Where is the Flood/post-Flood Boundary? Implications of Dinosaur Nests in the Mesozoic

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ABSTRACT

There is currently no consensus among creationists about the location of the Flood/post-Flood boundary in the geological record, although most consider the Mesozoic sediments to have been deposited by the Flood. However, a study of the palaeontological literature reveals that in situ *dinosaur nests occur at multiple levels throughout the Mesozoic. These nests stratigraphically overlie thousands of metres of Flood-deposited Palaeozoic sediments. Creationist arguments that attempt to accommodate multiple periods of nest building and nurture of juveniles within the limited time available during the Flood have not proven convincing. The nests are strong evidence that the Mesozoic host sediments are post-Flood.*

INTRODUCTION

There is considerable disagreement among creationists about the location of the Flood/post-Flood boundary in the stratigraphic record. Most have argued that the boundary occurs within the Cainozoic,[1] while others favour the Cretaceous/Tertiary (K/T) boundary.[2] Proponents of both these hypotheses view the Mesozoic as having been deposited during the Flood. However, this poses a number of difficulties, one of the most problematic of which is the occurrence of *in situ* fossil nests in Mesozoic sediments. I should state plainly at the outset that it is not possible to resolve this difficulty by denying the relative position of the Mesozoic sediments in the stratigraphic record. While the radiometric dates appended to the geological column require drastic rescaling, the methods used by geologists to assign a relative geological age are sound. In other words, the geological column is a reality.

There is now an extensive literature on Mesozoic eggs and nests, and numerous descriptive papers have been published. A recent book[3] has attempted to organise and summarise this information before the sheer volume of material makes the task impossible. Since their discovery in 1859, dinosaur eggs and nests have been found on almost every continent, with the greatest number of localities situated in Mongolia, China, France, India, and North America.[4] Here I will present an overview of those aspects of fossil eggs and nests which are relevant to the question of whether they were formed post-Flood. The overview will, of necessity, be incomplete; readers who require a more comprehensive survey are directed to the paper by Carpenter and Alf.[5]

STRATIGRAPHIC DISTRIBUTION OF DINOSAUR EGGS AND NESTS

Nearly all dinosaur eggs and eggshell fragments to date have been recovered from Upper Cretaceous sediments (see Figure 1), although there is a growing number of localities that have yielded older material. I will begin this survey with the Upper Cretaceous occurrences and then look at progressively older examples. Localities yielding only eggshell fragments will be ignored, because studies indicate that eggshell fragments can survive considerable transport without significant abrasion. Chicken eggshells placed in a tumbler with sand and water and tumbled for up to 70 hours,

Figure 1. An Upper Cretaceous dinosaur nest displayed in an exhibit at the Zoology Museum, University of Cambridge, UK. Photograph by Steven Robinson.

equivalent to a transport distance of 68 km, showed no observable decrease in size.[6] The presence of eggshell fragments alone is not, therefore, helpful in distinguishing Flood from post-Flood sediments. It may even be possible for whole eggs to be transported, as Kennedy[7] has argued for dinosaur eggs in a storm surge sequence in the Allen Formation (Upper Cretaceous) of Argentina. However, where eggs are neatly arranged in linear rows or circular patterns, sometimes in pre-constructed mounds, transport cannot be invoked. Such nests are clearly *in situ.*

Upper Cretaceous

The first relatively complete dinosaur eggs to be found in the western hemisphere were collected by James Jensen in July 1966 from the North Horn Formation in the Wasatch Plateau of Central Utah. Additional fossil *egg* material was discovered in the same area later that year by Donald Burge.[8] Three distinct zones containing fossil eggs or eggshell fragments were identified, provisionally designated Zone I, Zone II, and Zone III (see Figure 2).[9] Zone I yielded four partially complete eggs, two crushed eggs, and two in reasonably normal ovoid shape. Two of the best specimens were found embedded in a soft sandstone unit, standing on their small end, with their long axes vertical. Both the completeness and the orientation of these eggs indicate that they were found *in situ.* By contrast, Zone II (about 10 metres above Zone I) and Zone III (about 47 m above Zone I) yielded only scattered fragments of shell that appeared to be transported.

Horner and Makela[10] describe 15 one-metre-long juvenile hadrosaurs ('duck-bills') found together in 1978 in a nest-like structure in the Two Medicine Formation near Choteau, Teton County, Montana. The nest was an oval, concave structure about two metres in diameter at its weathered surface, and about 0.75 m deep near its centre. This concavity was situated at the apex of a mound about three metres in diameter and about 1.5 m above the surrounding topography, although the authors say that this may have been an artefact of differential weathering of the sediments. The association of such a structure with several juvenile hadrosaurs strongly suggests that this was an *in situ* nest. However, not only had a nest been built, and eggs laid and hatched, but according to the authors, wear on the teeth of these young dinosaurs indicates that they had been feeding for some time. Some of the teeth were worn along more than three-quarters of their length.[11] It is difficult to see how this sequence of events can be accommodated within the year of the Flood. On the other hand, the data are consistent with a post-Flood interpretation.

Further significant discoveries have been made in this

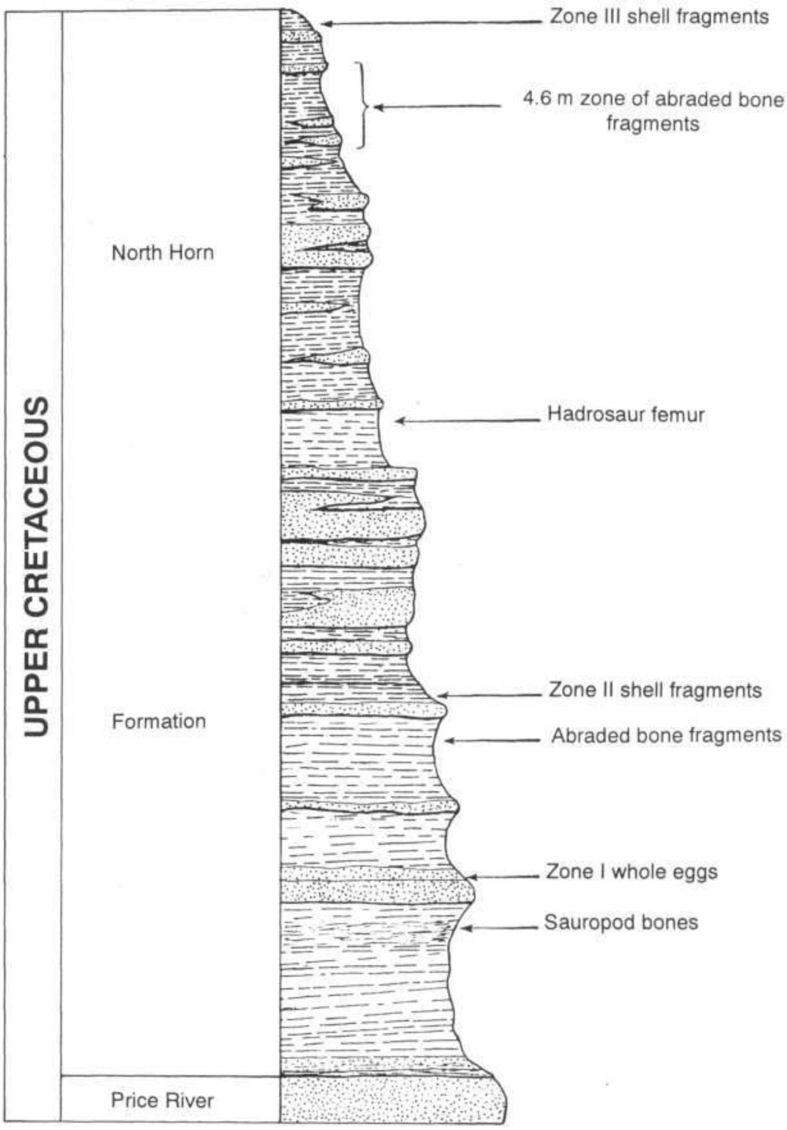

Figure 2. Generalized stratigraphic section of the lower North Horn Formation at the dinosaur locality described by Jensen. Vertical scale: 1 cm equals approximately 4.0 m.

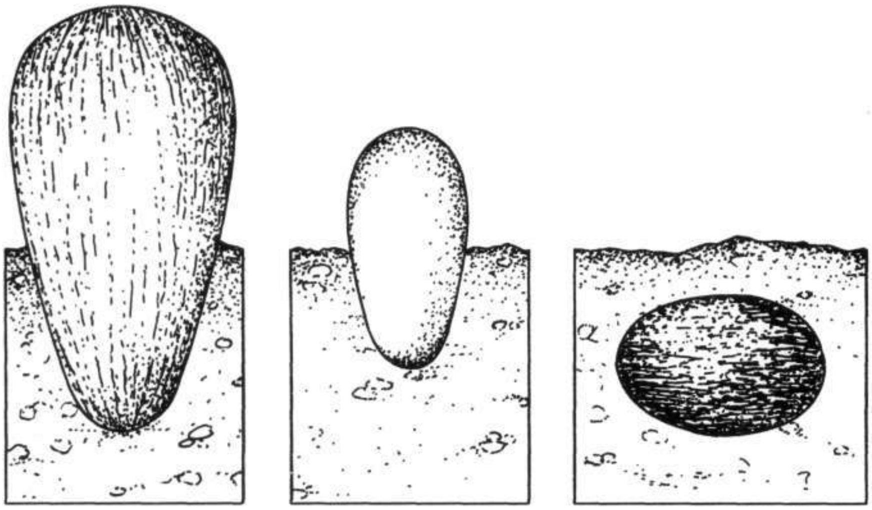

***Figure** 3. Three types of dinosaur egg discovered at the Upper Cretaceous Montana sites. The large ovoid egg at the left is a reconstruction of a hadrosaur egg, based on shell fragments found in nests associated with juvenile hadrosaur remains. The egg is about 20 cm long. The smaller elongate egg in the middle probably belonged to a hypsilophodont. The egg at the right is of unknown origin. The first two egg types are typically found in an upright position partially buried in sediment. The third type is usually found lying horizontally in paired linear rows completely covered by sediment. From Horner. Drawing by Russell Grief.*

area (see Figure 3).[12] A second nest of younger hadrosaurian juveniles (0.5 metres long) was discovered in the same horizon that yielded the '1978 nest'. Also found were the weathered remains of six unoccupied nests containing abundant eggshell fragments. Each nest appears to have been a circular or oval pit within a preconstructed mud mound. The occurrence of eight nests, spaced at least seven metres apart along a single time horizon, suggests that these hadrosaurs were nesting in a colony.

A second nesting site in Teton County has yielded ten ornithopod nests containing the hatched remains of up to 24 eggs per clutch. Each nest is approximately one metre in diameter, and they are separated horizontally from one another by about two metres. The important point here is that these nests were found on at least three sedimentary horizons within a three-metre vertical section (see Figure 4).[13] Thus nest construction, egg-laying, and nurture of juveniles occurred at this locality three times. If one cycle of this sort is difficult to fit into the Flood year, the establishment of three successive nesting colonies one after the other surely strains the imagination, notwithstanding that the growth rate of baby dinosaurs was rapid.[14]

On the other hand, the rarity of eggs and juveniles in comparison with the number of adult dinosaurs discovered is also difficult to explain in any long-age chronology.[15] Taken at face value, the paucity of such fossils suggests that colonisation of the region was transitory. Other data speak of catastrophic depositional processes. For example, in 1981 the remains were found of at least 10,000 maiasaurs that were simultaneously overwhelmed and entombed by ash during a volcanic event.[16] Likewise, it has been suggested that the baby maiasaurs described by Horner[17,18] were entombed in floodplain silts during an abnormally large flood.[19]

Fossil nests have also been discovered in the Upper Cretaceous of China, Mongolia, India, Romania, and Spain. Young[20] reports a collection of about 2,916 eggshells and 78 more or less complete eggs from the Nanhsiung and Szesheng areas of China. Nine nearly complete or partly preserved nests were found. The best preserved nest in the collection consisted of 20 eggs arranged in a circular manner and inwardly inclined, on at least two levels. The complete nest may have contained more than 40 eggs. For more detailed

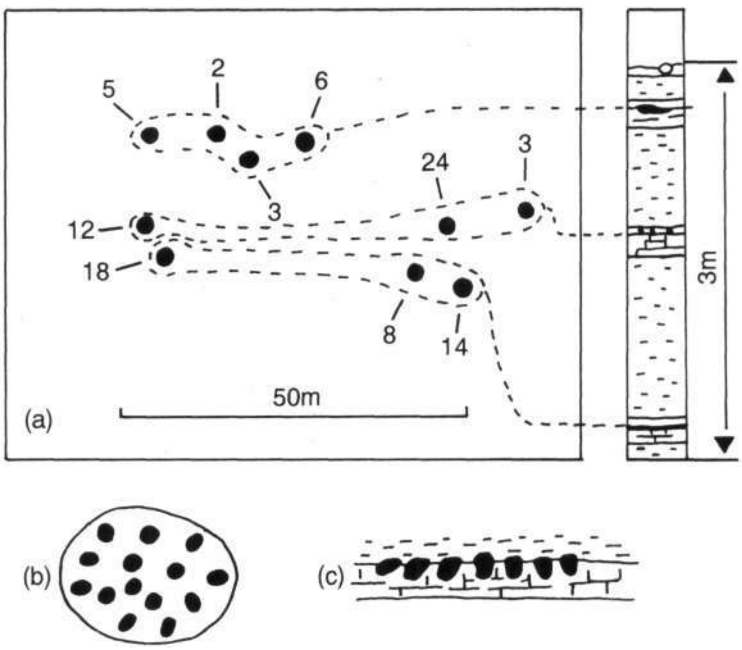

***Figure** 4. (a) Map and vertical section of Willow Creek Anticline locality showing a number of egg clutches attributed to a hypsilophodont-like ornithopod. The clutches occur on at least three different horizons in a three-metre section. Values represent the number of eggs per nest, broken lines enclose clutches found on single horizons.*
(b) Typical clutch arrangement viewed from above.
(c) Egg clutch viewed from the side showing the partial burial of the eggs in siliceous carbonate sediment. From Homer.

descriptions of these nests, the reader is directed to Young's paper.[21] Examination of the photographs accompanying the paper makes it difficult to avoid the conclusion that these eggs were *in situ.* Nests and more or less complete eggs are also known from the Upper Cretaceous of the Laiyang district and have been described in additional papers by Young.[22,23] Again, Young's descriptions and illustrations leave little doubt that these finds represent true *in situ* nests.

In 1923 the Central Asian Expedition of the American Museum of Natural History, led by R. C. Andrews, found 50 more or less entire eggs, along with thousands of shell fragments. These Mongolian discoveries were the first to be widely publicised. One clutch consisted of 30-35 eggs laid fanwise in three layers. Subsequent work led to the discovery of numerous other *in situ* clutches.[24] Mongolia was back in the news recently when palaeontologists described a remarkable find of an *Oviraptor* sitting on a neatly arranged circular cluster of eggs in a brooding posture.[25] Clearly this nest is preserved *in situ.*

Several egg clutches have been documented within the infratrappean limestone (Lameta Formation) of Kheda district, Gujarat, India.[26] The number of eggs per clutch usually varies from three to seven, although ten eggs were found in an isolated clutch at Rahioli. Some individual horizons contained several regularly spaced clutches and appear to have been nesting grounds. At Rahioli at least 11 clutches were found within an area of about 1,200 m^2.

Fourteen subspherical dinosaur eggs were found arranged in four linear rows in a 0.5-metre-thick clay band in an Upper Cretaceous sequence in the Hateg Basin of Romania.[27] No skeletal remains were found. Linear rows of eggs are also known from the Montana sites[28] and from the Upper Cretaceous of France.[29,30]

Sanz *et al.*[31] have recently reported the discovery of abundant egg and bone material from the Arenisca de Aren Formation of the southern Pyrenees. The material is distributed over an area of about 15 km^2, and many closely-spaced, well-preserved nests occur in a two-metre-thick red sandstone layer at the top of the formation. Each nest contains one to seven eggs; most have only two or three. The abundance of the material suggests that the area was a nesting ground, and that dinosaurs may have returned to this area during several reproductive seasons.

Upper Jurassic

Hirsch *et al.*[32] have reported a bowl-shaped nest-like structure in the Upper Jurassic Morrison Formation of Colorado. Numerous shell fragments and a single crushed egg were recovered from this nest. Other Upper Jurassic sites have also been claimed as possible nesting sites.[33,34]

Lower Jurassic

A clutch of six dinosaurian eggs of uncertain taxonomic affinity were found in a sandstone block derived from the Elliot Formation (Red Bed Stage), northern Orange Free State, South Africa. The initial report stated that these sediments were Upper Triassic in age,[35] but more recent publications assign the Elliot Formation to the Lower Jurassic.[36] Kitching's preliminary account noted that three of the eggs clearly contained foetal remains in an advanced stage of development, while one juvenile appeared to have hatched prior to fossilisation, leaving a collapsed and shapeless eggshell embedded in the matrix. Partial remains of two other eggs were also exposed.

Upper Triassic

The oldest known dinosaur nest is from the Upper Triassic of Patagonia, Argentina.[37] Eggshell fragments found in close association with five prosauropod *(Mussaurus)* hatchlings of identical size indicates an *in situ* nest.

Permian

A single vertebrate *egg* derived from the Permian Admiral Formation was described by Romer and Price.[38] A re-evaluation of this specimen by Hirsch[39] suggests that it was not a calcareous fossil egg as Romer and Price had implied, but possibly a soft-shelled reptilian *egg.* As it was found on the surface, no information is available concerning its mode of occurrence (for example, orientation in the host sediment).

IMPLICATIONS FOR LOCATING THE FLOOD/ POST-FLOOD BOUNDARY

As previously noted, many creationists have expressed their view that the Flood/post-Flood boundary is located near the K/T junction in the stratigraphic record, or even within the Cainozoic. Both these boundary locations place the Mesozoic nesting sites described above within the Flood year itself. One author who has recognised the problem posed by the nests, and who has attempted to reconcile them with a Flood/post-Flood boundary after the Cretaceous, is Michael Oard.[40] Oard proposes that all the dinosaur nests were formed within 150 days, the time that he assigns to the transgression of the Flood waters over the land. However, a straightforward reading of Genesis 7 indicates that the waters had inundated the land — even the highest mountains — by Day 40 of the Flood year. Oard frankly admits that he favours the 150-day interpretation of Genesis 7 in order to accommodate the building of dinosaur nests:

> *'Because of dinosaur tracks on thousands of meters of Flood sediments and baby dinosaurs hatched from eggs, I favor 150 days before all air breathing animals on land died.'*[41]

But is the 150-day chronology a valid one? The interpretation does not, surely, take the biblical account at face value, and Oard makes no attempt to justify it from the text. Furthermore, the geological evidence indicates that the whole earth was submerged long before the Mesozoic, probably by the Upper Ordovician.[42] If the nest sites were formed early in the Flood, they ought to occur much lower in the stratigraphic column than they do. All the dinosaurbearing sediments are Mesozoic in age and, as Oard acknowledges, many of them overlie enormous thicknesses of Palaeozoic and Mesozoic deposits.[43] If all the Palaeozoic and Mesozoic rocks represent just the first 150 days of the Flood, then we are left with a seriously distorted record. The remainder of the Flood — still over 200 days according to Oard's interpretation — has to be squeezed into just the Tertiary. This is not a sensible correlation of biblical and geological events. The dinosaur nests are simply in the wrong stratigraphic position to be considered early Flood deposits.

Even more damaging to Oard's thesis are the localities where nests occur on several successive horizons. I have already noted the successive nest-bearing horizons reported by Horner.[44] How are we to accommodate several successive nest-building periods within 150 days, remembering that we also have to leave sufficient time for the rest of the Mesozoic, the entire Palaeozoic, and possibly a considerable portion of the Proterozoic to be deposited before the dinosaurs can even begin to build the first nest? Examples such as these stretch Oard's Flood chronology beyond breaking point.

Oard's paper is untenable on other counts. He postulates thousands of dinosaurs floating and swimming in the Flood waters for hundreds of miles, before finally lighting upon temporary strips of land to make tracks and build their nests. What terrestrial animals could really have survived in these conditions? And if the Flood was sufficiently tranquil to allow this to happen — and to leave the nest horizons largely uneroded — why did not some dinosaurs survive the Flood altogether, just as they did up to the end of the Cretaceous? Indeed, if Oard's explanation was correct, it would be difficult not to believe that some human beings were also able to survive the Flood in small boats. The Bible describes something altogether different: a catastrophe so sudden and violent that all land animals outside the Ark perished without exception. Oard's scenario also has to reckon with the fact that during the time these dinosaurs were supposedly swimming and floating in the Flood waters, several kilometres of sediment must have been laid down underneath them!

Further difficulties arise when we consider the gastroliths (stomach stones) associated with some dinosaur remains. Stokes[45] investigated gastroliths from some Lower Cretaceous dinosaurs, and found that many of them were composed of lithified, fossil-bearing sedimentary rock which appeared to be derived from Palaeozoic and pre-Cretaceous Mesozoic deposits. Fossils contained in these gastroliths included a sponge thought to have come from the Kaibab Limestone (Permian), a distinctive chert which probably came from an Ordovician source, and petrified wood identical to that found in the Chinle Formation (Triassic). These data support the post-Flood interpretation of the Mesozoic, unless we wish to argue that, as well as fleeing from the rising Flood waters, making tracks, and building nests, dinosaurs were swallowing lithified fragments of earlier Flood deposits for use as stomach stones.

Taking into account the stratigraphic position of the dinosaur nest sites and the evidences for time (months, years) at these sites, the most reasonable explanation is that they date from the early post-Flood era. Nest construction — in a variety of patterns[46] — indicates a period of relative stability and the re-establishment of normal reproductive behaviour. Moreover, the global distribution of nests indicates that, in accordance with geologically deduced palaeogeographic maps, a large portion of the world was then above water. Two possible — though not wholly sufficient — explanations then present themselves for the apparent increase in numbers of eggs and nests towards the Upper Cretaceous. The increase may reflect the expansion of the dinosaur population as the world was recolonised following the Flood. In addition, the concentration of eggs and nests in the Upper Cretaceous may reflect lower sedimentation rates at that time. In the post-Flood era depositional rates, although generally higher than at present, are likely to have been quite variable. Lower sedimentation rates are also implied by the hiatuses evident through the Upper Cretaceous Chalk.[47] The data fit better with post-Flood recolonisation of the Earth than with the Flood catastrophe itself.

CONCLUSIONS

The occurrence of *in situ* eggs and nests in Triassic, Jurassic, and Cretaceous sediments indicates that at least these systems must be post-Flood. This deduction is supported by the recent discovery of apparently *in situ* termite nests in the Triassic sediments of Arizona's Petrified Forest National Park.[48]

Oard's attempt to place dinosaur nests within the Flood year is contradicted by the relative stratigraphic position of the Mesozoic sediments. His chronology also fails to do justice to the evidences for time (months, years) that exist at the nesting sites. The Flood/post-Flood boundary should therefore be sought in the pre-Triassic record.

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