is perhaps significant that a report of fossilised stomach contents in a hadrosaur (appendix, Krausel, 1922), and commented on in Krassilov, 1981, also ascribes a similar method of feeding in the Hadrosauridae.

STOKES, W.L., and A.F. BRUHN, 1960. Dinosaur tracks from Zion National Park and vicinity, Utah. *Proc. Utah Acad. Sci, Arts and Letters* 37:75-76.

STONE, J.F., and W. LANGSTON, 1975. Late Maestrichtian? - Paleocene palynomorphs associated with the sauropod dinosaur? *Alamosaurus sanjuanensis*. *Geol, Soc. Amer., Abst, Prog*. 7:238-239.

STORER, J.E. 1975. Dinosaur tracks, *Columbosaurus ungulatus* (Saurischia: Coelurosauria), from the Dunvegen Formation (Cenomanian) of northeastern British Columbia. *Can. J. Earth Sci*. 12(10):1805-1807.

SUES, H-D. 1977. The skull of *Velociraptor mongoliensis*, a small Cretaceous theropod dinosaur from Mongolia, *Palaeontol, Z*. 51(3/4):173-184.
A re-description of the cranial osteology of *Velociraptor* material collected from late Cretaceous strata in the Gobi.

SUES, H-D. 1978. A new small theropod dinosaur from the Judith River Formation (Campanian) of Alberta Canada. *Zool. J. Linn. Soc*. 62(4):381-400.

SUES, H-D. 1980a. Anatomy and relationships of a hypsilophodontid dinosaur *Zephyrosaurus schaffi*, new genus new species from the Lower Cretaceous of North America. *Palaeontogr. Abt. A Palaeozool.-Stratigr*. 169(1-3):51-72.

SUES, H-D. 1980b. A pachycephalosaurid dinosaur (*Majungathlous atopus*, new record), from the Upper Cretaceous of Madagascar and its paleobiological implications. *J. Paleontol*. 54(5): 954-962.

SWAINE, J. 1962. *Iguanodon* footprints. *New Sci.* 13:520.

SWINTON, W.E. 1960. The origin of birds. In: A.J. Marshall (ed.), *Biology and comparative physiology of birds*, Vol. 1., p. 1-14, Academic Press, New York.

SWINTON, W.E. 1964. Origin of birds. In: A.L. Thompson (ed.), *A new Dictionary of Birds*, p. 559-562, Nelson, London.

SWINTON, W.E. 1970. *The dinosaurs*, Wiley-Interscience, New York, 331 p.

A primarily taxonomic revision of the two dinosaurian orders by one of the leading authorities on the subject in his time. Dinosaur discovery, environments, origins, anatomy, physiology and extinction are also discussed. The author mentions (and illustrates) several key genera discovered in the Gobi, finds that were often omitted by other western authors of this era.

TAQUET, P. 1972. Un crane de Ctenochasma (Pterodactyloidea) du Portlandien inferieur de la Haute-Marne, dans les collections du Musee de Saint-Dizier. *C. R. Hebd. Seances Acad. Sci. Ser. D. Sci. Nat.* (Paris) 274(3):362-364.

TAQUET, P. 1975. Remarques sur l'evolution des Iguanodontides et l'origin des Hadrosaurides. Prob. actuels Paleont. (Evol. Vert.) *C. N. R. S. Colloq. internat.* 1973:503-511.

TAQUET, P. 1977. Redescription of the cranium of a theropod dinosaur from Dives (Normandy). *Ann. Paleontol. Vertebr.* 63(2):191-206.

TARSITANO, S., and M.K. HECHT, 1980. A reconsideration of the reptilian relationships of *Archaeopteryx*. *Zool. J. Linn. Soc.* 69:149-182.

In this paper, a review of the morphology of *Archaeopteryx* (also see Ostrom, 1976a), the authors address the question of the fossil's phylogenetic position using a cladistic approach. After a consideration of the original material, including the skull, vertebral column, pectoral girdle and forelimbs, digits, and pelvic girdle and hindlimbs, the phylogenetic question is considered. Previous hypotheses are divided into six possible groups, with *Archaeopteryx* being variously described as: 1) a bird with relationships to the Ornithischia (Galton, 1970a), an alternative no longer considered; 2) a bird with relationships to theropod dinosaurs (primarily Ostrom); 3) a bird with affinities to thecodonts (appendix, Heilmann, 1926); 4) a bird with relationships to primitive archosaurs such as crocodilians (Walker, 1972); 5) a primitive archosaur of unknown affinities, and 6) a feathered dinosaur (appendix, Lowe). The incongruity of the digits of *Archaeopteryx* with those of theropods is discussed (see also Hecht and Tarsitano, 1982), and it is noted that the loss of the fourth digit in the Theropoda precludes this group from *Archaeopteryx* ancestry because modern birds have retained this digit. The pubes of *Archaeopteryx* are described as caudally directed (as opposed to the anteriorly directed position proposed by Ostrom, 1973), and morphologically closer to those of thecodonts than those of theropods. As in Hecht and Tarsitano (1982) the authors clearly favour a thecodont relationship for *Archaeopteryx*, though due to the poor fossil record of this group, a direct ancestry cannot be given. They suggest that the primitive archosaurs be treated as a grade (as opposed to a monophyletic group) and be divided into two groups, characterised by the presence or absence of dermal armour and the condition of the tarsus. It is within the group characterised by the lack of dermal armour and the presence of the mesotarsus that can be found the ancestor of not only *Archaeopteryx* but also *Longisquama* (see Sharov, 1970) and the dinosaur groups as well. *Archaeopteryx* itself may be derived from the thecodont level at some point between the *Lagosuchus* and *Euparkia* levels of development. Finally, as a result of this analysis, the authors note that previous efforts to link endothermy in *Archaeopteryx* and *Longisquama* to endothermy in theropod dinosaurs would not be relevant. For a 'stem group' approach to the problem of the phylogenetic position of *Archaeopteryx*, see Thulborn, 1984.

TERYAEV, V.A. 1960a. Homology between the fingers in the wings of the Pterosauria and the forelimbs of other reptiles. *Zool. Zhur.* 39(2):278-281. (In Russian with English summary).

TERYAEV, V.A. 1960b. The nature of pteroid in the wing of pterosaurs. *Zool. Zhur.* 39(4):580-584. (In Russian with English summary).

THALER, L. 1962. Empreintes de pas de dinosaures dans les dolomies du Lias inferieur des Gausses (note preliminaire). *C. R. somm. seanc. Soc. geol. France* 1962:190-192.

THOMAS, R.D.K., and E.G. OLSON, (eds.), 1980. *A cold look at the warm-blooded dinosaurs*, AAAS Selected Symposium 28, Westview Press, Boulder, 514 p.

For individual papers presented at this symposium, see Bakker, 1980; Baur and Friedl, 1980; Beland and Russell, 1980; Farlow, 1980; Greenberg, 1980; Hopson, 1980a; Hotton, 1980; Ostrom, 1980; Regal and Cans, 1980; Ricqles, 1980; Roth and Roth, 1980; Spotilla, 1980.
Also see Feder, 1981.

THULBORN, R.A. 1970a. The skull of *Fabrosaurus australis*, a Triassic ornithischian dinosaur. Palaeontology 13:414-432.

THULBORN, R.A. 1970b. The systematic position of the Triassic ornithischian dinosaur *Lycorhinus angustidens. Zool. J. Linn. Soc.* 49(3):235-245.

THULBORN, R.A. 1971a. Origins and evolution of ornithischian dinosaurs. *Nature, Lond.* 234:75-78.

The author notes that the ornithischians were already almost world-wide in distribution by the late Triassic, and suggests that the group had a monophyletic origin from an advanced group of pseudosuchian thecodonts. The unusual bird-like pelvis came about with a backwards rotation of the pubic bone, followed by growth of the prepubis. A provisional family tree of ornithischians is given at the end of the paper, which depicts ankylosaurs and stegosaurs branching off very early from other ornithischians, with psittacosaurs (lying at the base of the ceratopsian branch), hadrosaurs and pachycephalosaurs subsequently branching off from mid Jurassic to early Cretaceous times.

THULBORN, R.A. 1971b. Toothwear and jaw action in the Triassic ornithischian dinosaur *Fabrosaurus. J. Zool.* (Lond.) 164:165-179.

THULBORN, R.A. 1972. The postcranial skeleton of the Triassic ornithischian dinosaur *Fabrosaurus australis. Palaeontology, Lond.* 15:29-60.

THULBORN, R.A. 1973. Thermoregulation in dinosaurs. *Nature, Lond.* 245:51-52.

A comment on Bakker's hypotheses regarding dinosaur physiology and endothermy.

THULBORN, R.A. 1974. A new heterodontosaurid dinosaur (Reptilia: Ornithischia) from the Upper Triassic Red Beds of Lesotho. *Zool. J. Linn. Soc.* 55:151-175.

THULBORN, R.A. 1975. Dinosaur polyphyly and the classification of archosaurs and birds. *Aust. J. Zool.* 23:249-270.

The author proposes that the intention to reclassify birds and archosaurs (Bakker and Galton, 1974) should be pursued, but it is suggested that the classification suggested by these authors is extreme. It is, instead, proposed that the order Theropoda should be included in the class Aves within the subclass Archaeornithes. Conversely, the evidence for dinosaur endothermy, as presented by Bakker, is considered to be inconclusive, and the author proposes that if any group of archosaurs rivaled the birds in endothermic activity, it was the Pterosauria (see Padian, 1983b).

THULBORN, R.A. 1977. Relationships of the Lower Jurassic dinosaur *Scelidosaurus harrisonii*. *J. Paleontol.* 51:725-739.

THULBORN, R.A. 1978. Aestivation among ornithopod dinosaurs of the African Trias. *Lethaia* 11:185-198.

THULBORN, R.A. 1979. A proterosuchian thecodont (*Kalisuchus rewanensis* new genus new species) from the Rewan formation of Queensland, Australia. *Mem. Qd. Mus.* 19(3):331-356.

THULBORN, R.A. 1981. Estimated speed of a giant bipedal dinosaur. *Nature, Lond.* 292: 273-274.

The author uses the methods of Alexander (1976) to re-evaluate the tracks made by an ornithopod (probably a hadrosaur) dinosaur in Colorado. The re-interpretation is for the pace of stride to be 7.5 ft, as opposed to the 15 ft. original estimate (due to the fact that hadrosaur footprints are remarkably symmetrical. The speed of travel estimated for a pace of 7.5 ft. is 8.5 km/hr.

THULBORN, R.A. 1982. Speeds and gaits of dinosaurs. *Palaeogeogr., Palaeoclimatol., Palaeoecol.* 38:227-256.

Based on methods developed by Alexander (1976), the author uses the measurements of dinosaur skeletons supplemented with measurements of fossilised trackways to estimate the maximum possible speeds for some 62 dinosaurs representing 51 genera. The known relationships between speed, gait and body size, as derived from the study of living mammals, is used in this analysis. It is concluded that small, bipedal theropods were capable of speeds of between 35 and 40 km/h. [though the author later (Thulborn and Wade, 1984) suggests that 60 km/h. may have been a maximum, at least for ornithomimids], while larger bipedal dinosaurs could probably reach maximums of 15-20 km/h. Stegosaurs and ankylosaurs were probably as low as 6-8 km/h., sauropods may have reached somewhat higher, about 12-17 km/h., while some ceratopsians may have been capable of attaining 25 km/h. See Coombs, 1978c; Thulborn and Wade, 1979,1984.

THULBORN, R.A. 1984. The avian relationship of *Archaeopteryx* and the origin of birds. *Zool. J. Linn. Soc.* 82:119-158.

An analysis of the phylogenetic position of *Archaeopteryx* using the ‘stem group’ concept (see also Tarsitano and Hecht for a cladistic approach). The author suggests that the possession of feathers (the primary character linking *Archaeopteryx* to the class Aves) may have been a condition shared with some theropods (though as several authorities have noted, there is no evidence for this). The popular concept of a pro-avis stage that bridged the gap between typical reptiles and the first birds should, according to the author, be abandoned, and it is argued that the major avian characters were evolved well after the *Archaeopteryx* level. In this analysis, *Archaeopteryx* would be assigned to the suborder Theropoda, and the boundary between typical reptiles and birds would be placed at a morphological gap that may have coincided with the origin of true flight.

THULBORN, R.A., and M. WADE, 1979. Dinosaur stampede in the Cretaceous of Queensland. *Lethaia* 12:275-279.

THULBORN, R.A., and M. WADE, 1984. Dinosaur trackways in the Winton Formation (Mid-Cretaceous) of Queensland. *Mem. Qd. Mus.* 21(2):413-517.

In probably the most comprehensive analysis of dinosaur trackways, the fossilised tracks of…

over 150 bipedal dinosaurs are considered. One of the tracks is attributed to a large (2.6 m. high at hips) carnosaur while all the other (smaller) tracks are attributed to ornithopods and smaller coelurosaurs, the former varying from 14 to 158 cm. high at the hips, the latter from 13 to 22 cm. at the hips. The carnosaur was walking at an estimated speed of 7 km/h., the ornithopods appear to have been running at a galloping pace of 16 km/h., while the coelurosaurs, which were also running, reached about 12 km/h. It is assumed that the ornithopods and coelurosaurs were caught up in a stampede triggered by the approach of the carnosaur. If the running abilities of the coelurosaurs are translated to the larger ornithomimids, the author estimates that the latter may have been capable of speeds of up to 60 km/h. See Coombs, 1978c; Thulborn, 1982; Thulborn and Wade, 1979.

TRACY, C.R. 1976. Tyrannosaurs: evidence for endothermy? *Amer. Nat.* 110:1105-1106.
A short reply to Bakker's earlier papers concerning dinosaur endothermy. The author notes that Bakker's use of tyrannosaur predator/prey ratios as evidence for endothermy would be discounted if tyrannosaurs were secondary carnivores (feeding on smaller carnivorous types) or if they were cannibalistic in habit (as are many male crocodilians). See Farlow, 1980,1983.

TUCKER, M.E., and T.P. BURCHETTE, 1977. Triassic dinosaur footprints from South Wales: their context and preservation. *Palaeogeogr., Palaeoclimatol., Palaeoecol.* 22:195-208.
The authors describe two types of dinosaur trackways from graded sandstone, which have been assigned to the pseudo genus *Anchisauripus*. The environment where this dinosaur lived was low-lying (piedmont) and adjacent to a mountain range. The prints were made in slightly damp muddy sediment that was quickly buried by a shallow sheet of slow-moving water. The animals that made the tracks were bipedal and traveled at a strolling, casual pace.

TUMANOVA, T.A. 1977. New data on the ankylosaur *Tarchia gigantea. Paleontol. Zhur.* 4:92-100. (In Russian).
This paper describes the osteology of the largest (up to 17 feet) and one of the most recent Gobi ankylosaurs, remains of which have been found by both Russian and Polish workers in the Barun Goyot Formation. 'Tarchia' is the Mongolian word for brain, so named because of the high-domed (but still relatively small) braincase.

TUMANOVA, T.A. 1981. Morphological uniqueness of Ankylosauria. *Paleontol. Zhur.* 3: 124-128. (In Russian).

TWEEDIE, M. 1977. *The world of dinosaurs*, Weidenfield and Nicolson, London, 143 p.
A popular account of dinosaur evolution, biology and ecology. The question of endothermy and the possibility that birds are saurischian descendants are discussed in chapter four.

TYSON, H. 1981. The structure and relationships of the horned dinosaur *Arrhinoceratops* (Ornithischia: Ceratopsidae). *Can. J. Earth Sci.* 18(8):1241-1247.

TZE-KUEI, C., and C. YUAN-KAI, 1974. Microscopic studies on the dinosaurian egg-shells from Laiyang, Shantung Province. *Sci. Sin.* 17(l):73-89.

VAN HEERDEN, 1979. The morphology and taxonomy of *Euskelosaurus* (Reptilia: Saurischia; Late Triassic) from South Africa. *Navors. Nas. Mus.* (Bloemfontein), 4:21-84.

VAN VALEN, L. 1969. What was the largest dinosaur? *Copeia* 1969:624-626.

VAN VALEN, L., and R.E. SLOAN, 1977. Ecology and the extinction of the dinosaurs. *Evolutionary Theory* 2:37-64.

A sequence of vertebrate faunas in Montana that span the Cretaceous-Paleocene boundary, provides evidence of the process that was involved in dinosaur extinction. The authors reconstruct the contemporary floral and faunal communities. Botanical evidence indicates that a decline in winter temperatures and a replacement of subtropical flora by temperate flora occurred during this period. The temperate flora gradually moved southward, taking with it a faunal community lacking dinosaurs, and eventually replacing the subtropical community by diffuse competition. There is some evidence that dinosaur extinction occurred later in the tropics than in Montana. See Krassilov, 1981.

VIERA, L.I., and J.A. TORRES, 1979. The Wealden of the zone of Enciso (Sierra de los Cameros) and its fauna of great reptiles [Spain]. *Munibe* 31(1/2):141-158. (In Spanish with English summary).

VOSS-FOUCART, M.F. 1968. Paleoproteins des coquilles fossiles d'oeufs de dinosauriens du Cretace superieur de Provence. *Compt. Biochem. et Physiol.* 24(l):31-36.

VOSS-FOUCART, M.F. 1971. Est il possible d'expliquer l'extinction des Dinosaures a la fin du Cretace? *Nat. Belg.* 52(2):101-108.

WADE, M. 1979. Tracking dinosaurs; the Winton excavation. *Aust. Nat. Hist.* 19:286-291.

WALKER, A.D. 1964. Triassic reptiles from the Elgin area: *Ornithosuchus* and the origin of carnosaurs. *Phil. Trans, Roy. Soc. Lond.* 248:53-134.

WALKER, A.D. 1972. New light on the origin of birds and crocodiles. *Nature, Lond.* 237: 157-263.

Crocodilians possess a number of features similar to those of birds, including the structure of the heart and several aspects of skull morphology. These and other similarities are usually assumed to be the result of independent descent from a thecodont source. The author, after a study of crocodile and bird skulls and a comparison with a Triassic crocodile, *Sphenosuchus*, suggests that birds and crocodiles share a common origin. The nature of the quadrate articulation, the vestiges of kinetism, the palatal structure, the occiput and the basipterygoid process are all listed as evidence. Support for this stand can be found in Martin et al, 1980, and Whetstone and Martin, 1979, though few authorities now consider such a common origin likely. See Hecht and Tarsitano, 1982; Ostrom, 1973; Tarsitano and Hecht, 1980; Thulborn, 1984.

WALKER, A.D. 1977. Evolution of the pelvis in birds and dinosaurs. In: S.M. Andrews, R.S. Miles and A.D. Walker (eds.), *Problems in vertebrate evolution.* Linn. Soc. Lond., Symp. 4:319-358, Academic Press, London.

WALKER, A.D. 1980. The pelvis of *Archaeopteryx. Geol. Magazine* 117:595-600.

WALL, W.P., and P.M. GALTON, 1979. Notes on pachycephalosaurid dinosaurs (Reptilia: Ornithischia) from North America with comments on their status as ornithopods. *Can. J. Earth Sci.* 16(6):1176-1186.

WEAVER, J.C. 1983. The improbable endotherm: the energetics of the sauropod dinosaur *Brachiosaurus. Paleobiology* 9(2):173-182.

WEEMS, R.E. 1980. An unusual newly discovered archosaur from the Upper Triassic of Virginia, USA. *Trans. Amer. Phil. Soc.* 70(7):3-53.

An important paper because of its effect on archosaur classification. A new family (Doswelliidae) and a new suborder (Doswelliina) are created to accommodate *Doswellia kaltenbachi*. Similar material had been previously collected in the 1950s and in 1968, and had been tentatively placed within two genera, *Spinosuchus* and *Rutidon*. That material is now reclassified as *D. kaltenbachi*. The new material, retrieved from Upper Triassic delta deposit formations, included articulated vertebrae, a rib and the posterior region of the skull. The author classifies *D. kaltenbachi* close to the Proterosuchia, but it has diverged from that group by the following traits: dorsal and lateral (not ventral) armour; sharply downflexed and widened tail; heavy sacrum with the ilia distally outflared; a unique manner of rib/vertebrae articulation not encountered elsewhere within the Reptilia, as well as many skull features similar to those found within the Crocodilia (but evolved independently). The author speculates that *D. kaltenbachi* was a forager capable of rooting and digging with the strong jaws and feet. The shape of the tail enabled the animal to fold it beneath the body, thus forming an armoured shield. In this respect, *D. kaltenbachi* was analogous to modern anteaters, armadillos and aardvarks. The diet probably included fish, insects, insect larvae, crayfish and bivalves. A highly stylised but informative restoration is given.

WEISHAMPEL, D.B. 1981a. Acoustic analyses of potential vocalisation in lambeosaurine dinosaurs (Reptilia: Ornithischia). *Paleobiology* 7:252-261.

The possibility that lambeosaurine (hollow-crested) hadrosaurs used the interior of the crests as vocal resonating chambers was first suggested by Wiman, 1931 (appendix) and was later supported by Hopson, 1975a (this paper also has a review of alternative hypotheses that have been advanced to explain the morphology of hadrosaur crests). In this analysis, the author considers the auditory anatomy of lambeosaurine hadrosaurs, finding additional support for viewing the crests as resonating chambers. The evidence suggests that adults vocalised over a wide but mainly low range of frequencies. Such frequencies were probably adopted in order to minimise the dampening effect that vegetation has on high frequency vocalisations. There is some evidence that sexual dimorphic vocalisation was present in some species, for example, if the type specimens *Parasaurolophus cyrtocristatus* and *P. walkeri* were conspecific (female and male, respectively) as they do indeed appear to be. This paper adds to the growing body of literature that indicates the Hadrosauridae exhibited a complex and integrated lifestyle with a high degree of sociality (see for example, Hopson, 1977b; Horner, 1982; Horner and Makela, 1979). It should, however, also be mentioned that Maryanska and Osmolska (1979,1981a), after studies of the Mongolian hadrosaur *Saurolophus angustirostris*, suggest that portions of the nasal cavity housed rigid glands involved in thermoregulation or respiration, a condition that would discount the possibility of acoustic signalling (Wheeler [1978], also assigns a thermoregulatory function to the crests of lambeosaurines).

WEISHAMPEL, D.B. 1981b. The nasal cavity of lambeosaurine hadrosaurids (Reptilia: Ornithischia): comparative anatomy and homologies. *J. Paleontol.* 55:1046-1057.

WEISHAMPEL, D.B., and J.A. JENSEN, 1979. *Parasaurolophus*, new record (Reptilia: Hadrosauridae) from Utah, USA. *J. Paleontol.* 53(6):1422-1427.

WELLES, S.P. 1970. *Dilophosaurus* (Reptilia: Saurischia), a new name for a dinosaur. *J. Paleontol.* 44:989.

WELLES, S.P. 1971. Dinosaur footprints from the Kayenta Formation of northern Arizona. *Plateau* 44:27-38.

WELLES, S.P. 1972. Dinosaurs come to the academy. *Pac. Discovery* 25:3-11.

WELLES, S.P., and R.A. LONG, 1974. The tarsus of theropod dinosaurs. *Ann. S. Afr. Mus.* 64:191-218.

WELLNHOFER, P. 1970. Die Pterodactyloidea (Pterosauria) der Oberjura Plattenkalke Suddeutschlands, Abh. Bayer. *Akad. Wiss. N. F.* 141:1-133.

WELLNHOFER, P. 1974a. *Campylognathoides liasicus* (Quenstedt), an Upper Liassic pterosaur from Holzmaden. The Pittsburgh specimen. *Ann. Carnegie Mus.* 45(2):5-34.

WELLNHOFER, P. 1974b. Das funfte Skelettexemplar von *Archaeopteryx. Palaeontographica, A* 147:169-216.

WELLNHOFER, P. 1975. Die Rhamphorhynchoidea (Pterosauria) der Oberjura Plattenkalke Suddeutschlands 1. Allgemeine Skelettmorphologie. *Palaeontographica, A* 148:1-33.

WELLNHOFER, P. 1977. Die Pterosaurier. *Naturwissenschaften* 64(l):23-29.
The author suggests that all pterosaurs were hair-insulated (see Sharov, 1971) and were homeothermic. The structure of the brain closely approached the avian level, though it was relatively smaller. Although pterosaurs have to be classified as archosaurs, and hence reptiles, their exact origin is not known. See Padian, 1983b.

WESTPHAL, F. 1976. Phytosauria. In: 0. Kuhn (ed.), *Handbuch der Palaoherpetologie*, 13:99-120, Gustav Fischer, Stuttgart.

WHEELER, P.E. 1978. Elaborate CNS cooling structures in large dinosaurs. *Nature, Lond.* 275:441-443.
Without consideration of the question of dinosaur endothermy, large dinosaurs with low surface to volume ratios dwelling in warm homeoclimatic conditions must have faced heat dissipation problems (see also McGowan, 1979). In this paper, the author considers the various methods that may have been employed by large dinosaurs to protect the brain from elevated temperatures. Lambeosaurine hadrosaurs possessed cranial crests containing enlarged nasal cavities that may have housed enlarged mucosal areas (see also Maryanska and Osmolska, 1979,1981a). Such areas would have increased the rate of evaporative heat loss from the head. Under stress, increased air flow through the cavities due to panting would increase the rate of cooling still further (this analysis in no way discounts the possibility that the external crest shape may have served as a visual display function in a sexual selective context, sensu Davitashvili). The solid-crested Hadrosaurinae possessed expanded external nares that may have contained an enlarged cartilaginous nasal capsule, forming an extensive evaporative surface, the blood from which would have cooled the brain either by draining into enlarged sinuses close to the brain or by cooling arterial blood by counter-current heat exchange. Sauropods too, possessed enlarged external nares, indicating a spacious nasal capsule that could have functioned in a thermoregulatory manner. The horns of ceratopsians, like those of modern ruminants, were probably heavily vascularised. in ruminants, increased blood flow in the horns is cooled by convection at the horn surface, and ceratopsians may have adopted a similar system to regu-...

-late brain temperatures. Carnosaurs possessed small nares but they also had flexible jaw elements. This suggests the presence of an extensive gular area that would have increased the evaporative surface area. Extra cooling may have been provided by active fluttering of this region (a method employed by extant varanids and some large birds). The large and heavily vascularised bony plates of stegosaurs no doubt carried out a thermoregulatory function (see Farlow et al, 1976), with the largest plates being located in the sacral area where the spinal chord apparently was greatly enlarged into a ganglion larger than the brain itself.

WHETSTONE, K.N., and L.D. MARTIN, 1979. New look at the origin of birds and crocodiles. *Nature, Lond.* 279:234-246.

A study of the auditory specialisations of birds and crocodiles appears to lend support for Walker's (1972) proposal for a common pseudosuchian origin of the two groups. In the otic region of birds and crocodiles, the perilymphatic duct leaves the otic capsule lateral to its primitive position and becomes exposed as a secondary tympanic membrane in the middle ear cavity (analogous to the 'round window' condition in mammals). Dinosaurs and early thecodonts appear to lack this condition – termed 'fenestra pseudorotunda'. As noted previously, (see Martin et al, 1980), few authorities now consider such a close avian/crocodilian relationship likely.

WILD, R. 1975. A pterosaur fossil from the Epsilon Liassic (Toarcium) of Erzingen (Swabian Jura). Stuttg. Beitr. *Naturkd. Ser. B.* (Geol. Palaeontol.) 17:1-16. (In German with English summary).

WILD, R. 1978. Die Flugsaurier (Reptilia, Pterosauria) aus der Oberen Trias von Cene dei Bergamo, *Italien. Boll. Soc. Pal. Ital.* 17(2):176-256.

WILD, R. 1984. Pterosaurs from the Upper Triassic of Italy. *Naturwissenschaften* 71(1):1-11. (In German with English summary).

WILLIAMS, D.L.G., R.S. SEYMOUR and P. KEROURIO, 1984. Structure of fossil dinosaur eggshell from the Aix Basin, Prance. *Palaeogeogr., Palaeoclimatol., Palaeoecol.* 45(1):23-38.

WORSLEY, T.R. 1971. Terminal Cretaceous events. *Nature, Lond.* 230:318-320.

Evidence from the JOIDES Deep Sea Drilling Project provided some insights into the Cretaceous extinctions that included the dinosaurs. The samples showed decrease of temperatures by late Maastrichtian times, with climatic belts becoming more differentiated. There was also greatly reduced clastic influx into the oceans, possibly resulting from decreased atmospheric CO2 levels. This may have been caused by an excessive Cretaceous phytoplankton bloom which resulted in world-wide deposition of chalk. Polar cooling of seawater (due to the break-up of the southern landmasses) may also have had a similar effect.

XHOZATSKII, L.I., B. MESZAROS and B. VIGH, 1977. The ultrastructure of some dinosaurian egg shells on the basis of data obtained by scanning electron microscopy. *Acta Biol. Debrecina* 14:123-138. (In Russian with English summary).

YADAGIRI, P., and K. AYYASAMI, 1979. A new stegosaurian dinosaur from Upper Cretaceous sediments of south India. *J. Geol. Soc. India* 20(11):521-530.

YALDEN, D.W. 1970. The flying ability in *Archaeopteryx. Ibis* 113:349-356.

Until this paper, most authorities considered *Archaeopteryx* as being incapable of true flapping…

flight. Following a paper by Pennycuick who provided basic formulae for the parameters needed to calculate aerodynamic abilities for this fossil, the author re-evaluates the flying abilities of *Archaeopteryx* using the dimensions of the London and Berlin specimens. If *Archaeopteryx* was a true flyer, the length of the coracoids indicates that the pectoral muscles were quite short. This in itself, would affect the wing beat frequency rather than the power of the stroke, and the author speculates that the wing muscles may have been as powerful as those of modern birds with the same muscle mass. The presence of a furcula, representing fused clavicles, is another anatomical feature implying true flying ability, though the precise function of this structure is not known. True flying ability is also supported by the structure of the manus and the distribution of primary and secondary feathers. The structure of the thoracic area, however, suggests that irrespective of the level of flying ability, such activity could not be maintained for any great length of time, and the author envisages *Archaeopteryx* fluttering uncertainly among forest canopies (see also Hecht and Tarsitano, 1982).

YALDEN, D.W. 1971. Flying ability in *Archaeopteryx. Nature, Lond.* 231:127.
The author comments on previous estimates of the wing loading in *Archaeopteryx*, and suggests that they are unduly pessimistic. He proposes that the wing area was a third larger than previously given, and that as the animal was probably arboreal, it only had to climb and fly short distances between branches, or from trees to the ground.

YALDEN, D.W. 1984. What size was *Archaeopteryx? Zool. J. Linn. Soc.* 82:177-188.
A new three dimensional model of *Archaeopteryx* indicates the mass was no more than 271 g. See Hepstonstall, 1970.

ZAMBELLI, R. 1973. *Eudimorphodon ranzii* gen. nov., sp. nov., uno pterosauro Triassico. *Ist. Lombardo* (Rend. Sci), B 107:27-32.

ZARUBA, B., and Z. BURIAN (illustrator), 1983. Prehistoric life on Earth, Hamlyn, 61 p.
Some of Zdenek Burian's later restorations (including convincing renditions of *Longisquama insignis*, see Sharov, 1970) are presented in this large format work, which is aimed at younger readers. See also Augusta and Burian, 1960, 1961; Benes and Burian, 1979; Spinar and Burian, 1972.

ZHEN, S.N. 1976. A new species of hadrosaur from Shandong. *Vertebr. Palasiat.* 14(3):166-168. (In Chinese with English summary).

APPENDIX

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