# Dinosaurs in the Oardic Flood

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**ABSTRACT**

*Dinosaur fossils dominate the terrestrial animal record of the Mesozoic and provide important data for determining when in Earth history the Flood might have ended. In 1995 the suggestion was made that dinosaur fossils represent animals living and dying during the Flood. The evidence and arguments for this are examined, it being concluded that dinosaurs were not exceptional swimmers, and that the terrestrial deposits on which they walked, laid eggs and in which they were buried are not consistent with a cataclysmic flood going on at the time. Further, dinosaur track and body fossils appear too late in the geological record to accord with the theory that the Flood began in the late Precambrian and ended after the Mesozoic. In both cases, earlier boundaries are indicated.*

In the penultimate issue of this journal Michael Oard argued that the extinction of the dinosaurs around the end of the Mesozoic should be attributed to Noah's Flood,[1] contrary to the interpretation which others set out in a previous issue that the Flood was over by the Mesozoic.[2"7] Notwithstanding the fact that three of the opposing papers had discussed the dinosaur record at some length, Oard alluded to them only twice, in both cases picking up remarks made by Paul Garner.

Garner had described the '1978 nest site' in the Two Medicine Formation, Montana (see Figure 1), and as part of that description had pointed out that worn teeth in the mouths of baby dinosaurs was evidence that they had been feeding for some time. He concluded:

> *It is difficult to see how this sequence of events can be accommodated within the year of the Flood'*

- referring not only to the worn teeth but to the building of a large nest, the laying, incubation and hatching of 15 eggs, and the growth of the nestlings to a length of 1 metre. Oard responded by quoting two authorities in support of the idea that the wear marks could have been made by the embryo while still in the egg, permitting himself the conclusion:

> *'Therefore, data on dinosaur eggs that at first seem inimical, may still be explained within a Flood model after further information is published!*

This seems a large lesson to draw from so small a finding. Garner's main point was that the sequence of events represented by the nest site was not at all what one might expect to have been happening in the middle of a world-destroying cataclysm. These events were: the

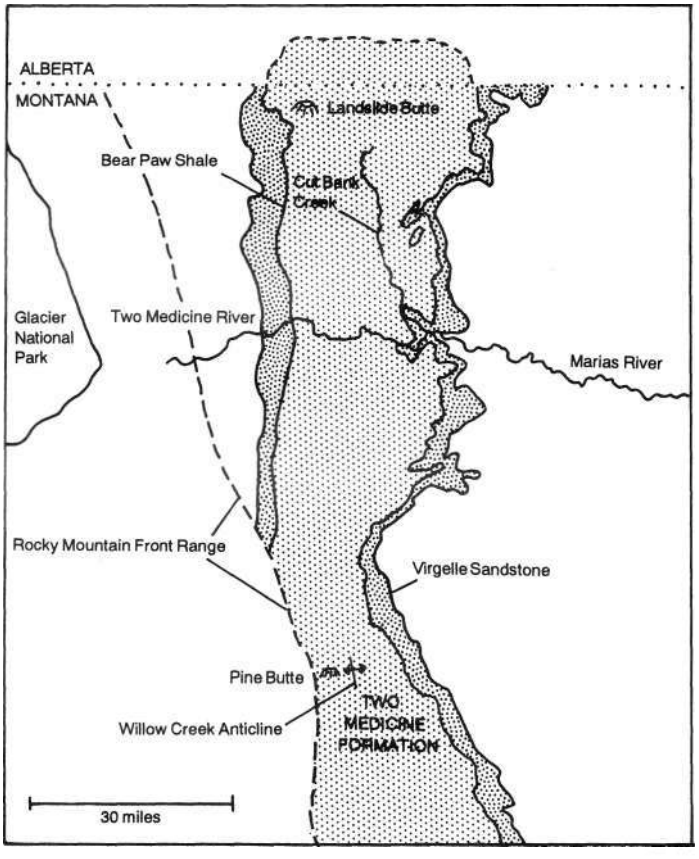
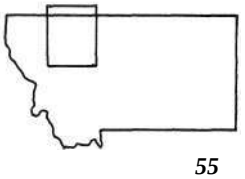



***Figure 1.*** *Part of northern Montana. The Two Medicine Formation, running parallel with the Rocky Mountains to the west, is widely exposed.*



cessation of sedimentation and 'emergence' of a land surface, the arrival of dinosaurs from an area unaffected by the flooding, the construction of a 1.5-metre-high mound on top of which the eggs were laid in a bowl-like depression, the incubation of the embryos from the time the eggs were laid until they hatched, the subsequent growth of the hatchlings, their death in the nest, and the subsequent decay (or scavenging) of their bodies until the bones disarticulated — all at the same stratigraphic level. This sequence would surely have occupied many months, whether or not there had been teeth marks.

In his other allusion, Oard noted Garner's acceptance of the evidence that, at a site not far from the baby hadrosaurs discovered in 1978, a cycle of nest construction, egg-laying and nurturing of juveniles had occurred three times in succession. This site will be discussed later. Initially I should like to respond to Oard's article by considering in what manner we should address the question of where the Flood is in the geological record.

## DISTINGUISHING BETWEEN COMPETING THEORIES

David Malcolm notes that

> *'very many articles have been written by creationists, making the point that evolution is not able to be falsified, and therefore it is not science.'*[8]

If there is some truth in this argument, one should balance against it the often-heard contention that creationism is not science — because it explains the origin of the world by reference to a cause outside the world, whereas science is by definition the search for material causes. Insofar as this is the case, one may argue with scarcely less justice that creationism too cannot be falsified. However, in my view there is little truth in either charge. Because the theories of evolution and special creation are mutually exclusive and attempt to account for evidence which either does or does not accord with them, particular versions of the theories **can** be falsified; they cannot both be true, and while there will always be uncertainties, we should at least be able to draw conclusions about which is the more probable theory.

The question of whether a theory can be falsified is particularly relevant to Flood models. According to Karl Popper (as summarised by Malcolm), scientific progress comes about ideally through five stages:

(1) Problem (usually a rebuff to an existing theory or expectation).
(2) Proposed solution, that is, a new theory.
(3) Deduction of testable propositions from the new theory
(4) Tests, that is, attempted refutations through, among other things, observation and experiment.
(5) Preference established between competing theories.

So far as concerns us, the problem is various weaknesses in the theory that the Earth's geological record was formed over billions of years and that the fossils within them are evidence of a simple-to-complex process of evolution. The proposed solution is the Price-Clark theory resurrected by John Whitcomb and Henry Morris (what I have called the 'post-Cretaceous' Flood model).

If it is agreed that the above steps summarise the way in which science should evaluate a new theory, it becomes important to ask whether creationists have followed these steps. Have we as a body sought to test and refute the proposed alternative to the evolutionist interpretation of Earth history (with the emotional freedom of knowing that even if the proposed solution is wrong, so is the existing theory)? In the view of those authors who concluded that the Flood was over by the Mesozoic, there has been no such attempt. Among the reasons adduced for considering the post-Cretaceous model unsatisfactory, probably the most fundamental were these:

(1) The model proposes that the Earth was inundated by marine waters, so that fossils of terrestrial life — representing the animals of the pre-Flood world — would appear before fossils of marine life. In the fossil record itself the reverse is true.
(2) The post-Cretaceous model interprets the order of first appearance of the major animal groups in the geological column (that is, marine invertebrates, vertebrates, amphibians, terrestrial reptiles, dinosaurs, mammals, birds, and finally man) as reflecting the inundation of progressively more elevated habitats, so that lower Palaeozoic strata represented pre-Flood seafloors, upper Palaeozoic strata the interface between sea and land, Mesozoic strata pre-Flood lowlands, and the Cainozoic, where mammals were most common, pre-Flood highlands. This is geological nonsense. If one considers the geological record in any given place, it is evident that Cainozoic strata lie above Mesozoic strata, and those in turn lie above Palaeozoic strata. The succession is stratigraphic, not geographic.
(3) In the Scriptural account, the *mabbul* ('Cataclysm') overwhelmed the Earth in the first 40 days, whereupon the waters continued to prevail over the Earth for a further period, and on the 150th day, the Ark ran aground. By that point the waters were generally receding, but did not completely disappear from the Ararat region until more than 300 days after the beginning of the *mabbul.* In that part of the geological record identified with the Flood — that is, the Upper Proterozoic, the Palaeozoic, the Mesozoic and the Lower Cainozoic — there ought to be some correspondence with this sequence of events. But there is none. On the contrary, there is abundant evidence in Mesozoic and Cainozoic strata of terrestrial animals living on the surfaces of those strata.
(4) Throughout the Phanerozoic there is abundant evidence of *in-situ* growths of marine organisms. The largest-scale example is chalk, being composed largely of coccoliths that were shed by plankton in the water column and sank to the seafloor. There are many other

> examples, including hardgrounds actually within the chalk. It is not possible to account for so many successive generations — discernible sometimes as [micro]evolutionary lineages — on the assumption that they occurred within the space of one year.

It seemed to us that these points were fundamental enough to amount to a refutation of the post-Cretaceous hypothesis, especially in their cumulative effect. Whether or not that is so, it is incumbent on Oard, who appears now to be the principal champion of that hypothesis, to address such points and not carry on as if they had never been made or were not significant.

Not only do Oard's arguments demand costly sacrifices in terms of ordinary reasonableness, they also demand an enormous departure from any 'straightforward interpretation' of Scripture (to use Russell Humphreys' phrase). As Oard concedes, if Whitcomb and Morris (along with all or nearly all other exegetes who have addressed the issue) are correct in understanding that the Flood waters covered the Earth at the latest by Day 40, there is not the slightest hope of accommodating the dinosaur evidence within the post-Cretaceous model. To create some semblance of plausibility, it is necessary to extend the period in which the Earth became inundated to five months. I invite readers to consider for themselves whether this constitutes an acceptable interpretation. In my view it does not; on the contrary, I find it disturbing (and revealing) that 'the Flood paradigm' is now being defended with a reading on a par with the 'gap' theory. The paradigm is constraining the interpretation of Scripture, rather than vice versa; or to put it another way, a geological model of what might have happened is determining the historical account of what did happen.

## DINOSAURS IN THE OARDIC FLOOD

Oard's hypothesis holds that many dinosaurs survived the first 150 days of the Flood, and having been swept out to sea were (somehow) swept back again, landing on newly exposed sediments where they made tracks and laid eggs.[9] Vast expanses of Flood sediments thousand of metres thick were exposed on every continent, for dinosaurs left tracks and eggs on every continent. But by Day 150, as the sediments returned to the waves, all dinosaurs had perished.

As a starting point, therefore, it is essential to establish that dinosaurs were capable of surviving the cataclysmic waters which swept them out to sea and back. Horses, dogs, bears, elephants, even human beings can swim in placid waters. Here, by contrast, we are not talking about placid waters, but a cataclysm such as the world has never known, before or since. If the available evidence cannot sustain the idea that the dinosaurs known to be living in the Mesozoic were virtually aquatic, the hypothesis is dead in the water.

Oard devotes surprisingly little space to this premise. In his **Creation Research Society Quarterly** article he cites a paper by Coombs as his main authority, but does not elaborate. In the **CEN Technical Journal** article he inserts a parenthetic reference to two papers which document no more than the occurrence of shallow-water tracks, while conceding that stegosaurs, ankylosaurs and ceratopsians were probably poor rather than proficient swimmers.

Coombs' paper presents evidence that some theropod dinosaurs might have been able to swim.[10] Certain tracks in the Lower Jurassic rocks at Rocky Hill, Connecticut, show signs of having been made by a floating animal pushing itself along the bottom with the tips of its toes. The track sequences begin and end abruptly, suggesting that the animals were sometimes swimming or at least floating, with their feet off the bottom. There is no evidence, however, that a great cataclysm was raging at this time. The dark grey mudstones were deposited along the fluctuating margins of a lake. The unusual tiptoe tracks appear to have been made beneath relatively still water, and normal, full-foot tracks were preserved in the cohesive muds when, during dry spells, these became exposed to the air.

The other papers cited also document complete tracks in shallow water. Again, this is no evidence for a global cataclysm, or for swimming abilities. The paper by Phillip Currie records tracks in a number of areas, including the St Mary River Formation (which in Montana overlies the Two Medicine Formation).[11] Many of the beds are rooted.[12] In one 177-metre section Currie logged a succession of more than 100 track-bearing strata. The palaeo-environment is believed to have been seasonally flooded savannah along the margin of the Western Interior Seaway (see below).

Although not cited, John Horner infers from the mobility of their skull bones that some kinds of hadrosaur fed on vegetation in the water and were in that sense semi-aquatic.[13] One genus, *Gryptosaurus*, had webbed feet and a deep tail that would have worked well for sculling. On the other hand, most hadrosaurs appear to have been essentially terrestrial.[14]

Most other dinosaurs also appear to have been essentially terrestrial, and it is doubtful whether they had the anatomy to survive even the stormy seas which pound our coasts today. As Robert Carroll puts it,

> *'. . . the rigidity of the axial skeleton associated with upright posture and parasagittal limb movements may preclude the patterns of aquatic locomotion common to the lepidosaurs, primitive archosaurs, and crocodiles.'*[15]

Without an ability to store large quantities of air for a long time under water, dinosaurs would simply have drowned, just as all other terrestrial animals would. Fatalities in the fossil record show that they were incapable of surviving even local floods, and, as Oard acknowledges, it is hard to imagine the heavily armoured stegosaurs, ankylosaurs and ceratopsians being able to swim at all.

Apart from these difficulties, there is the further problem that the dinosaur record is confined almost entirely to the Mesozoic. Thus we must suppose that the animals survived *'rapid erosion and sedimentation at the beginning of the Flood'* but perished in the same numbers during its middle stage, when conditions were less hostile and sedimentation rates much lower. Somehow, almost no bodies came to be fossilised in Palaeozoic deposits, but hundreds of thousands were fossilised in the Triassic, Jurassic and Cretaceous — often, as Oard emphasises, in monospecific bone-beds, as if they had managed to keep as one herd all the while that they were tossing in the sea.

Similar puzzles present themselves in relation to the track record. As Garton[4] pointed out, one testable proposition which may be deduced from the post-Cretaceous model is that, if dinosaur tracks are to occur at all in the fossil record, they will occur only at the pre-Flood/Flood boundary (below the Cambrian) and in strata after the Flood/post-Flood boundary (above the Cretaceous). The same should be true of birds and other terrestrial animals, since they also perished in the Flood and had to be repopulated from the Ark. In reality, vertebrate tracks do not appear before the Devonian and dinosaur tracks not before the Middle Triassic, about the same time as the body

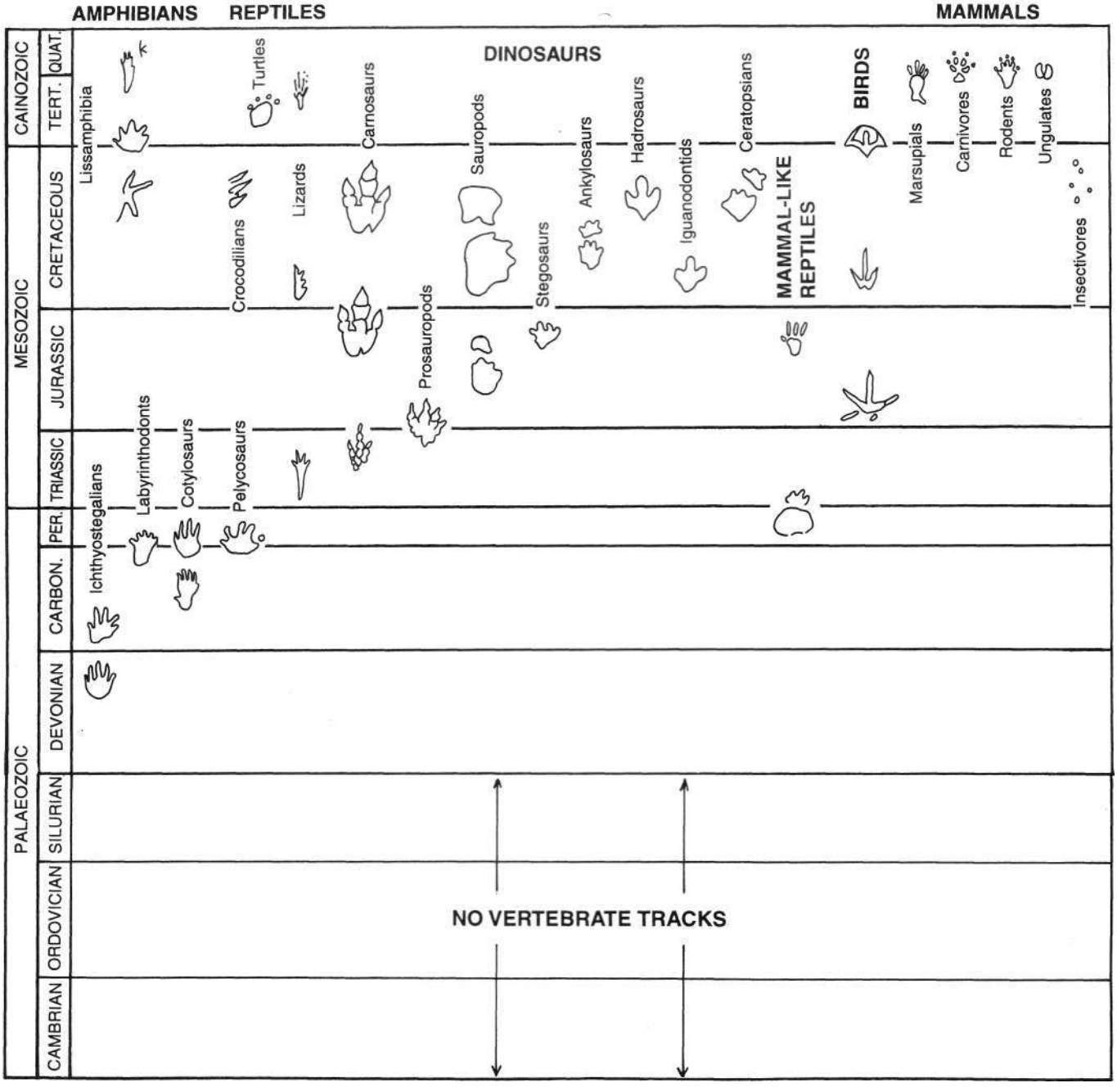



***Figure 2.*** *Global summary of the fossil track record left by vertebrates (after Garton,[4] Figure 2).*

fossils (see Figure 2). How is this? Whereas the strata containing dinosaur tracks belong to the upper half of the geological record attributed to the Flood, according to Scripture all terrestrial animals were destroyed by the *mabbul* early in the Flood year, and after that there were no terrestrial animals living upon the land until the Flood ended.

In Oard's model all strata from Cambrian to Cretaceous represent the early stages of the Flood, before the Earth was fully under water, and are predicted to show 'rapid erosion and sedimentation'. This means that the only strata remaining for the period when the waters prevailed over the Earth and subsequently ebbed away — 200 days according to Oard's reckoning, otherwise nearer 300 days — are the Tertiary strata. But terrestrial animal tracks (those of marsupials, carnivores, rodents, ungulates, lizards) are also found in the Tertiary. Consequently, in Oard's scheme, we have animals trying to escape the deluge right to the time when Noah steps out of the Ark.

The reader might suppose that in the face of this absurdity there must be overwhelming reasons for attributing the post-Palaeozoic strata to the Flood, next to which all seeming absurdities pale into insignificance. If so, the reader is entitled to know what they are, and how, theologically, we are to cope with a record that appears to be so at odds with itself

Meanwhile, before any theorist asserts that the Cambrian to Cretaceous represents a period of rising Flood waters and is 'likely' to show rapid erosion and sedimentation, he has a duty to establish that such assertions are in line with the sedimentary record itself— to test the predictions against the data. As I pointed out in my paper, the assertions are contrary to the evidence. Few parts of the United States (where many of the tracks are) had escaped marine inundation even by the end of the Ordovician, much further down in the stratigraphic record, and since dinosaur tracks occur only in Mesozoic strata, it is plain that wherever they occur, they occur on land which had previously been inundated. Sedimentation ceased long enough for animals to appear from somewhere else, make tracks, lay eggs and hatch their young.

In what sense, then, is it a scientific statement to say that this was a time of 'rising Flood waters'? Oard asserts:

> *'Tracklayers on more than one bedding plane represent brief exposures during a generally continuous sedimentation event.'*

What evidence are we given to support this contention and invalidate the studies of Ronov,[16] Hallam, Algeo and Seslavinsky, Haq and others (see Roy Holt's paper for references) which show that sea-levels during the Palaeozoic and Mesozoic were not continually rising? Absolutely none, because there is none. Oard goes on:

> *'The oscillations in local sea-level would have been caused by local or distant tectonic events, tides, the dynamics of the Flood currents, tsunamis, etc'*

But by *'the oscillations in local sea-level'* one might suppose that the author had in mind precisely the sort of data which shows that sea-levels had reached their maximum already by the Lower Palaeozoic, and that at no time during the Phanerozoic was more than 50-60 per cent of the Earth covered by water. Surely it is a minimum requirement of any Flood model that the entire Earth could have been under water at some point?

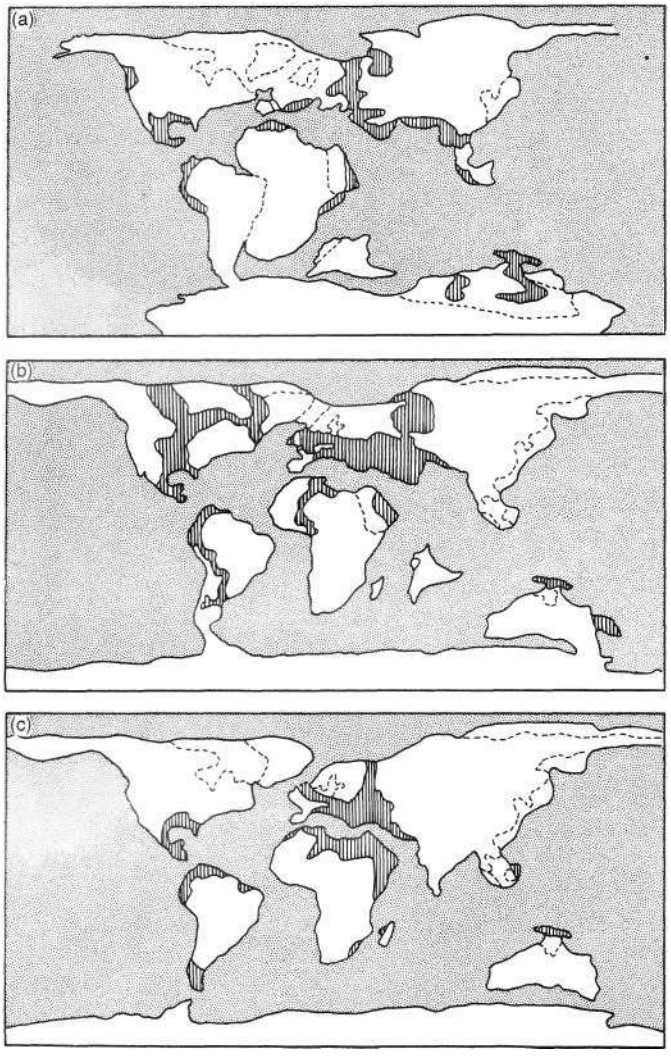



***Figure 3.*** *World geography in (a) the Early Cretaceous, (b) the Late Cretaceous, and (c) the Late Eocene. The stippling indicates ocean; hatching indicates epicontinental seas; dotted lines indicate modern coastlines.*

Being inconvenient, if it is understood at all, the evidence of palaeogeography and sequence stratigraphy is either passed over or trodden over. Oard seems to know nothing about distinguishing sea from land in the sedimentary record. As was pointed out,[4] what he imagines to have been sea during the Cretaceous was actually land, with the Rocky Mountains rising to the west and the Palaeozoic Appalachians established on the east; his imagined land, a strip running down the western interior of North America, was a shallow sea (see Figure 3) — a

sea that dried up just after the Cretaceous, as global sea-levels fell. Where there was water, sediments formed; where there was no water, there was no sedimentation.

With the same disregard for elementary distinctions (and my own discussion of the fossils), he likewise denies that the dinosaurs at Ukhaa Tolgod, in the Gobi Desert, were overwhelmed by sandstorms, stating, *It is doubtful a sandstorm could freeze frame a brooding dinosaur'.* It is *'more likely'*, we are told, that *'a giant watery sandwave'* freeze-framed the animal. A simple statement like this is seemingly enough to convert an aeolian deposit into an aqueous one! How could a 'watery sandwave' travelling horizontally not dislodge the animal? All Oard is doing in this sort of discussion is filtering the evidence through the lens of his own ideology, pronouncing the thing 'likely' if it fits with his idea of the Flood and 'doubtful' if it does not.

Even today the Gobi Desert is well-known for its sudden and violent sandstorms. Michael Novacek describes his own experience of one:

> *'I looked up and saw the northern horizon frothing with a tremendous dust cloud. One of those legendary Gobi sandstorms, our first, was hurtling in our direction. It was, in its terrible power, magnificent. . . . The cloud itself had an orange glow, . . . casting a great shadow, a curtain, of brilliant green.'*[11]

As some readers will appreciate from having seen the film **The English Patient,** such storms can shift vast amounts of sand in just a few hours. Because of the evidence at Ukhaa Tolgod and other places, some Mesozoic sandstorms are thought to have been more violent still. This would, of course, be in keeping with a model which places the Mesozoic some centuries after the Flood.

## JUVENILE DINOSAURS

One prediction arising from Card's tranquil Flood theory (tranquil in practice, although thousands of metres of sediment are assumed to have been laid down in weeks) is that babies and young juvenile dinosaurs, being unable to survive the *'initial onslaught of the Flood'*, would be rare in the fossil record.

> *'Baby dinosaurs could not keep up with the fleeing herd and perished quickly. Their bones were not fossilised because they were too fragile'.*

Without the benefit of knowing what is in the fossil record, one would predict on this footing no babies, no young juveniles (surely) and few half-grown juveniles (none in the case of small dinosaurs). Also, if this line of reasoning is to have any usefulness, one must be willing to accept that all body fossils derive from animals that were once living at approximately the horizon where they are fossilised. So far as I can see, Oard does accept this. Accordingly, an abundance of babies and/or young juveniles in the fossil record, or credible explanations for their rarity, would refute or at least nullify the prediction, and vice versa.

In reality, Oard knows that babies and young juveniles do occur in the Mesozoic. Consequently the prediction has to be modified, to the effect that shortly before the Flood a good many female dinosaurs were impregnated and, surviving the initial onslaught of the Flood, were just on the point of giving birth when they happened upon land. On this basis it can be pretended that *'the finding of fossilised dinosaur eggs, sometimes in nests . . . in many parts of the world, is not unexpected'.*

Oard reserves his surprise for the rarity of baby dinosaurs outside nesting areas, as if this were an odd situation and favoured his explanations. But it does not. The nesting areas were simply where the babies were safest and naturally belonged. Nor is it easy to understand why he should make a point about their rarity when he also suggests that their bones were too fragile to be fossilised. The abundance of such bones in the nesting areas shows that they were not too fragile, any more than were the bones of other small animals, such as lizards, and indeed small dinosaurs.

In any case, Oard greatly exaggerates the rarity of dinosaur babies, quoting the following passage from Horner and Gorman:

> *'As succeeding years yielded no other major finds of baby dinosaurs, the question grew in importance. If you think about it,. . . more dinosaurs should have died young than died old; that's what happens with most animals. And the high infant mortality should have produced a lot of fossils over the course of 140 million years — a lot of fossils that had never been found.'*[13]

The point the authors were making, however, was that in recent years (since 1979) the problem described had much diminished, because great numbers of dinosaur babies **had** now been found. The quotation is therefore misleading. As Lockley puts it in one of the articles Oard consulted:

> *'Baby dinosaurs were once considered rare (Richmond, 1965), a perception we no longer uphold (Horner & Gorman, 1988; Chure, 1992).'*[18]

Just how badly Oard misrepresents the position can be gauged by reading the book by Horner and Gorman oneself (it is written at a popular level). The last chapter is entitled 'Babies Everywhere'. If that is journalistically to overstate the position, Horner also offers a palaeogeographic explanation for there not being more babies fossilised: they were reared in the relative safety of the upper coastal plains, where conditions for preservation were less favourable, whereas adults tended to inhabit the plains nearer the sea.[13] Nadon improves on this explanation by interpreting the upper plains as seasonal wetlands, which hadrosaurs could negotiate better than their predators, and suggests that the mounds were constructed to raise the nests above water; adults and young migrated to the lower coastal plains in the dry season.[12]

Similarly, Oard quotes Coombs in support of the assertion that there are also 'very few' tracks of young

juveniles, though Coombs himself states that they are 'quite' rather than 'very' rare. He then disposes of the suggestion that taphonomic bias might have something to do with it by noting that in Amboseli National Park 50 per cent of (fresh) elephant tracks were made by juveniles. This, of course, tells us nothing about taphonomic bias. What needs to be considered is that the tracks of baby animals would have been much shallower and therefore more susceptible to erosion (whether subaerially or by the next sedimentary event). Since dinosaur tracks are often preserved only in layers underlying the surface that had contact with the animals, taphonomic bias is an important factor.

Oard continues:

*'Although elephants probably grow much slower than dinosaurs grew, and it can be difficult recognising a small track, dinosaurs are expected to have produced many more babies than elephants. So the reasons for the rarity of tracks of both babies and juveniles is* [sic] *not in accord with observations from the modern world.'*

But the rate at which dinosaurs grew to maturity is highly relevant to the problem. As Oard acknowledges, juveniles are thought to have grown at a spectacular rate. Sauropods, for example, may have reached maturity in only six years,[19] and may have attained foot lengths already half those of adults by about two years.[18] Hadrosaurs may have reached a body length of 3 m after one year.[20] Thus, with potential lifespans possibly exceeding 100 years, the great majority of tracks would be full-sized.

In the Jindong Formation (Lower Cretaceous) of southern Korea there are 160 track horizons, one after the other. Apparently Oard does not consider this sequence problematic enough to merit discussion. Nonetheless, according to his model, animals should be fleeing the waters of the Flood in terror — not returning to the same place 160 times. The site is also notable for preserving *'by far the smallest sauropod tracks recorded anywhere in the world'*, with the majority (about 70 per cent) representing, according to one model of juvenile growth, animals less than a year old.[18] Hence, contrary to the impression given by Oard, Lockley mentions the elephant tracks in the Amboseli National Park as a modern analogue for their age-size distribution!

It also needs to be pointed out that Coombs' observation that tracks of juveniles are quite rare applies only to babies and very young juveniles. Tracks of older juveniles are plentiful.[18]

## TRACK ORIENTATIONS

Oard claims that practically all trackways are straight. Whether this is true in any significant sense is to be doubted. Although it may hold good for sauropods, *'most ichnocoenoses* [track assemblages] *have no coordinate directional orientation'*.[21] Even with sauropods there are important exceptions. At the Korean site just mentioned, none of the small trackways and almost none of the larger sauropod ones run in parallel, but suggest milling around and simple changes of direction.[18]

Moreover, a straight trackway, whether made by an ancient dinosaur or a human being on a beach today, does **not** mean that the animal is *'desperately trying to escape some catastrophe'*. As Garton pointed out:

> *'The rarity, worldwide, of any track-makers showing evidence for running* [two references cited] *is a strong argument against the Whitcomb and Morris model'*

In the face of such an elementary observation, it seems odd logic to conclude that the occurrence of straight trackways on every continent is evidence of a global cataclysm. Indeed, far from showing signs of any panic, many of the trackways run parallel to the ancient shores![22] The animals were not fleeing anything from that direction.

## EGG-LAYING IN THE PYRENEES

The problems posed by dinosaur fossils are not limited to tracks and nest sites. Another point to consider is the fact that they come after the completion of two Phanerozoic rock cycles (the Caledonian and the Hercynian) and that the later fossils coincide with the early stages of a third (the Alpine). By 'rock cycle' I mean a sequence of sedimentation followed by orogenic uplift, erosion of the land uplifted, and consequent renewal of sediment supply. After the Caledonian and Hercynian cycles, the Late Cretaceous saw the commencement of a third major cycle, manifested, in North America, in the formation of the Rockies and, in Europe, in the formation of the Alps and the Pyrenees.

In 1995 a dinosaur site at Basturs, northern Spain, attracted media attention because of the large number of eggs attributed to it. Oard describes it in this manner:

> *'A new discovery from Spain suggests a whopping 300,000 eggs packed into a rock volume of about 12,000 cubic metres. These rocks are probably within marine sandstone, so according to the uniformitarian paradigm the nests are automatically said to have been laid at the seashore. Despite all these eggs, embryos within the eggs are rare'.*

The allegation that the sandstone was merely assumed to be an ancient seashore is gratuitous. Does Oard know that the reporters disregarded available evidence on the point? What would he propose as the correct environmental setting?

As it happens, in 1996 I visited and studied this area with the assistance of a geologist who had been researching the sedimentology of the region for many years. The '300,000' eggs (an extrapolated and possibly excessive figure) consist mostly of shell fragments, typically no longer than 1.5 cm, scattered in a matrix of sandstone 'red beds' approximately 2 m thick. There have survived a few whole eggs, but these too are somewhat fragmentary. While it is debatable whether the fragments are all those of *in-situ* eggs, it does seem that at least some of the whole eggs

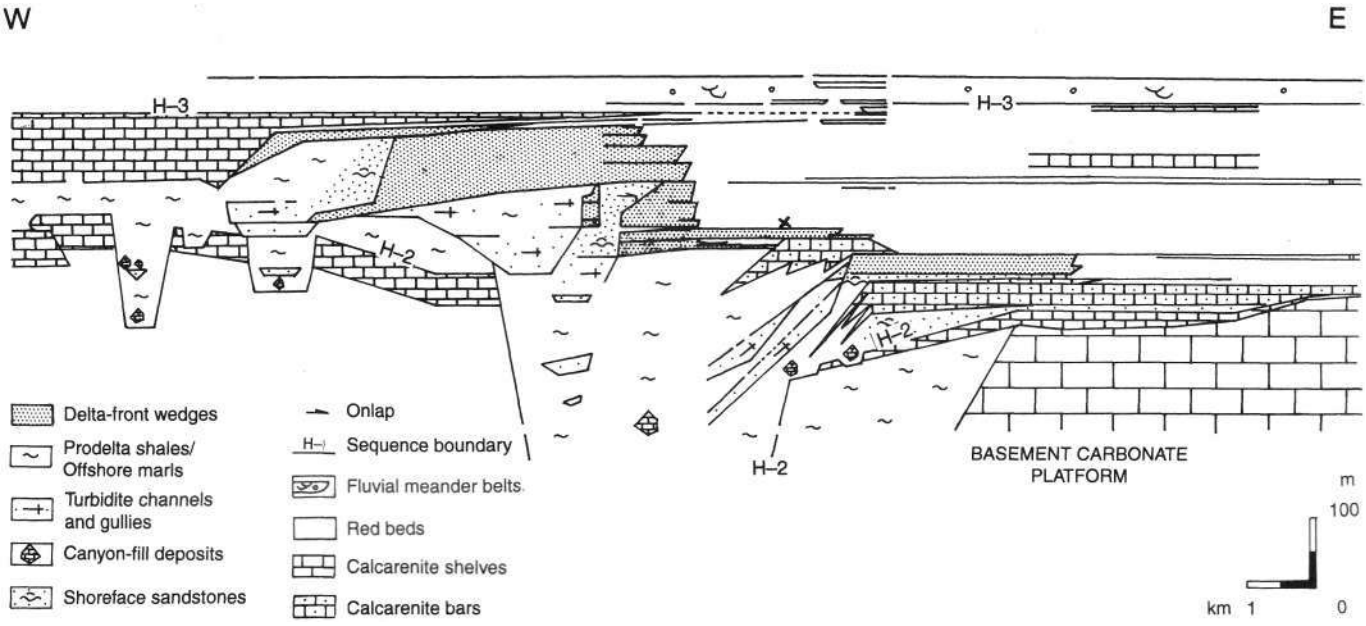



***Figure** 4. The Aren-2 sequence (Lower Maastrichtian) between horizons H-2 and H-3 of Figure 4. The Basturs eggs site is indicated with a cross. Foothills of the southern Pyrenees, near Tremp.*

are close to their original positions, since they are disposed on the surface in clusters.

The sandstone is 'marine' only in the sense that it includes carbonate grains derived mostly from the skeletons of shallow-marine organisms. The sand element derives from terrestrial rocks, being eroded from highlands which were forming as sea-floor generation in the opening North Atlantic squeezed Spain against France, in an anti-clockwise movement, while the plate of Africa pushed from the south. Wedges of sand prograded westward into the elongated basin between the converging landmasses. The eggs occur on top of the first such wedge (see Figure 4). Laterally, the units can be traced into tidal sandstones (characterised by sigmoidal and herringbone cross-bedding) and then shales and marls, in a sequence typical of a progression from onshore to offshore. Vertically, the sequence describes the infilling of the basin, with the shoreline retreating westwards. Thus, taking all these features into account, it seems reasonable to interpret the sandstone in which the eggshells occur as laid down in shallow water close to the shore, possibly in an estuarine setting, and as acquiring its red colour by oxidation as it became exposed to the air.

Although the geology of the area is complex, a closer consideration of it may serve to emphasise how ill the evidence fits into the post-Cretaceous model. The Pyrenees are a product of continental plate collision, when great sections of Mesozoic rock became detached from their base and slid over other rocks, causing the crust to shorten and thicken. As illustrated in Figure 5, the first thrust sheet was the Boixols Thrust (some 5 km thick), pushing towards the west and creating in front of it a foredeep which filled with turbidites.[23] The turbidites were supplied via alluvial fans and river systems from uplifted land above and behind the thrust sheet. In time the Boixols Thrust ground to a halt and was followed by the Riu Thrust, then the Turbon Thrust, and finally the Campanue Thrust. Ardevol *et al.* describe each of these depositional sequences (five are illustrated) in terms of sequence stratigraphy, with surfaces H-l, H-2, etc. representing the 'highstand systems tract' (the point of highest relative sea-level) with which each one terminates.

The Aren-1 sequence, 1500 m thick, begins with marine prodelta shales, followed by tidal sandstones, in a shallowing-upwards sequence (with the shoreline retreating). The sandstones are followed by transgressive marls, grading into a 50-metre thick layer of calcarenites (coarse limestones) at H-2. The calcarenites contain echinoids and rudist patch-reefs. The thickness of the strata, the style of sedimentation and the growth of the rudists (a kind of large bivalve) all denote a considerable passage of time. In geochronological terms they occupy a small part of the Cretaceous, from mid Campanian to earliest Maastrichtian — in radiometric terms, about 4.5 million years. Based on foraminifera, the chronostratigraphy is fairly secure and independent of anything which might be disparaged as 'uniformitarian'.

The Aren-2 sequence, in which the dinosaur eggs occur, begins with the weathered karst surface of H-2 and comprises the lowstand sequence of five prograding delta-front wedges mentioned above. Overlying these is a layer of calcarenites up to 75 m thick at H-3 (see Figure 4). The whole sequence, filling up the accommodation space in front of the Boixols Thrust that remained after Aren-1, is about 250 m thick and is of Early Maastrichtian age — in radiometric terms spanning about 2 million years. In Oard's Flood model it would span about 11 hours ($^{2}/_{700}$ x 150 days). Whether a herd of pregnant dinosaurs *'desperately trying*

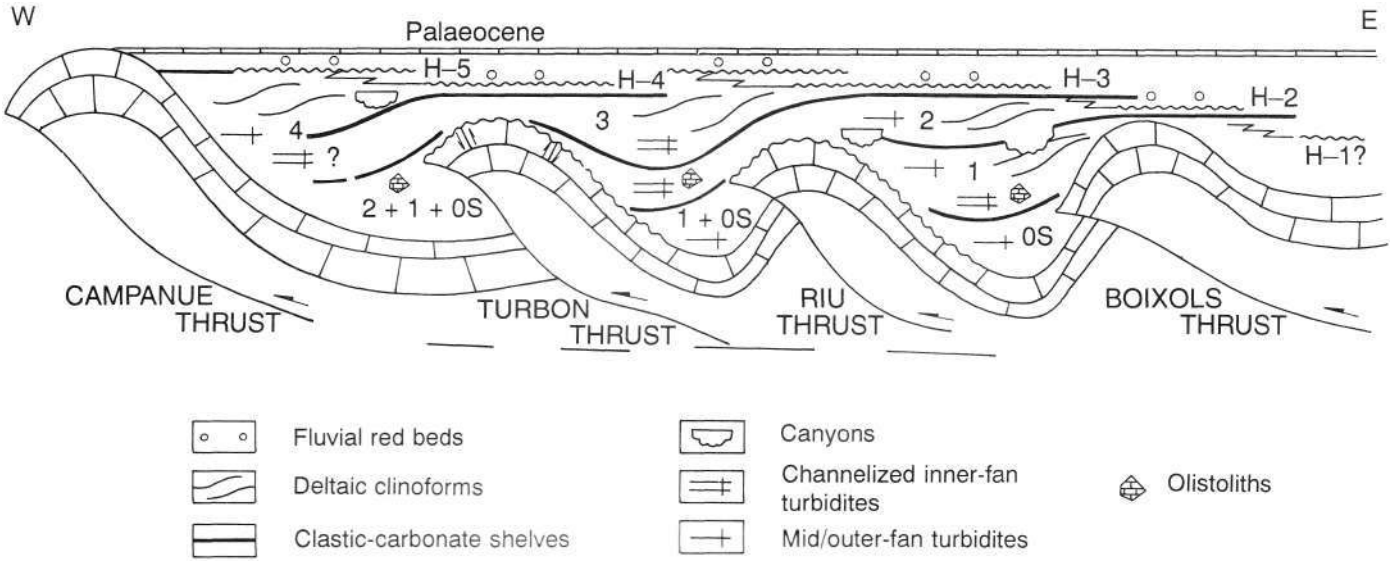



***Figure 5.*** *Sequential movement of thrust splays, from Late Santonian to Late Palaeocene, in the southern Pyrenees. During phases of uplift and thrusting, lowstand system tracts accumulated on the footwall syncline and onlapped onto the back limb of the next structure. When uplift ceased, the remaining accommodation space was filled up with finer-grained transgressive system tracts, followed by highstand shelves. These limestones (thick lines) developed as the movement of each thrust ended, at a time of comparative tectonic quiescence. Thus H-2 fossilises the cessation of the Riu Thrust, H-3 fossilises the cessation of the Turbon Thrust, and so on. Numbers denote Aren depositional sequences; 'OS'= older sequences. (After Ardevol* et al.[23]*)*

*to escape the encroaching Flood waters'* could have laid up to 300,000 eggs in the space of 11 hours or less may, I think, be doubted. Sufficient time must also be allowed for the karst surface at H-2, the subsequent development of several submarine canyons cutting down from that level (the largest, 5 km wide and 300 m deep), the *in-situ* root-beds above the egg site (see Figure 6), and the carbonates at H-3. In Oard's model their development must also be included in the 11 hours.

The end of Aren-2 marks the end of the Aren Sandstone Formation mentioned in the report, but not the end of the dinosaurs, which in this locality may have survived right up to the K-T boundary. Aren-3 and 4, together comprising up to 400 m of mudstones intercalated with fluvial channels and lacustrine limestones, span the Late Maastrichtian immediately below the boundary. Here too, signs of vegetation are apparent, notably lenses of amorphous coal and a spectacular succession of pyritised roots (see Figure 7). A trampled surface of sauropod tracks, dubbed by the tourist authority 'Parco Cretaci' (Cretaceous Park), was still being uncovered while I was there; the exposed part covered an area as big as a football pitch, and if it included straight trackways, none could be made out (see Figure 8).

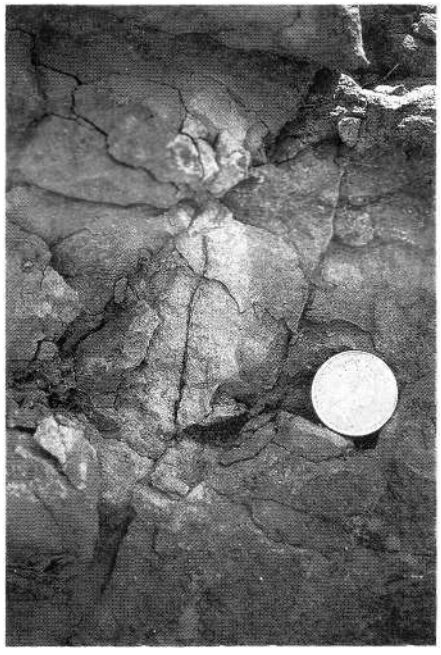


***Figure 6.*** *Detail from root-bed near the Basturs egg site. Collapsed carbonaceous root, surrounded by organic discolouration.*

After Aren-4, in the Late Palaeocene, the whole region was flooded in the course of another transgression (see Figure 5), after which thrust movements, and with them the whole process by which the Pyrenees rose thousands of metres, continued until the Early Miocene. Again, the formation of mountain ranges at this time does not accord with Oard's model, for the latter presumes that the Early Tertiary was a period of global inundation, when 'all the mountains under the whole heaven were covered' — even though Genesis tells us that the Ark ran aground on Day 150. How can one hope to make sense of such details? Substantial mountain ranges had already formed in two previous rock cycles, the Caledonian (Lower Palaeozoic) and the Hercynian (Upper Palaeozoic). Orogenies in the Precambrian are also known.

## DINOSAUR GRAVEYARDS

Mass burials, whether of dinosaurs, fishes, or other sorts of animal, have long held a prominent place in diluvialist apologetics. In relation to the dinosaurs Oard says:

*'The most obvious aspect of dinosaur fossils is that most dinosaurs must have been buried rapidly in water*

— but then, for good measure, adds:

*'Alternately, the dinosaurs could also*

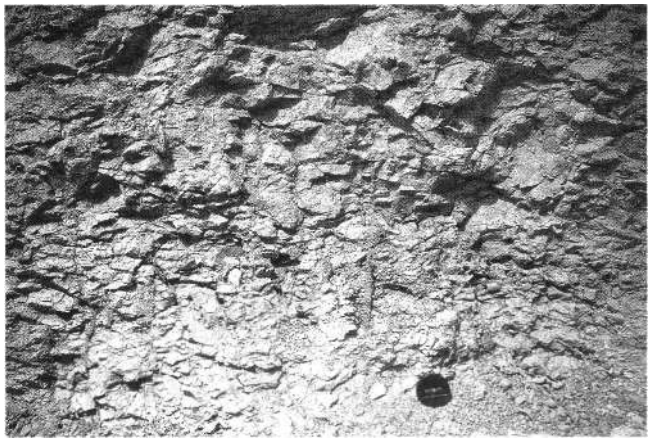


**Figure 7.** Root-bed from the Tremp Formation (upper Maastrichtian).

*have been entombed in giant mass flows* [of mud].'

He says that some of the enclosing sediments are *'obvious marine sediments* ', whereas terrestrial sediments are only 'assumed' to be terrestrial. Thus, discussing a terrestrial deposit such as that at Ukhaa Tolgod, he feels free to assume that it was in fact marine. A case of heads I win, tails you lose! In reality, of course, geologists do not 'assume' that a sediment is terrestrial, but infer it from the evidence of sediment source (for example, highlands), sediment type. sedimentation patterns both on the large and the small scale, and fossils, both macro and micro, plant and animal — in other words, all the evidence that could bear on the question. Such inferences need have little to do with any pre-commitment to a 'uniformitarian' (that is, old-Earth) philosophy.

Oard illustrates the contention that dinosaur graveyards represent mass deaths during a global flood with a graveyard discovered in 1981 by Horner and others in the Two Medicine Formation — perhaps the biggest of all examples. Here an estimated 10,000 hadrosaurs were entombed, over an area measuring 2 km east-west by 0.5 km north-south. The bones were disassociated, sometimes in a vertical position, and oriented east-west. After giving us this information, Oard quotes Horner and Gorman to show that the creatures died in some cataclysm. I reproduce the quotation below, together with the omitted preceding sentence:

> *'Furthermore, the damage was not really of the sort that could happen to living animals. How could any mud slide, no matter how catastrophic, have the force to take a two- or three-ton animal that had just died and smash it around so much that its femur — still embedded in the flesh of its thigh — split lengthwise*[9] *'*

Oard omits the first sentence because it says the exact opposite of what he wishes us to think. According to Horner, the animals must have been dead when their bones were subjected to this damage, and, if so, a mud slide **might** account for their condition, whereas a flood of water could not. Thus, again, the impression imparted is misleading.

Let me add, then, a few more details.[24] Consistently half a metre above the bones was a layer of volcanic ash. Sedimentological evidence showed that, although buried in mudstone, the remains of the animals had not come to rest in a river bed. The deposit contained no babies, but included a number of juveniles less than half grown. All the bones were damaged in some way: some fragmentary, some broken in half, some apparently sheared. Smaller bones, such as hands and toes, small ribs and neural arches of vertebrae, were rare in most of the deposit but were the most common parts at the easternmost end. On reflection, Horner rejected the idea that a catastrophic mud slide could explain the death of the hadrosaurs, for not even the most powerful mudflow could break bones lengthwise when they were still padded in flesh and bound together by ligaments. An important clue was the nature of the fractures: they were clean breaks, not jagged and splintery as when fresh bones are broken. The bones appeared to have been broken **after** they had fossilised.

Another important clue was the intense volcanism in the area — as Horner notes, volcanoes the size of Mt St Helens were 'a dime a dozen' in the Late Cretaceous, and to the west and south of the site there were much bigger ones. According to the suggestion of a co-worker, Jeff Hooker, it seemed possible that a large hadrosaur herd had been suddenly killed by the gases, smoke and ash of a volcanic eruption. Over time the flesh rotted away, leaving the bones among ash and dirt, where they were subject to the action of acidic groundwater. The groundwater might have dissolved parts of the bones, leaving some looking as if they had been sheared lengthwise. It could also have begun to fossilise them as they took in minerals from the water. Some sort of mudflow then swept them along to their present position after fossilisation. As indicated by the dimensions of the whole area, by the orientation of the bones, and the sorting of them according to size, the flow was from west to east, that is, from the direction of the mountains.

This was, as Horner says, no ordinary spring flood, but a catastrophic inundation. Perhaps the breaching of a

**Figure 8.** Sauropod tracks from 'Parco Cretaci' near Isona, foothills of the southern Pyrenees.

lake was responsible, turning the field of death into a huge slurry of bones, mud and volcanic ash. As the floodwaters abated, the bones settled first, being heaviest, then the mud, and finally a thin layer of ash. The layer of ash marks the end of the inundation.

The Montanan example is not untypical. According to Coombs, nearly all the material in monospecific bone-beds is disarticulated and broken, suggesting prolonged exposure to decay or dismemberment by scavengers.[21]

## THE END-CRETACEOUS EXTINCTIONS

Oard begins his exposition of reasons for believing the adult dinosaurs in the fossil record to have been pre-Flood animals in this way:

> *For most creationists, the extinction of the dinosaurs, as well as other extinctions, is not a mystery. In fact, the extinction of the dinosaurs and many other creatures has an easy answer — they simply died in the Genesis Flood (except those dinosaurs likely taken on the Ark, which probably died* [out?] *soon after the Flood):*

That all dinosaurs other than those on the Ark perished during the Flood is not, of course, disputed, for we know this axiomatically from Genesis. The thing to be explained is their sudden exit from the fossil record at the end of the Cretaceous. An easy answer to that will not be found in Genesis. Oard speaks of the dinosaurs' destruction in the Flood and their disappearance from the fossil record as if they were, for creationists, necessarily the same thing. Accordingly, he supposed that their extinction after the Flood is not reflected in the fossil record. The alternative. that their destruction **during** the Flood is not reflected in the record whereas their extinction after the Flood is. receives no mention.

Since the majority of terrestrial animals in the fossil record, including dinosaurs, have no living descendants, we have the bizarre situation where all those creatures, as they recruited after the Flood, perished in catastrophes unknown to geology: so far as the fossil record is concerned, the post-Flood world was more efficacious in destroying life than the Flood itself. The dinosaurs survived all that the Palaeozoic could throw at them, yet none of their descendants survived the comparatively benign conditions of the post-Flood world!

Conversely, the majority of terrestrial animals in the living world have no fossil representatives. Thus it must be conceded that **their** destruction in the Flood, at least, is not reflected in the fossil record — as postulated in the alternative scenario. Are there not hints here that we should break the link in our thinking between the Flood and fossils?

Despite creationist expectations to the contrary, there is no correlation between marine sedimentation and terrestrial extinctions. Vast areas and huge thicknesses of marine sediments covered North America before fossilising a single tetrapod. Reptiles did not begin to be fossilised until the Carboniferous, dinosaurs and mammals not until the Triassic. From the Carboniferous onwards terrestrial animals continued to be fossilised until the end of the Cainozoic, along with their nests, burrows, faeces and tracks. In the received model, no hiatus corresponding to the period between Day 40 of the Flood and the re-population of the Earth after the Flood exists.

Extinctions, in the sense of last appearances in the fossil record, also occur in all periods from the Carboniferous, and cluster in a statistically significant fashion. The greatest clusters occur in the Late Carboniferous, Late Permian, end Triassic, end Jurassic, mid Cretaceous, end Cretaceous and Late Eocene (see Figure 9).[25] The extinction of the dinosaurs as a group coincides with the last but one of these, at the end of the Mesozoic. A similar pattern characterises the marine record, reinforcing the impression that the extinctions are the effect of events, or groups of events, which occurred at those particular times. The end of the Cretaceous, for example, saw the extinction not only of dinosaurs, pterosaurs, enantiornithine birds and some families of marsupial mammals, but also ammonites, belemnites, some bivalve groups, some teleost fish families and over half of the various plankton groups.

Oard's approach to the problem of the end-Cretaceous extinctions is

(1) to isolate the dinosaurs from the other groups affected,
(2) to suggest that some dinosaurs lived on into the Tertiary, and
(3) to ignore (not in discussion, but in his model) the leading explanations offered by geologists and palaeontologists operating within what he calls 'the uniformitarian paradigm' (hardly an apt phrase in this context).

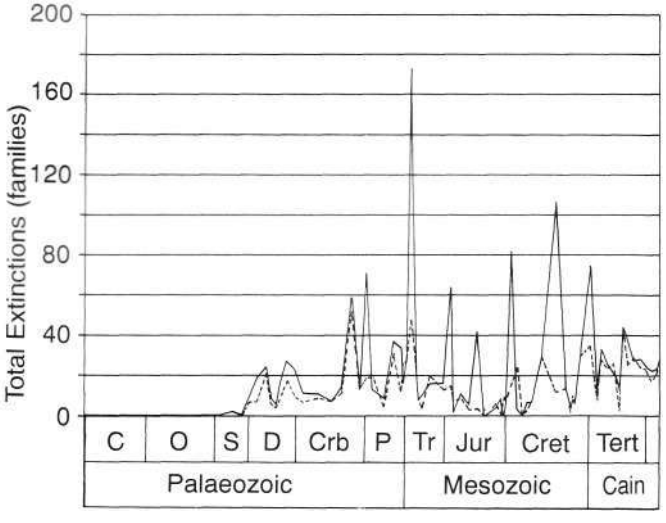



***Figure 9.*** *Extinctions of families of continental organisms in relation to the timescale of Harland* et al., *1990. Data from* ***The Fossil Record 2*** *presented in graph form by Benton (1995), with caveats. Minima (dashed lines) and maxima (solid lines) are based on assessments of uncertainty about dates of 'origin' and extinction and about the environments of some families.*

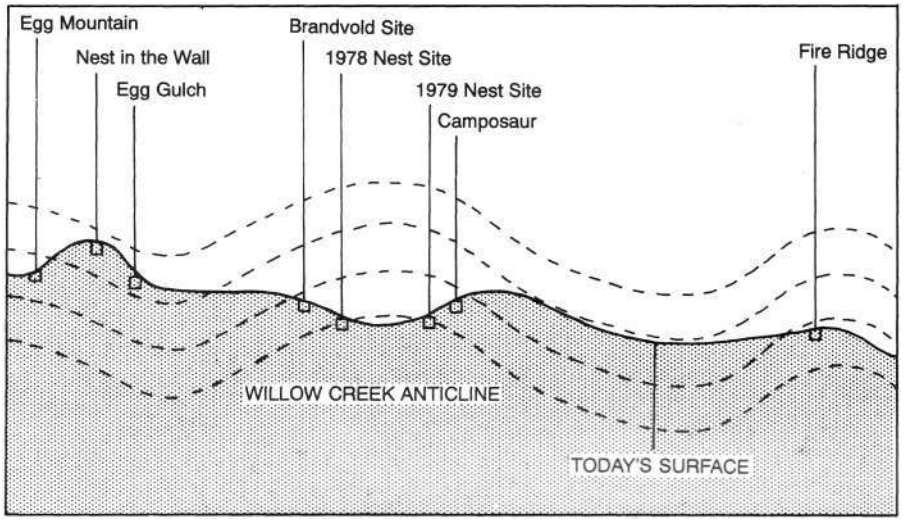



***Figure 10.*** *Schematic cross-section of the Willow Creek Anticline (see Figure 1), with dotted lines tracing its contours before erosion. The anticline formed as thrust sheets pushed from the west, during incipient formation of the Rocky Mountains. The dinosaur graveyard discussed in the text is exposed at the Brandvold and Camposaur sites; the three consecutive nest and egg horizons were from Egg Mountain. (From Horner and Gorman, 1988).*

Concerning the first point, to divorce the extinction of the dinosaurs from the other terrestrial and marine groups is to minimise the extent of the problem, one which encompasses the extinction of many other animal groups at that juncture. The terrestrial and marine records trace essentially the same pattern.[25] Concerning the second point, the suggestion that some dinosaurs lived on into the Tertiary only adds to the difficulty of identifying a part of the fossil record when no terrestrial animals were alive outside the Ark, corresponding to the period from Day 150 to Day 370 of the Flood. The fossil and biblical records nowhere match up. As for the third point, due weight needs to be given to factors such as falling sea-levels[26] (in a young-Earth context, rapidly falling), large-scale volcanism, and the effects of an asteroid impact which blew a crater 195 km in diameter.[27] These events are identifiable agents of destruction in their own right, next to which the Flood lacking geological expression as a distinguishable event at this time, is virtually an irrelevance. Just after the Cretaceous, moreover, there is abundant evidence of life recovering from the disaster.[2829]

## HOW MANY HORIZONS?

In a number of Upper Cretaceous localities, dinosaur nests and/or whole eggs are preserved on more than one horizon. In a 100-metre section at Ukhaa Tolgod, for example, five levels are preserved;[30] in a 100-metre section near Aix-en-Provence, France, five levels;[31] in the Two Medicine Formation, at least six levels,[13] including three at Egg Mountain (see Figure 10) and one (but possibly three) at the '1978 nest site'. If one were to include the levels where only fragmented shells are found (as often would be reasonable), the numbers would be much higher.

In an effort to show that *'just having eggs at different stratigraphic levels is really not a problem'*, Oard sows doubt, in a general way, about whether stratigraphic sections tens of kilometres apart have been correctly correlated. In this context he discusses the three levels at Egg Mountain, where he says there may be two, or four, rather than three, egg horizons within the 3-metre section. I have not been able to check this point, since it is not referenced; the original report refers to *'at least'* three horizons and therefore appears to have taken a conservative view.

The one other point affecting the chronological significance of the site is the contention that the eggs may not have hatched, but have been scavenged. If so, and if the eggs had been laid only a short while before being scavenged, the time represented by the sequence might be much reduced. Oard notes:

> *'Skeletons of 20 to 25 young dinosaurs are scattered among the eggs. Could they have scavenged the eggs?'*

If they did, it is odd that they were more interested in scavenging than in the Flood which, we are invited to believe, immediately overtook them, in the very act of scavenging. But in fact, if one reads the report from which Oard draws his information,[32] one finds that the young dinosaurs were scattered **outside** the nests, and were almost certainly the hatchlings from the neatly broken eggs. Moreover, many of the bones had desiccation cracks, suggesting that they had lain on the surface for some time.[33] Since we are required only to weigh up degrees of probability, and to choose, in most cases, probable rather than improbable explanations, Garner's 'face-value' interpretation of the evidence seems justified.

Oard mentions the vast number of tracks at the top of the (Middle Jurassic) Entrada Sandstone, in Utah, describing the area as *'an alleged desert'*. Actually, it is alleged to be on the **edge** of the desert, where the sands merge with coastal plain deposits. The extent of the megatracksite is estimated to be at least 300 square kilometres, with an average density of between one and ten tracks per square metre. This represents a substantial span of time — less or more, depending on the number of animals envisaged. How many animals does Oard imagine to have survived the Flood at this point? How much time does he consider available for the production of these tracks, bearing in mind that it lies stratigraphically beneath the Glen Rose megatracksite, which in turn lies stratigraphically beneath the Dakota Group megatracksite,

not to mention the many smaller sites in between — and that the Montana nest sites lie stratigraphically above them all?

But the evidence of dinosaurs living at one level after another from the Middle Triassic to the Upper Cretaceous — usually in the form of tracks but also in the form of dung, evacuated stomach stones, nests, and eggs — is not the only such problem which current Flood models have to face. Tracks and coprolites are just the terrestrial equivalent of the bioturbation and faecal pellets left by marine fauna. An *in-situ* egg horizon is just the terrestrial equivalent of an *in-situ* bed of brachiopods, or oysters. To illustrate the scale of the problem, Alan Moro has recently reported unmistakably *in-situ* clumps and thickets of rudists from Croatia: a succession of five such horizons in one 9-metre section (his Figure 3) and a further seven in another (his Figure 4).[34] These multiple generations occupy a mere fraction of the Upper Cretaceous! Other examples, equally incomprehensible if not always as quantitatively impressive, could be adduced for every system of the Phanerozoic.

The instinctive reaction of most creationists faced with such evidence is to express doubt regarding the standard methods of relative dating. As Oard puts it,

> *'This raises the question of how, if at all, the "geological column" fits into a Flood depositional model. . . . If creationists believe that the geological column* [that is, the column from latest Precambrian onwards] *is an exact Flood depositional sequence, we would have to believe that each index fossils* [sic] *were deposited* ***worldwide*** *at the* ***same*** *time during the Flood year We would have to believe that a particular type of trilobite, for instance, was deposited during week three, while a particular type of brachiopod was laid down during week seven. Why could not the trilobite be deposited in week seven in one part of the world and the brachiopod in week three in another?'*[9]

This is an important point, notwithstanding that the mooted possibilities do nothing to dispose of the problems discussed here. However, the truth is that the basic scheme and methods of the geological column are unassailable. If any reader seriously doubts this, he may wish to read the paper in which I set forth reasons for this conclusion.[35] Surely we must give up the habit of invoking the alleged non-reliability of the geological column whenever the faunal evidence threatens to falsify our models.

## IS DILUVIALIST GEOLOGY SCIENTIFIC?

Bible-believing diluvialists are not exempt from the obligation to test hypotheses. The bones, tracks, nests, eggs and dung of the dinosaurs are not data to be overcome, at any cost, in the cause of some *a priori* hypothesis; they are examples of data by which to test the hypothesis, and if it is falsified, to put a boundary round that part of the geological record where the Flood is not. Are we, then, willing to hold our ideas at arm's length in this way and, if need be, to drop them? Can we face the possibility that much of what we have written and spoken may have to be retracted?

What we are getting at the moment are attempts to save the post-Cretaceous hypothesis, much as philosophers once bolted makeshift epicycles onto the geocentric model of Ptolemy. We are getting story-telling instead of science:

> *'Too often, adaptive "stories" are based on circular arguments, since the fossil evidence cited in support of each case is precisely what was to be explained in the first place, and no data remains to test the assertion. Moreover, any contradictory evidence that comes to light is all too frequently merely used to modify, rather than to refute the story.'*[36]

These are the words of an evolutionist speaking about the way evidence is interpreted to fit the theory of evolution, but of course the same point is true of Flood geology.

In my view it is not right that we should castigate evolutionists for their preconceptions while being unconcerned about the beam in our own eye. Nor is it right that we should declare, as does Malcolm, that

> *'every possible state of affairs is consistent with the theory of evolution so this theory contains no scientific information'*[8]

especially while we argue in the same fashion ourselves. If the dinosaur evidence considered in this article does not invalidate 'the' Flood paradigm, what could?

In the past year, I have made attempts to test my own model of Flood geochronology. Not without some reluctance, I have had to admit that it too is wanting. One of the hypotheses not adequately tested was the assumption that Palaeozoic hardgrounds — as mentioned above, the marine equivalent of dinosaur track and egg horizons — occurred only in areas of light sedimentation and that chronostratigraphy in the Palaeozoic was sufficiently indeterminate for time to be borrowed from strata above and below them. This proves not to be the case.[35,37] Another hypothesis which I have had to back away from is the assumption that nearly all invertebrate fossils of the Lower Palaeozoic originated from pre-Flood ocean floors. (It is already generally accepted that those found on hardgrounds do not.) Biostratigraphic evidence indicates, rather, that most such animals originated from communities living at the levels where they were fossilised. This is also the conclusion to be drawn from the often fine state of preservation, the source and nature of the enclosing sediment, and the numerous cases of evolutionary lineages over time.

As a result of such considerations, I no longer hold to the framework outlined in my paper of two years ago, in which the beginning of the Flood was put somewhere in the Precambrian and its end in the Upper Palaeozoic. Accordingly, the above critique of the post-Cretaceous model is not written from that perspective.

Dying to our hypotheses, our preconceptions, our self-importance is, I suggest, the only way forward for us all.

Creation science is not exempt from the rule that a grain of wheat must fall into the ground and die if it is to bring forth much fruit.

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