Papers

Can Flood Geology Explain the Fossil Record?

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ABSTRACT

The beginning of the Flood should be dated in the geological column no later than the Middle Riphean (Upper Precambrian), when the single landmass ('Rodinia') rifted apart and soon became engulfed by water. The end of the Flood should be located around the end of the Lower Carboniferous. With these two boundaries established it becomes possible to account for the pattern of the fossil record system by system, even down to 'epoch' level. By contrast, interpretations which locate the end of the Flood after the Cretaceous appear to conflict with the fossil record.

INTRODUCTION

Although creationists claim to be able to explain the geological column and its associated fossils by reference to the Genesis Flood, it is not generally appreciated that there is more than one such explanation, whereas, of course, only one can be correct. Wise summarises the present state of affairs in a footnote:

> *'European geologists tend to locate the Flood/post-Flood boundary near the Palaeozoic/Mesozoic boundary, a substantial contingent of US creationists place it well up in the Neogene of the Cenozoic, and a few of us place it near the Mesozoic/Cenozoic boundary.*[n]

This is not a peripheral issue. Where one places the end of the Flood determines how much of the fossil record is attributed to the Flood itself and how much to geological instability thereafter; and since post-Flood instability is likely to have lasted much longer than one year — the Ice Age, for example, must have lasted many decades — explanations of the fossil succession within the Flood year will be radically different from explanations of the succession which is considered post-Flood. For the same reason, apart from the geological evidence, the principal evidence to be brought to bear on the boundary problem must be the fossil succession itself, comprehended in its entirety. The location of the dividing-line should not be considered in isolation.

This paper will argue that the Flood/post-Flood boundary should be placed around the end of the Lower Carboniferous. For this purpose the three interpretations summarised above will be treated as essentially two: a 'pre-Permian' model espoused by most European Flood geologists, and a 'post-Cretaceous' model espoused by most American and Australian Flood geologists.

A Non-Random Order of First Appearance and Last Appearance

Fossils do not appear randomly in the geological column. All but the last fifth of the fossil record as measured by the evolutionary timescale contains the remains of only single-celled animals. Multicellular animals do not appear until late in the Precambrian, when the Ediacaran fauna makes its appearance: flat, soft-bodied organisms unique to the Vendian period.[2] From an evolutionary point of view they appear to be an experiment in multicellular life that failed, before the explosion of complex life at the base of the Cambrian. Then invertebrate forms appear in abundance: jellyfish, molluscs, starfish, trilobites, crustaceans, sponges, marine worms, and a great number of phyla which, like the Ediacaran fauna, have no modern relatives. The first chordates, believed to be ancestral to the later vertebrates because a notochord or stiff rod ran along their back, also appear in the Cambrian.[3,5] True vertebrates, represented by jawless fish, appear for the first time late in the Cambrian, followed in the Devonian by cartilaginous and bony fish (Figure 1). Amphibians appear in the Late Devonian, reptiles

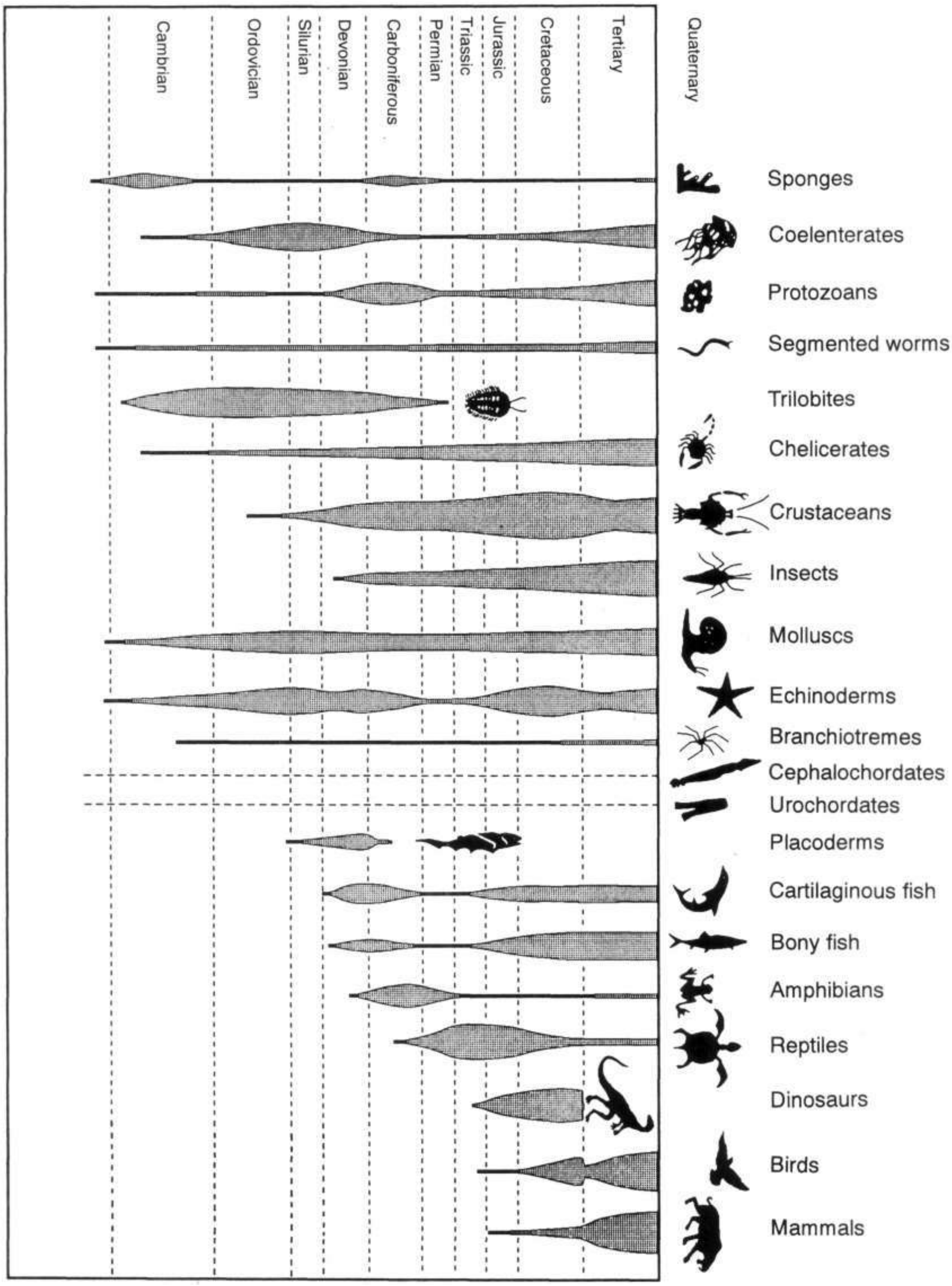

Figure 1. *An impressionistic representation of the fossil record, showing the frequency of occurrence of most animal groups.*

in the Early Carboniferous, flying reptiles and dinosaurs in the Late Triassic, birds *(Archaeopteryx* being a famous example) and mammals not certainly until the Jurassic, man not until the Late Tertiary. This is a non-random order in the sense that the same sequence recurs (though rarely a complete sequence) wherever it is tested.

The succession of plants in the fossil record is also far from random. Seaweeds appear already in the Cambrian, whereas the first subaerial plants do not occur in appreciable numbers until the Devonian. Horsetails, lycopods and ferns, the tissues of which became fossilised as coal, begin to appear in the Devonian and Carboniferous, as do the first gymnosperms, or seed-bearing plants, such as extinct kinds of cycad and conifer. Ginkgos appear from the Triassic.

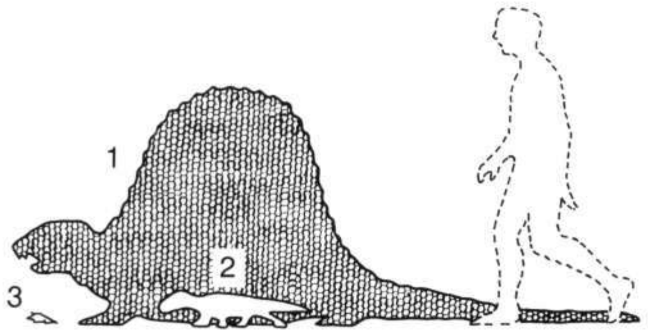

Figure 2. *Did mammals evolve from reptiles? Concerning the above diagram Benton writes:*

The animals involved in the story of mammalian jaw evolution vary greatly in size, but the thread of change is clear. The largest is the primitive pelycosaur *Dimetrodon* (1), followed by the next in the sequence, *Thrinaxodon* (2), and *Morganucodon* (3), a tiny shrew-sized animal'.

Mammals remained tiny through most of the Cretaceous. However, at the beginning of the Tertiary, there appeared abruptly mammals as large as a rhinoceros. No objective assessment would conclude from such massive changes that reptiles (for example, Dimetrodon,) *evolved into 'mammal-like'reptiles (for example,* Thrinaxodon^, *or that 'mammal-like'reptiles evolved into reptile-like mammals (for example,* Morganucodon,). *The enormous abstraction and generalisation involved in classifying animals as reptiles, mammal-like reptiles and so on obscures what are in reality, not smooth transitions from one particular animal to another, but abrupt differences.*

Angiosperms, or flowering plants, of which there are now over 250,000 species, do not occur generally until the Early Cretaceous.[6]

A similar point may be made with regard to final appearances. Many Cambrian animals became extinct before the onset of the Ordovician, many types offish died out at or soon after the end of the Devonian, trilobites finally died out in the Triassic, and so on. Although they occur throughout the record, extinctions cluster at particular junctures, most strikingly near the end of the Permian, when some 63 per cent of terrestrial families and 49 per cent of marine families attested in the fossil record became extinct,[7] and at the end of the Cretaceous, marked by the demise of creatures such as the ammonites and dinosaurs.

A random pattern would be one where vertebrates and invertebrates, reptiles, birds and mammals, gymnosperms and angiosperms, occurred in appropriate marine or terrestrial deposits at every point in the record. Instead, fossils occur in a geologically determinable sequence, where marine animals appear before terrestrial animals, aquatic plants before land plants, and man, together with many other plant and animal species, appears last. Once a particular genus, family or order appears, there is often a relatively continuous record of it until its disappearance. Indeed, certain periods seem to be dominated by certain types of animal, certain types of plant, and certain types of environment. Index fossils are a reflection of this non-randomness at the 'species' level. Superficially, the notion that life evolved from one stage to another, beginning in the sea, may not seem implausible.

One could enumerate many reasons why the theory of evolution cannot, in fact, account for the fossil succession, most of them well-known to creationists. First, there are very rare exceptions to the general order of appearance, and some of these violate the presumed order of evolution. Second, there are no transitional fossils[8] to demonstrate that, say, a certain type of invertebrate evolved into a vertebrate, or a certain type of 'mammal-like reptile' evolved into a mammal[9] (Figure 2).[10] Third, in order to account for the relatively late appearance of marine reptiles and mammals, it becomes necessary to suppose that evolution went backwards, that is, that having evolved via fishes and amphibians, some land animals returned to the sea. Fourth, many fossil forms persist from their very first appearance allegedly tens or even hundreds of millions of years ago until their latest appearance without significant change. Fifth, extinctions of certain animals (for example, the dinosaurs) cannot be linked to the simultaneous emergence of closely related animals which acquired a useful mutation and survived. And sixth, the hardiest and most successful organisms are also the genetically simplest and supposedly least evolved, namely algae and bacteria.[11] To elaborate such points would be to demonstrate that the theory of evolution is far from historically proven.

However, if the diluvial explanation of the fossil succession is to have sufficient credibility of its own, it must be able to explain the succession more satisfactorily than its counterpart. To show that the evolutionary explanation is deficient does not amount to showing that a diluvial explanation is better.

A Real Succession

The founders of modern diluvialism are Whitcomb and Morris. Their book **The Genesis Flood** sought to demonstrate that almost all the fossil record — the Palaeozoic, the Mesozoic, and the Cainozoic up to the Pleistocene — was laid down during the Flood.[12] In this respect their work still speaks for the majority of creationists today.

One of the ways Whitcomb and Morris sought to explain the fossil succession was to deny, or minimise, its reality. They claimed, for example, to perceive a vicious circle:

> *'The fossils alone are used to assign a geologic time to the rock stratum, and yet this very sequence of fossils is said to constitute the greatest proof of organic evolution!'*[13]

Although this argument is still current among creationists and appears repeatedly in the popular literature, it is both misleading and untrue. By 'geologic time' is meant simply a geologic system relative to other systems. As every creationist knows, the systems are dated in absolute terms by radiometric methods, and these, at least for the Phanerozoic, have some validity,[14"17] notwithstanding that they sometimes give wildly discrepant results[18] and cannot be applied directly to sedimentary rocks. Nor would most scientists argue that the greatest proof of organic evolution is the mere fact that the fossils occur in a regular sequence. There is no circular reasoning. The main features of the fossil succession were apparent to geologists well before Darwin published his theory of evolution,[19-20] for they recognized that over wide areas rocks could be correlated by reference to their facies irrespective of their fossils, and that an orderly fossil succession ran parallel with this lithological succession. The lithological correlations confirmed that different regions had passed through identifiable stages in the fossil succession concurrently. In this regard it greatly helped the geologists of England and Wales that they lived among rocks which encompassed every 'epoch' (subdivision of a geological period or system) except the Miocene.[21]

The possibility of analysing the world's rocks according to a universally valid timescale testifies to the fact that depositional events, as well as climatic, faunal and floral changes, once took place on a regional and even worldwide scale. Sloss remarks on

> *'a fundamental homogeneity of the stratigraphy of the cr atonic interior of North America. Individual major rock units can be traced over very wide areas; this permits the long-range timestratigraphic correlation of these units on physical as well as biostratigraphic bases.*[m]

As Morton has pointed out, such facts are in no way inimical to a diluvialist understanding of the geological record![23] The record can be analysed, ordered and interpreted on a global basis because the Flood and the catastrophism which followed it occurred globally.

Take as an example the incidence of coal in the record (Figure *3).*[14] Not found earlier than the Late Devonian, an 1 preponderating in the Carboniferous and Permian, coal has a non-random distribution. Moreover, the plants of Permo-Carboniferous coals are different from the plants of, say, Tertiary coal and are distinctive of those particular systems. If the fossil succession were not a real phenomenon, coal seams and the plants from which they formed would occur randomly throughout the column. Similarly, the Cretaceous system is so named because rocks of that period are characterised by chalk, which first occurs at that stratigraphic level. Like certain other types of rock, it is a highly persistent facies, indicative of environmental conditions that prevailed worldwide and were limited to a unique stage in earth history.[25] It therefore not only confirms the diluvialist expectation that the unique, worldwide Flood should be evidenced in unique, worldwide effects, but corroborates the universality of the geological column. The anomalous concentration of iridium which has been found worldwide at over 150 Cretaceous-Tertiary boundary sections in the last two decades — long after the boundaries were determined — also serves to validate the geological column.

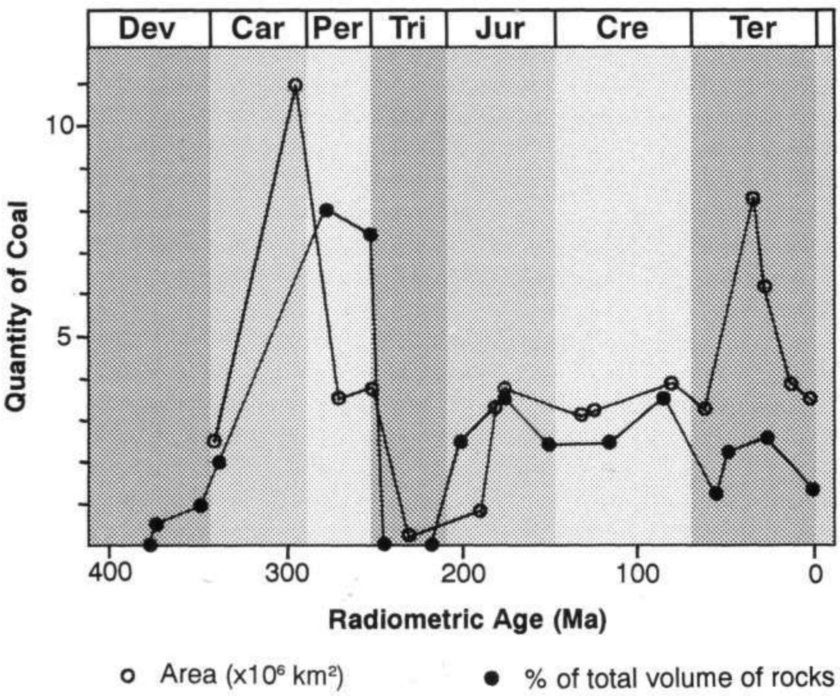

Figure 3. *Estimated world abundance of coal-bearing sedimentary material (after Faure et al.). The rapid decline to near zero after the Permian may reflect the exhaustion of the pre-Flood aquatic forests as they became stranded on the margins ofPangaea in the first century after the Flood. The coal from the Late Triassic onwards stems from a different kind of vegetation (compare Figure 12) and in the main represents the terrestrial (but still allochthonously deposited) forests that grew up after the Flood.*

Whitcomb and Morris minimised the fossil succession further by arguing that overthrusts, that is, places where rocks with earlier fossils lie on top of rocks with later fossils, cannot be explained by the thrusting of earlier rock over later rock. This is not, however, supported by the evidence adduced for it, for example the Lewis Overthrust of Montana.[26] Contrary to popular creationist belief, overthrusting is deduced first and foremost from geophysical evidence rather than from any inverted order of fossils, and is demonstrable only in regions of deformation, a dramatic example being the multiple thrusts of non-fossiliferous Precambrian over Palaeozoic rock in the highlands of Scotland (Figure 4).[27,M] Overthrusts testify to the operation of catastrophic processes, and since they are not primarily inferred from the fossils, they tend only to confirm the geological column.

The third argument Whitcomb and Morris laid against the validity of the geological column was that of 'misplaced fossils'. The examples adduced were alleged human footprints in the Cretaceous rocks of Texas, and in Carboniferous rocks of Pennsylvania and other states. But in 1986 the Institute for Creation Research admitted that *'it would now be improper for*

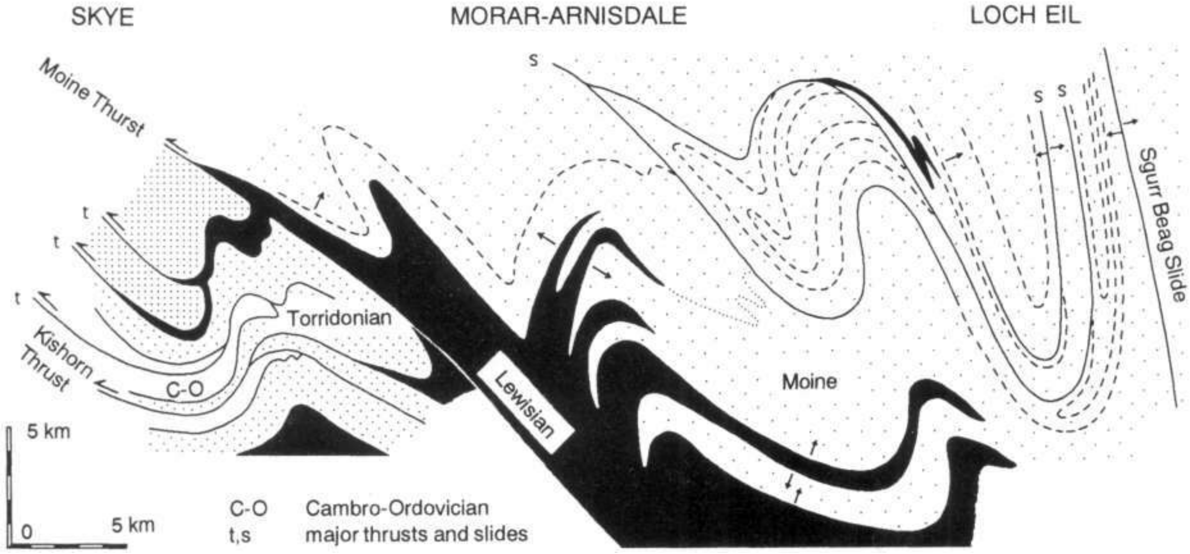

Figure 4. Structural section across the Moine outcrop of western Scotland, showing massive overthrusting. The Moine and Torridonian successions are both Upper Precambrian, being so dated on the basis of stratigraphic position (above the Lewisian) and certain radiometric dates. The red sandstone fades of the Torridonian and the absence of multicellular fossils distinguish it from the later Cambro-Ordovician rocks. Arrows indicate direction ofyounging inferred from stratigraphy and sedimentation structures. Thrusts produced underwater by immense lateral compression of sediments deposited at the beginning of the Flood caused the later rocks to be sandwiched between Torridonian rocks above and below. It is obvious that the thrusts are not deduced from some evolution-defying sequence of fossils. (Diagram after Powell.)

creationists to continue to use the Paluxy data as evidence against evolution '[29] largely due to the research of Neufield[30] and Kuban.[31-32] The Carboniferous tracks, so far as I know, have not been repudiated. Whitcomb and Morris considered them *'plain and powerful evidence'* that man was walking the earth at the same time as the amphibians which evolutionists believe to be his remote ancestors; only philosophical bias prevented evolutionists from recognizing this *'objective scientific evidence'.* However, Monroe's reasons for doubting the evidence are sound,[33] and even Snelling, a geologist who has defended the post-Cretaceous model, concludes:

> *'As far as we are aware at the present time, there are no indisputable human fossils in the fossil record that we could say belong to the pre-Flood human culture(s).'*[34]

Nor is it clear why Whitcomb and Morris should have deemed it possible that human survivors walked on unlithified Flood deposits in North America as the Flood was coming to an end. Again, the absence of reliably documented human fossils earlier than the Pliocene only demonstrates that the fossil succession is non-random.

Other 'misplaced' fossils have been adduced by Woodmorappe (Table I).[35] Once one allows for reworking, downwash and minor extensions of stratigraphic range, however, the over 200 cases boil down to a handful, and serve to emphasize the extreme rarity of out-of-sequence fossils. Other examples might include minuscule fish remains from the Cambrian;[36-38] vascular plants from the Cambrian, which, if not a contradiction of plant evolution *per se,* certainly contradict the current theories;[39-42] birds possibly from as early as the Triassic, contemporary with the very first dinosaurs;[43-47] and human footprints and bone fossils predating man's presumed ancestor, *Homo habilis.*[48,49] The reason why such anomalies occur is that the normal order of fossils is not a record of evolution and therefore may admit of exceptions, not because the associated rocks and other fossils within them have been invalidly correlated. The anomalies are real precisely because the correlations are sound.

Thus, the iconoclasm of Whitcomb and Morris in this area — still prevalent, as recent contributions to this journal make clear[50,51] — is unwarranted and indeed embarrassing. The assertion that the geological column is built on the premise of biological evolution is untrue. Fossils are used to assign rocks a place in the geological column not because the order in which they occur shows a gradual evolution from simpler to more complex life — it does not — but because they occur in a definite succession. To suggest, as Froede does, that an alternative timescale should be developed which

> *'will allow the user the flexibility to evaluate individual sites and large areas without confusing evolutionary geology with the stratigraphic record'*

is simply to wish that the evidence were different from what it is.[52]

In short, creationist impugnments of the geological column are as unfounded as evolutionist contentions that

FOSSIL TYPE	HIGHER	LOWER	TOTALS
Spores	63	9	72
Pollen	40	6	46
Conodonts	33	3	36
Foraminifers	15	4	19
Acritarchs	15	0	15
Nannoplankton	5	0	5
Fusulinids	3	0	3
Dinoflagellates	3	0	3
Algal cysts	3	0	3
Brachiopods*	3	0	3
Chitinozoans	3	0	3
Trilobites	3	0	3
Algae	1	1	2
Coccoliths	1	1	2
Mammal bones*	1	1	2
Nannoflora	2	0	2
Crinoids	2	0	2
Graptolites*	1	0	1
Ostracodes	1	0	1
Palm wood	0	1	1
Plant tissue	0	1	1
Nannofossils	1	0	1
Archaeocyathids*	1	0	1
Thelodont, acanthodian fish scales	1	0	1
Ammonoids*	1	0	1
Diacrodians	1	0	1
TOTALS	**203**	**27**	**230**

Table 1. *Analysis of 'anomalously occurring fossils' compiled by Woodmorappe. Most of the anomalies (88 per cent) were fossils which occurred higher than their normal stratigraphic range, consistent with the explanation that most such instances were due to reworking of strata deposited earlier. Some reworking should be expected, no less within a catastrophist framework than within a uniformitarian one. Similarly, most occurrences of fossils below the normal stratigraphic range are likely to have resulted from downwashing into fissures within lower strata. These explanations are supported by the fact that in most cases the difference between the expected and actual age of the rock (as determined by the predominating fossils, stratigraphic correlation and other factors) is not more than one geological period. Furthermore, all but six of the 230 anomalies (asterisked) relate to microfossils, which are resistant to erosion, easily transported and therefore susceptible to reworking; they are also small enough to penetrate into lower layers by downwash. Only two of the 230 anomalies relate to terrestrial animals; in one case the bones were found in Early instead of Late Tertiary, in the other they were found in Late instead of Middle Tertiary. The anomalies, therefore, tend to validate rather than undermine the reality of the geological column.*

the lack of transitional forms is due to the extreme imperfection of the record. Anyone who still supposes that the geological column may be a misleading artefact should study and, if possible, dismember the literature which has established it. This has never been done.

THE PALAEOZOIC

In deciding between the two models it is essential to have a sound conception of the sequence of events in Genesis 7-8: the historical basis to which any model must regularly return.

The first point that ought to be emphasized is that the Flood began suddenly and violently. Within 24 hours all the fountains of the great deep broke forth, while torrential rain poured from the heavens. The Hebrew word for ' fountain', *ma 'yan,* signifies a terrestrial spring,[53] and after the separation of the waters on Days 2 and 3 of Creation Week, when the waters around the land are called seas, the 'deep' seems to signify the water which lay under the land. The Earth before the Flood was kept moist by innumerable springs which were fed from below (Genesis 2:6,10), the Earth being spread out 'upon' the waters (Psalm 136:6). The parallel phrase in the New Testament — ' fountains of waters' (Revelation 14:7) — also refers to terrestrial springs. Thus, when they erupted, the release of pressure allowed great masses of subterranean water to surge up and pour onto the land, much of it probably in the form of steam, breaking up the Earth's surface in a process of 'phreatic stripping'.[54] Water issued from below and above simultaneously, and the sea flooded the land not so much because its level rose, but because the land sank — as a result of the emptying of the reservoirs deep beneath it. Note that according to Genesis 7:24 the waters 'prevailed' from the very first day, as if inundation was almost instantaneous. The transgression of the sea (not an event expressly mentioned in Genesis) occurred only after the land had already been flooded.

Noah was warned: *"I will send rain upon the earth for forty days and forty nights, and every living thing that I have made I will blot out."* In its active sense, as an inundation of the Earth, the Flood is ascribed a duration of just 40 days (Genesis 7:4, 17), during which every living thing was obliterated. Thereafter the waters continued to prevail for 110 days, the whole Earth being submerged, and on the 151st day the Ark ran aground. By that stage the waters had already abated more than 15 cubits. Other mountain tops in the Ararat area were seen about 10 weeks later.

Other than noting that the fury of the waters had already begun to be assuaged before the end of 150 days, this chronology does not depart markedly from the exegesis of Whitcomb and Morris.[55] Indeed, in the present author's opinion it is the only interpretation viable; the record allows no scope for deferring total submersion to the end of the 150 days. This being so, we should expect total submersion of the Earth to be reflected early in the geological record, early enough for us to discern thereafter the up to 14 weeks during which the Earth continued to be submerged, the 11 weeks before land became visible, and the further 22 weeks before the Earth was considered dry enough for Noah and his family to disembark.

The post-Cretaceous model offers an inadequate reflection of the biblical chronology. Wise asks,

> *'Why couldn't the Paleozoic represent submarine deposition in the early Flood and the Permo-Mesozoic represent the transgression over the land in the later Flood?'*[56]

Coffin presents much the same interpretation, suggesting that the waters did not cover all the land until the Permian.[57] There are several reasons why such a scenario cannot be accepted.

To begin with, if we take maximum thicknesses per system as a guide to average proportions (see Table 2),[58,59] the record from the Upper Precambrian to the beginning of the Permian represents some 65 per cent of the total deposition from the Upper Precambrian to the end of the Mesozoic. If we assume, with Wise, that the land was flooded primarily by marine transgression and estimate for the sake of argument that the sea began to transgress over the land after about the first week, we are presented with a complete lack of proportionality. While pre-Permian rocks would then represent 65 per cent of total Flood deposition, the corresponding first seven days in the historical record would represent, as a proportion of 370 days, just two per cent!

Even more fundamentally, the Palaeozoic cannot represent submarine deposition and the Permo-Mesozoic the transgression of pre-Flood seas over the land because the Palaeozoic itself represents that transgression — the marine deposits of that era lie over continental deposits, not Precambrian ocean floors.

The transgression is represented by the diachronous unconformity that passes from latest Precambrian on the continental margins to Lower or Middle Ordovician in the continental interiors. The violence of this event is difficult to exaggerate. In Scotland it was immediately preceded by massive crustal warping. Precambrian layers of sandstone and gneiss arched up as the subterranean deep broke apart and its waters welled up through a rift which separated North America, including Scotland, from Britain to the south-east. The surrounding land collapsed, and as the waters swept over the land, slicing through the folds, they eroded hundreds of metres of sandstone and much of the underlying gneiss to leave a planar surface traceable over hundreds of miles. The Lower Cambrian quartzite above the unconformity also shows evidence of rapid deposition.[60]

SYSTEM	THICKNESS (km)
Miocene-Quaternary	13.0
Palaeocene-Oligocene	20.9
Cretaceous	15.8
Jurassic	13.1
Triassic	8.8
Permian	6.2
Carboniferous	13.8
Devonian	11.7
Silurian	8.9
Ordovician	13.8
Cambrian	11.8
Riphean/Vendian	19.0

Table 2. *Maximum recorded thicknesses of sediment in the Phanerozoic (source: Smith), together with the maximum thickness of the Precambrian in Australia back to 1300 Ma (source: Hunter).*

In Scotland there are two unconformities below the Cambrian. The earlier separates the Lewisian gneiss from the overlying Stoer and Torridon Groups; the later unconformity comes between these and the Cambrian quartzite. In Arizona, similarly, there is an unconformity between the Vishnu Schist and the overlying Unkar and Chuar Groups (consisting of limestone, shale, sandstone and conglomerate) and a second between these and the Tapeats Sandstone ('The Great Unconformity').[61] The two regions bear close comparison. The Torridonian Sandstone testifies, in its 'fluid evulsion structures', to sediment dumping on a massive scale, just as do similar features in the Unkar Group. These deposits above the metamorphosed rocks of the Precambrian — regularly thousands of metres thick — constitute the rocks which were eroded when the fountains of the deep broke open. The horizontal surface of trans-gression at the later unconformity marks the violent incoming of the sea some weeks later.

Ager remarks that an unfossiliferous quartzite lying conformably below fossiliferous Lower Cambrian and unconformably above a great variety of Precambrian rocks — exactly the situation in Scotland — occurs *'very commonly around the world'.* Indeed,

> *'It is not only the quartzite, but the whole deepening succession that tends to turn up almost everywhere, i.e. a basal conglomerate, followed by the orthoquartzite, followed by glauconitic sandstones, followed by marine shales and thin limestones.'*[62]

The lateral persistence of this succession is striking enough. What is yet more striking is that it represents an overall grading of particle sizes, from very coarse at the bottom to very fine at the top. This is the sort of 'upward-fining' pattern which one often finds in a series of beds, such as a cyclothem. In other words, the whole succession has the unity characteristic of a single episode of erosion and deposition, during which material is eroded by fast-moving currents, held in suspension, and then water-sorted as current velocity wanes — as a result, for example, of the water becoming deeper. Commonly a coarse lithology prevails at the bottom of the Cambrian succession (conglomerates and sandstones), a fine lithology at the top (limestone and dolomite), while shales, silts and mudstones occur in-between.[63] Widespread carbonate deposition continues until the end of the Lower Ordovician, after which a surface of erosion marks an unconformity over much of North America.[64] Marking the end of one continuous sequence, this would seem to represent, so far as North America is concerned, the virtual completion of transgression over the continent, followed by a steep increase in bioturbation as current strength and sedimentation rates decreased.[65]

As a worldwide marker, the basal conglomerate demands a worldwide explanation. In Norway the classic Sparagmite area extends from north of Oslo all the way into Sweden.[66] According to Ager,

> *'The sediments suggest rapid deposition, perhaps by floods . . ., and there is strong evidence to suggest localised deposition in grabens before the main marine transgression of the early Palaeozoic.'*[67]

Could it be that the 'localised deposition' before the main transgression represents the inundation of the land by torrential rain and subterranean waters before the sea invaded? In the British Isles a 'tillite' sequence with inbedded fragments up to 320 m long can be traced from Connemara in western Ireland to Banff in Scotland, and includes granite clasts that were picked up from sources hundreds of miles away. At Port Askaig, in Islay, the sequence is 750 m thick.[68] Dott describes how blocks of quartzite were torn from the Precambrian hills of Wisconsin (in the middle of the United States) by the action of 'tropical storm-waves' 30 ft high (estimated), before the clasts were covered by yellowish Cambrian sand.[69] And in the Grand Canyon area Precambrian rocks were downwarped into a huge northward-trending trough, as enormous limestone and shale clasts were eroded and redeposited in what is now the Sixtymile Formation. In the Kingston Peak Formation of the Mojave Desert (Upper Precambrian) there are clasts up to a mile long![70] As in Scotland, the transgression sliced through schist, gneiss, granite and sandstone to leave a horizontal surface traceable over hundreds of miles.

The Tapeats Formation at the bottom of the Grand Canyon dates from the Lower Cambrian and extends all the way from the western pre-Flood coast to New Mexico, several hundred miles inland. Above the Tapeats come the thicker formations of the Bright Angel Shale and Muav Limestone, also belonging to the Cambrian. Together with their correlatives they record continuing transgression inland, with simultaneous transgression proceeding in the opposite direction, westwards, from the newly opened 'proto-Atlantic' (see Figure 5).[71-73]

Except over the Transcontinental Arch, Cambrian rocks are found throughout the North American interior. Those regions where they are absent were either source areas for deposition elsewhere or eroded subsequently; there is no evidence of any pristine topography. By the Upper Ordovician the process was complete: the sea had spread eastwards and westwards across most, probably all,[74] of the continent — **after** the entire Precambrian land surface had been broken up, inundated and redeposited. If we adopt Austin's own estimate of the speed of transgression, upwards of two metres per second, 500 miles would have been covered in 4-5 days. If we halve this rate in order to take account of higher elevations inland, the whole continent could have been transgressed within four weeks.

Cambrian rocks, often with an unconformity at their base, are of worldwide occurrence, making it possible that by the Upper Ordovician every part of the earth was deluged. As Dalziel notes, remarking on the similarity of the *Skolithos* facies in Antarctica to that in Scotland,

> *'Strata deposited by the seawater that advanced to cover most of the continents 540 million years ago — as evinced by the presence of Cambrian seashores in such places as Wisconsin — are remarkably similar on all continents.'*[75]

In fact, there is no trace of a vegetated terrestrial surface at that time anywhere. The spores and woody plant material recovered from Cambrian strata[76-79] occur in sedimentary deposits and are not therefore in their original locations. Most palaeontologists consider that the oldest direct evidence for terrestrial life comes from the Middle Ordovician, only because the theory of evolution does not sit easily with terrestrial life as early as the Cambrian.[80] Again, the spores in question occur within sedimentary, non-vegetated deposits.

Whether or not one accepts that the Earth was inundated by the upwelling of subterranean waters before the incursion of marine waters, it seems clear that the Upper Precambrian to Lower Ordovician transgression must be placed within the first 150 days of the Genesis record. Accordingly, all Cambrian deposits must be Flood deposits, and wherever they are found, the land must be already under water. At that point the possibility of pristine land surfaces comes to an end, until a new surface emerges out of the Flood.

Woodmorappe has sought to explain the fossil succession by reference to what he calls Technically Associated Biologic Provinces (TABs), a complex theory which has recently been championed by Mehlert.[81-83] In this theory the Phanerozoic is divided into four units, Lower Palaeozoic (Cambrian to Devonian), Upper Palaeozoic, Mesozoic and Cainozoic, according to what Woodmorappe regards as four fundamentally distinct biotic assemblages, corresponding to four types of pre-Flood TABs. The fact that these always appear in the same order (although often only two of these divisions may be present) is ascribed to the successive deposition of adjacent TABs.

A fundamental defect of this theory is the assumption that in most regions Palaeozoic strata overlie what before the Flood was the floor of a sea. As Mehlert puts it,

> *'The dominant mode of sedimentation during the Flood involved very little tendency for TAB constituents to be transported much beyond their boundaries.'*[84]

In reality, although extensive regions may once have been underwater shelves, in general the continents of today are undoubtedly fragments of the supercontinent before the Flood. It follows, therefore, that the Lower Palaeozoic marine animals fossilised in, say, Iowa, hundreds of miles inland from the pre-Flood shore, must have been transported enormous distances (Figure 5). Because the whole Earth was under water well before the end of the Lower Palaeozoic, it is impossible to explain assemblages after the Lower Palaeozoic — including terrestrial assemblages — as originating from nearby provinces which had not yet been inundated.

Did Animals Escape to Higher Ground?

Another defect of the post-Cretaceous models is their failure to explain the non-random occurrence of terrestrial animal fossils. If one disregards amphibians, which arguably might not count as land-dwelling animals although they were certainly air-breathing, the earliest terrestrial animals date from the Lower Carboniferous.[85] They are followed in the Triassic by the dinosaurs, then small mammals, then large mammals and finally man, near the end of the fossil record.

The explanation offered by Whitcomb and Morris for this pattern — and it remains a significant component in Woodmorappe's theory — is first, that mammals tended to live at higher elevations, and second, that the larger, stronger animals were better able to escape the rising Flood waters and swollen streams rushing down from the hills.[86]

'As far as land animals and man were concerned, their greater mobility would have enabled most of them to escape temporarily to higher ground as the waters rose, only occasional individuals being swept away and entombed in the sediments. Eventually, of course, the floodwaters overtook even those who had fled to the highest elevations, but in most cases these men and animals would not be buried but simply drowned and then carried about by the waters on or near the surface until finally decomposed by the elements.'[87]

Morris characterises his expectation that the land animals would tend to be segregated stratigraphically in order of size and complexity on account of their greater mobility as an obvious prediction of his theory.[88] The prediction is, in fact, far from obvious.

The picture of rising Flood waters and swollen streams cascading from the hills seems to owe more to Michelangelo than to Genesis, and is at variance with what Morris argues elsewhere.

'Strangely and almost unbelievably, there have been a few competent geologists (Charles Lyell in the last century, J. L. Kulp, Davis Young and others in the current generation) who have gone on record as believing in a worldwide ***tranquil*** *cataclysm!'*[89]

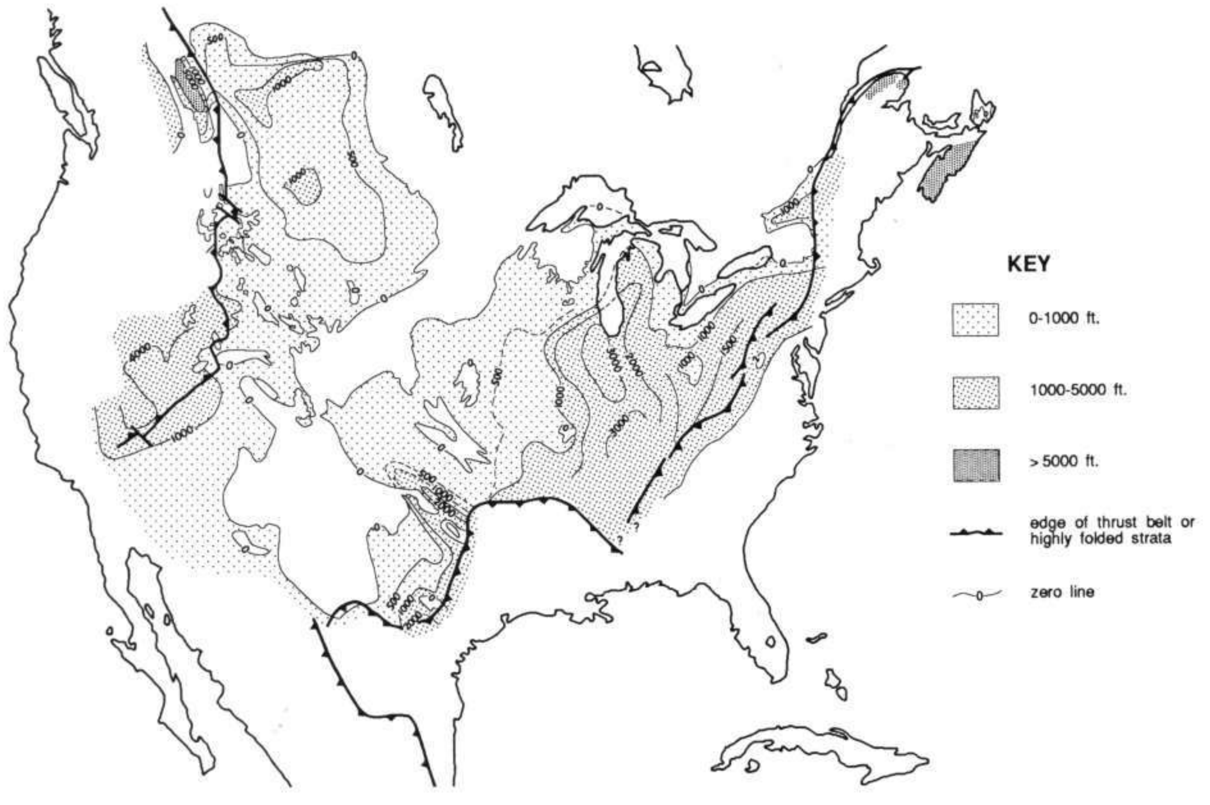

Figure 5. *Distribution of Upper Cambrian deposits across the United States and southern Canada (simplified from Cook and Bally). Only preserved strata are shown, and thicknesses therefore represent minimum values. The edge of the thrust belt is thought to mark the approximate edge of the pre-Flood continent. As a result of the eruption of the fountains of the deep' it is suggested that the entire surface of the craton had been broken up, inundated and redeposited already before the Cambrian. The subterranean reservoirs were located where there are now basins, and as these emptied, the craton subsided. From west and east the sea swept over the craton at least as far as the Transcontinental Arch (the central strip above the zero line), and by Late Ordovician the Transcontinental Arch too was under seawater. The craton did not begin to emerge until the Early Devonian, after which it was never again totally submerged.*

If this is strange, it is stranger that Morris should explain the fossil succession by proposing what is very much the same thing. He aptly cites accounts of floods from modern experience in order to give some impression of the gigantic forces which a global cataclysm would have unleashed. In 1872 storm-waves at Wick, Scotland, tore away a 1350-ton section of a breakwater; tsunamis from the eruption of Krakatoa in 1883 inundated neighbouring islands and drowned nearly 40,000 people; a wave that swept across the Bay of Bengal in 1876 left 200,000 dead; and so on.. Such incidents were as nothing compared with the waters of the Deluge, which could wrench away blocks a kilometre wide. The whole Earth was completely inundated even to the tops of the highest mountains, within seven weeks! Such was the destructive power of the earthquakes and eruptions which ripped up the land in the first few days that not a trace of the original land surface remains. In the words of Olson, a uniformitarian geologist:

> *'The continental nuclei at that time were largely stripped down to the crystalline basement. Ancient mountain systems were worn down to their roots reducing the continents more nearly to a plain than they have ever been before or since.'*[90]

There are no pre-Flood monuments, no petrified forests, no primordial mountains:

> 7 *have determined to make an end of all flesh; for the earth is filled with violence through them; behold, I will destroy them* ***along with the earth.'*** (Genesis 6:13)

The surface of the Earth was destroyed (Genesis 9:11). In these circumstances the idea that any man or animal had time or opportunity to escape the waters is utterly inconceivable. There was no escape even for winged animals.

Nor is there any basis for the suggestion that larger mammals tended to live at higher elevations than reptiles and smaller mammals. Gazelle, buffalo, horses, elephants, hippopotami are not creatures of the mountains. Even if in places some of the larger mammals had lived at higher elevations, such differences would have had not the slightest impact on the order of burial. As Whitcomb and Morris point out, the waters which overwhelmed the Earth came from above and below simultaneously, affecting inland and coastal regions simultaneously. Tectonic eruptions of water and lava tore through hills and low-lying ground without distinction.

Indeed, according to the post-Cretaceous model, one might have expected that in inland regions terrestrial animals would often be buried before marine animals, since landslides and all the other processes which are supposed to have buried the terrestrial Mesozoic animals would have buried them before the sea arrived. How is it, then, that there are no terrestrial fossils before the Permian half way up the fossil record? How is it that even the smaller, weaker and less mobile land-dwelling animals are found above marine animals in the geological column?

If differences in habitat elevation cannot explain the order of terrestrial fossils relative to each other, it follows that they also cannot explain why terrestrial fossils are preceded by marine fossils. While it is true that the sea must have been lower than the land in the pre-Flood world, during the Flood itself the sea was higher than the land! This seemingly obvious point has not been adequately appreciated by Flood geologists. Snelling writes:

> *'In the so-called Palaeozoic strata there is a preponderance of marine creatures, beginning with trilobites, corals, sea anemones, shellfish of all types, etc. This is what we would predict, given that the Flood waters carried sediments from the land out to the sea, where they would then be deposited, burying many of the relatively immobile seafloor-dwelling creatures, followed later by destruction and burial of fish.'*[91]

One is given to understand that the marine fossils of the Palaeozoic were buried under eroded terrestrial sediments in the pre-Flood ocean, and therefore, since such deposits are now found on every continent all over the world, the pre-Flood land should be located somewhere under the present oceans! In order to explain why there is no trace of humanity from before the Flood, Coffin explicitly makes the same suggestion.[92]

Needless to say, there are no geological grounds at all for such an argument, and Snelling, Coffin and the other geologists who have followed the post-Cretaceous model must know that. Indeed, in a recent paper Snelling and colleagues agree that *'most Flood sediments are found on the continents and continental margins and not on the ocean floor.'*[93] The Cambrian, Ordovician, Silurian and Devonian deposits exposed on the Earth today are marine and igneous deposits overlying a Precambrian basement, and that basement is the scoured remains of the primeval supercontinent. Strata at the pre-Flood boundary do not represent the surfaces of pre-Flood sea bottoms, while none of today's ocean floors are older than Mesozoic. The Atlantic Ocean, for instance, originated in the Jurassic, when 'Pangaea' rifted apart and new seafloor spread out from the Mid-Atlantic Ridge.[94] Thus, how can the presence of terrestrial fossils kilometres above marine fossils be in any way connected with the presence of higher ground, when the original land surface was **beneath** the marine fossils?

Terrestrial animals are totally absent from strata of the Lower Palaeozoic because they were obliterated:

> *'In seven days I will send rain upon the earth . . . and every living thing that I have made I will blot out from the face of the ground.'* (Genesis 7:4)
>
> *'All flesh died that moved upon the earth,. . . and every man; everything on the dry land in whose nostrils was the breath of life died. He blotted out every living thing that was on the face of the ground, man and animals and creeping things and birds of the air; they were blotted out from the earth.'* (Genesis 7:21-23)

The Hebrew verb translated 'blot out' in Genesis 6:7 and 7:4 is *machah* and means 'wipe' or 'wipe out', as in II Kings 21:13. The totality of the destruction is stressed by adding the phrases *'from the face of the ground'* and *'from the* *earth'* after the verb. In much the same way as it is reiterated that *'all flesh under the whole heaven'* was destroyed, signifying that the Flood was a universal judgment in which not a single man escaped, so these phrases suggest that all flesh was totally expunged from the Earth. The difficulty for adherents of the post-Cretaceous model who register the emphasis of these phrases is that they have to explain why man was wiped out without trace while other terrestrial animals were not. The explanation offered by Snelling is that the animals were not morally accountable, implying that God intervened in the processes of nature to ensure that man was not fossilised, while, paradoxically, the animals were fossilised so that they might remind us of the penalty incurred by sin.[95] John Morris, similarly, comments that the primary purpose of the Flood was the destruction of mankind rather than of the animals.[96] Not only are such explanations *ad hoc* and unscientific, but they contravene the testimony of Genesis that **all** creatures living on the ground were obliterated, without distinction.

Terrestrial animal life was obliterated by natural processes. Whitcomb and Morris themselves point out that in most cases men and animals would not have been buried, but would have been carried about by the waters on or near the surface until they finally decomposed. The exceptions, in their view, are the animals which were buried in the Mesozoic and Cainozoic. In the view of Wise and Austin, who understand the Flood to have ended at the end of the Cretaceous, the exceptions are fewer, since many of the animals familiar to us in the modern world do not appear in the fossil record until after the Cretaceous. In the pre-Permian model there are no exceptions.

Again, it is important to keep in mind the violence of events during the first six weeks of the Flood. In still waters the corpses of most terrestrial animals will float on the surface, and a few will sink to the bottom. In turbulent waters bodies which are heavier than water take longer to sink, and in the meantime are subject to processes which rapidly reduce them to nothing: physical dismemberment through continual buffeting, consumption by scavengers and predators (sharks, marine reptiles, carnivorous fish), abrasion and pulverisation in churning sediments, chemical and bacterial decomposition. In the conditions of the first 40 days — beginning with the stripping of the original land surface to depths of thousands of metres — it is difficult to imagine that any remains of land animals could have survived in recognizable form. With its widespread volcanism and metamorphism, the Upper Precambrian record suggests that land animals were annihilated almost instantly, by processes other than drowning and decay.

Lower Palaeozoic Marine Fauna

The only element in Whitcomb and Morris's explanation of the fossil succession which in any way withstands scrutiny is the argument that most fish, unlike the animals in Cambrian strata, lived above the sea bottom and, because of their ability to swim away from danger, were likely to have been buried, if at all, higher up in the column. The few jawless fish such as *Astraspis* which appear as early as the Ordovician were bottom-dwelling armoured creatures without fins and hence probably the least mobile of fishes.[97]

However, this explanation too needs clarifying and modifying, since fossils of animals which inhabited the sea bottom are found at all levels, not just the Cambrian: something the Whitcomb and Morris scenario does nothing to explain. Moreover, except at the margins of the pre-Flood continent, even the creatures living on the sea bottom and subsequently fossilised in the Cambrian could not have been buried until after they had been transported far from their original habitats. The advantage of the fishes, which also would have been borne along by the currents, was that they could swim away once the currents slackened and their sediment loads began to settle. It is this circumstance which explains why they scarcely ever appear in Cambrian strata. Fish that were already dead when the currents slackened would tend to have been buried higher up than the invertebrates because of their greater buoyancy. The mass burials of fish which, in the Palaeozoic, occur in Devonian strata were mostly the result of shoals being overwhelmed by epicontinental landslides while they were still alive. Since the conditions most favourable for such burials were shallow waters near emerging land, they are evidence that by the early Devonian the Flood was already waning.[98]

The conditions which resulted in fossilisation need to be interpreted with care. As is often pointed out, soft-bodied animals were occasionally preserved in astounding detail; so were the fragile stems of crinoids (sea-lilies), their ossicles still joined up in columns; delicate starfish were also occasionally buried undamaged. But as well as testifying to rapid deposition, such examples cannot have been transported a great distance. While it **might** be possible to interpret a few of the Ediacaran assemblages as virtually *in situ* burials, most examples are probably better understood as rapid colonisations of temporary seafloors. Palmer and Palmer describe a Middle Ordovician hardground in north-east Iowa which was colonised by worms, crinoids and bryozoa.[99] The bryozoa were not full-grown and occurred in scattered clumps, and in contrast to the generally complete cover of modern hardgrounds, the Ordovician example showed an overall five per cent cover, a poverty which the Palmers attributed partly to intensity of erosion. In the context of the Palaeozoic as a whole it might equally be attributed to brevity of non-deposition. Except in mid-continental exposures of the Ordovician strata, Palaeozoic hardgrounds are rare and invariably immature. They appear to have permitted limited colonisation because during the remainder of the Flood sedimentation there was light.[100,101] Comparatively low rates of sedimentation cannot always be adduced, however. Crinoids in particular seem to have 'bloomed' in the warm, carbonate-rich waters with extraordinary rapidity.

The existence of colonised hardgrounds together with the preservation of largely intact echinoiderms, trilobites

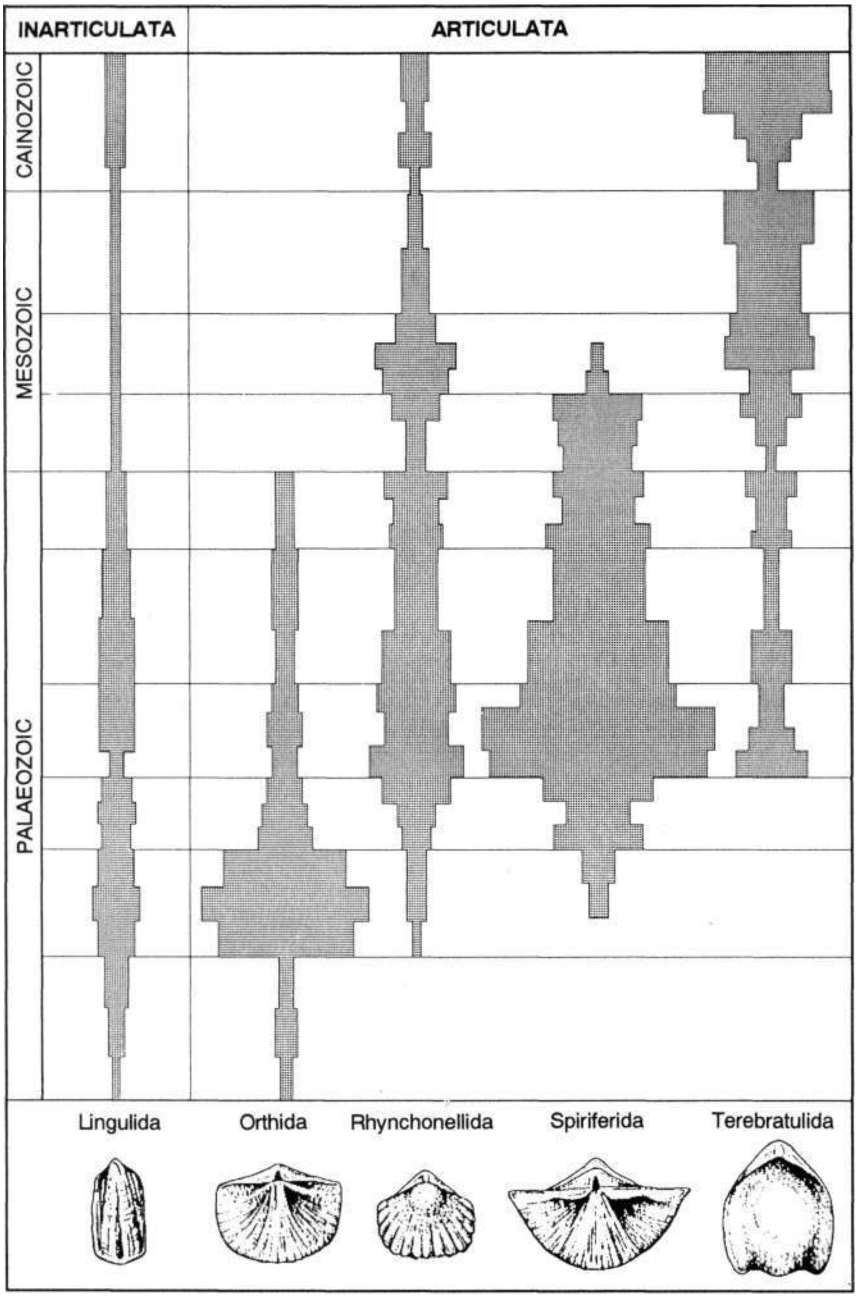

Figure 6. *Geological ranges of most brachiopod orders and their frequency of occurrence (after Ward). Not shown are* Pentamerida *(Cambrian to Devonian) and* Strophomenida *(Ordovician to Jurassic).* Lingulida, Rhynchonellida *and* Terebratulida *survived beyond the Tertiary to the present day. There is no evidence of progressive evolution from one order to another: they overlap, and indeed, during the Devonian through to the Permian all five orders occur. However, if the theory of evolution is deficient, how should Flood geology explain such patterns? According to the prevailing Whitcomb and Morris model, the creatures which lived on the sea bottom should all appear first in the Cambrian and cease to appear no later than the Carboniferous, when the sea is supposed to have begun spilling onto the land. The model fails to account for the fossil succession because It has not considered where, geographically, the pre-Flood sea is to be found and hence where the bottom of that sea is to be found. To attribute the appearance of invertebrates in Cambrian rocks to the burial of pre-Flood sea bottoms at the same time as attributing their appearance in Cretaceous rocks to the transgression of Flood waters onto pre-Flood land seems 'illogical or at the very least ad* hoc' *(Morton). Very often Cretaceous rocks lie above Cambrian (and later) rocks in the same region.*

It is proposed that the order in which all but the last type of brachiopod first appear may be explained by reference to the Cambro-Ordovician transgression (Figure 7). During the Devonian the land began to emerge from the waters, thereby instituting a different current regime. The first appearance of terebratulids in the Devonian was the result of supervening northerly and southerly currents bringing in a fauna previously confined to high latitudes. This would also explain why the Devonian was the period of maximum faunal diversity in the Palaeozoic.

and other invertebrates, makes it clear that temporary surfaces were being colonised during the Flood itself, sometimes by creatures that had come into existence during the Flood. It is unlikely to be the case that a broken brachiopod in some Silurian deposit was spawned on a pre-Flood seafloor and then transported hundreds of miles to its burial place; it might have been spawned on an Ordovician surface which was several months later eroded away, by the same powerful currents that broke its shell. Some 'reefal' deposits may call for a similar explanation.

As noted by Johnson and Baarli, published studies of presumed rocky shores older than the Cainozoic are rare.[102] Their report on a site in Manitoba, Canada, where Lower Silurian (possibly Upper Ordovician) limestone overlies Precambrian quartzite does not suggest a pre-Flood shore. Colonies of the tabulate coral *Favosites* were found, not on the basement itself, but only on the smoothly eroded boulders, 2-10 metres in diameter, which had broken away from the quartzite. The corals represent temporary colonisation during the Lower Palaeozoic.

Once it is recognized that all sedimentary deposits from Upper Precambrian to Devonian lie over pre-Flood land or continental shelf, it becomes possible in principle to explain not only the general succession from invertebrates to vertebrates, but also the biostratigraphic zonations which, on a much more refined scale, are used in relative dating.

Figure 6,[103-105] for example, shows the geological range of certain types of brachiopod — a real succession, in which the first orthids precede the first rhynchonellids, the first rhynchonellids the first spiriferids, and the first spiriferids the first terebratulids. Figure 7 illustrates how their strati graphic order may have been a translation of the order in which they were transported from their pre-Flood habitats. Although the explanation needs to be applied to particular sequences, the transgressive nature of the Lower Palaeozoic is well established and supported by studies which show a marked increase in the incidence of deep-water fauna from Cambrian to Ordovician.[106] The proposed model simply associates two facts — Lower Palaeozoic transgression and fossil successions — which have hitherto been understood in isolation.

The Re-emergence of Land

Although Genesis does not say explicitly that mountains were formed at the end of the Flood, orogenesis may be inferred to have taken place as part of the process whereby the land emerged above the water.[107] Thus, one of the reasons given by Whitcomb and Morris for putting the closing stage of the Flood at the end of the Pliocene was that major orogenesis took place about this time, both during the Pliocene and through much of the succeeding Pleistocene. The Alps, the Andes and the Himalayas all rose thousands of feet, and there was widespread uplift in other regions.

However, this is not as good a fit with the draining of the Flood waters as the authors make out. For one thing, according to their chronology these uplifts must have taken place near the end of the Flood, whereas in Genesis the mountains first became visible less than two thirds into the Flood year. By that point orogenesis must already have been at an advanced stage, for the emerging mountains must have resulted from the uplift and folding of newly laid strata that had previously been at the diluvial sea bottom. Hence, the occurrence of an orogenic episode at the end of the Flood, assuming the Whitcomb and Morris model, is no argument in its favour. There were in fact earlier orogenies, notably the stupendous Caledonian and Variscan orogenies of the Palaeozoic, and these were followed by a period of relative stability during the Triassic, Jurassic and much of the Cretaceous.

In the Mesozoic there is no juncture where the whole Earth could be said to have been thenceforth under water. That juncture is to be found only in the Ordovician, whereas as we shall consider presently, dry-land structures occur all through the Mesozoic: subaerially deposited basalts, aeolian red beds, root beds, bird and animal tracks, dinosaur nests and so on. Nor is there a juncture still higher in the Mesozoic where it is possible to claim that the first surfaces began to emerge from the water. That juncture is to be found much earlier at the end of the Silurian.

The Coal Measures

Coal does not occur in the geological column until the Upper Devonian. On northern continents it is most abundant in the Upper Carboniferous, on southern continents (the original Gondwana) it abounds in the Permian, and in both cases the deposits are nearly all located on the then continental margins. A second concentration of coal deposits begins in the Cretaceous and climaxes in the Tertiary (see Figure 3). Since this pattern of distribution is worldwide and can hardly be fortuitous, it requires an explanation.

Coal consists of carbonised fragments of plants and wood, sometimes preserved in fine detail. Among the coal beds it is not unusual to find upright tree trunks projecting through intervening shales and sandstone into the next bed above, and since these trunks lack most of their root systems, they demonstrate, along with other evidence, that the coal vegetation was transported by water.[108]

Most of the enclosing sediments are land-derived, resulting from floodplain and fluvio-deltaic progradation into deep basins.[109] That is, they formed laterally rather than vertically. The sedimentary cycles are extremely diverse,[110] with some comprising a fining-upwards sequence and others a coarsening-upwards sequence. Often one such cycle is immediately followed by another, without accompanying vegetation.

Most diluvialists have understood the coal measures to originate from mats of floating vegetation which were ripped from the land during the Flood. As the mats became waterlogged, they sank to the bottom and were covered by sedimentation, rather as happened to the water-logged tree bark on the surface of Spirit Lake after Mt St Helens erupted. This parallel has been drawn by several authors.[111-114] They

THE FIRST DAYS OF THE FLOOD

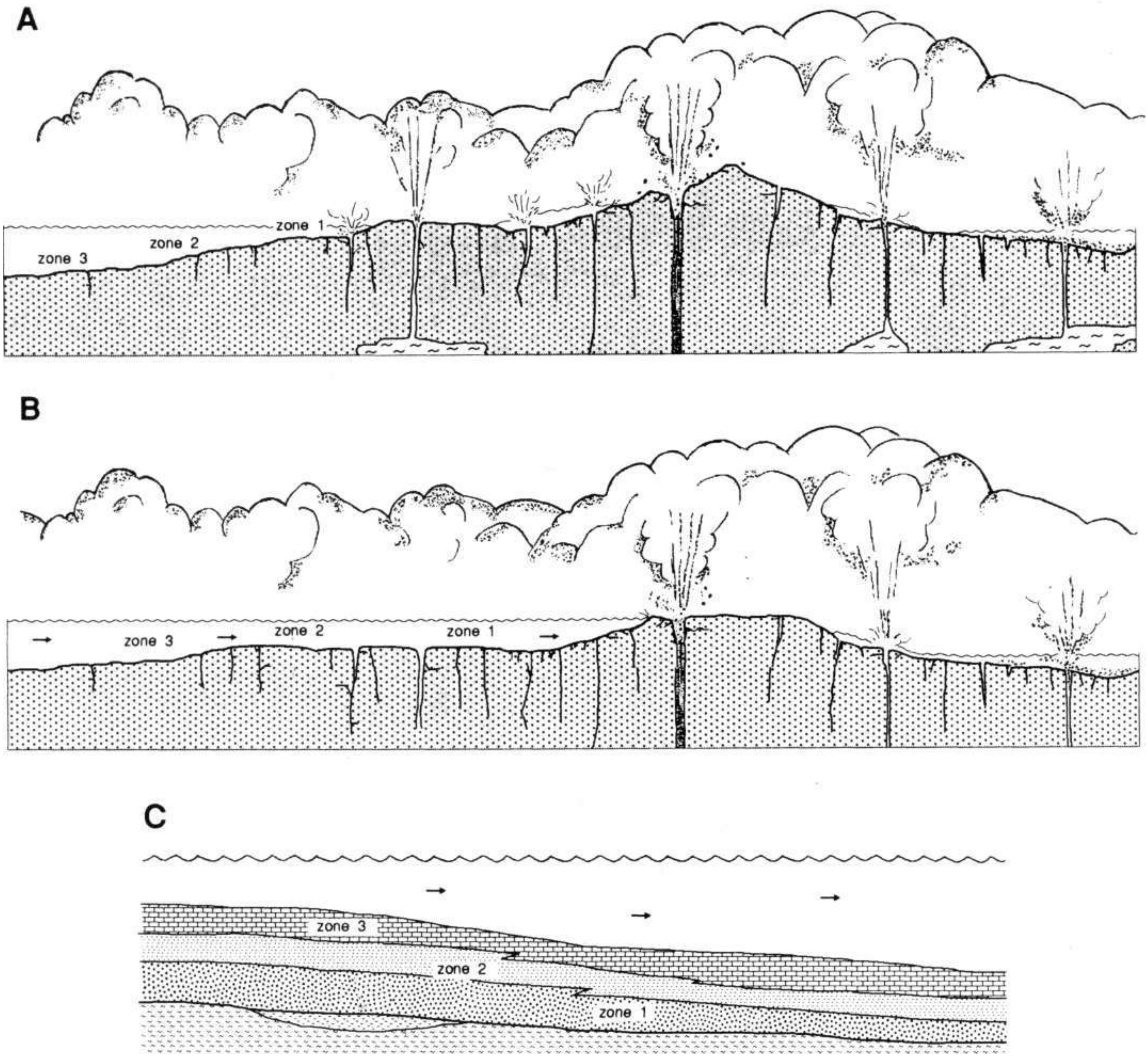

Figure 7. A *The Flood began with the springs of the great deep breaking forth, accompanied by torrential rain. The great deep lay beneath the land in natural chambers (Psalm 37:7) and may have been in the form of superheated water, which was released to the surface via the springs, which thereby irrigated the land. When the fountains erupted, much of the water escaped to the surface in the form of steam, which then condensed as rain. Within weeks phreatic stripping, combined with intense volcanism, earthquakes and rainfall, had broken up and flattened the Earth's surface to a depth of perhaps kilometres. Metamorphism may also have accompanied this sudden outflow of heat.*

B As the chambers emptied, the land sank and the sea invaded the land. The zones are distinct marine communities comprising

(i) fauna suited to the ecological conditions, especially water depth,

(ii) fauna common at the family level to several zones, and

(Hi) fauna which reflect pre-Flood speciation resulting from gradual dispersion and isolation.

C A closer view some days later. The fauna of zone 1 is picked up first because it is nearer the coast, and in the shallower water the currents are more violent. These factors operate to bring about both horizontal and vertical differentiation as the marine sediments are redeposited. That is, the fauna of zone 3 is deposited later and higher than the fauna of zone 2, and zone 2 later and higher than zone 1. Thus rapid marine transgression may account for the regular order of many macrofossil species in the Cambrian and Ordovician, and possibly also the Silurian. Often the trend is towards increasing size. Note that zone boundaries in the fossil record will not necessarily coincide with lithological boundaries.

point out that some of the trees dumped into the lake by mud flows sank to the bottom upright and retained that position when they became embedded. In general, however, diluvialists have been concerned more to demonstrate the allochthonous origin of coal than to show how it might have been formed in the Flood. Coffin, for example, after developing a powerful argument for its allochthonous origin, suggests vaguely that it was formed in the rising and falling of tidal waters as they began to overwhelm lowland forests[115] — an idea that comes little short of proposing an autochthonous origin.

A demonstration that the vegetation which turned into coal was transported is, of course, a demonstration that it was deposited in some sort of flood. But it cannot be assumed that this flood was a global inundation which began before the Cambrian and ended after the Cretaceous. For one thing, the Permo-Carboniferous, where most of the world's coal is concentrated, is about half way through the Upper Precambrian to mid-Tertiary succession, and *pro rata* therefore comes about 180 days into the attributed Flood year. If the waters were then still rising and only beginning to reach the lowland forests, it is difficult to see why in some places the forests should not have been buried (if there was enough sediment with which to bury them) where they grew. Indeed Coffin speculates that the trees of these forests may have been less buoyant than those growing in upland areas and (one is left to infer) may not have been light enough to float to the surface.

As with the idea that land animals had an opportunity to flee to higher ground, the geological record is matched to the Genesis record, after much catastrophist argument, only by postulating a tranquil Flood scenario. Presumably 'lowland forests' include those which were within a few hundred feet of the pre-Flood sea level, so that the rate of inundation since the start of the Flood could hardly have exceeded one or two feet per day! Yet Coffin states that by the end of the Permian the whole earth was under water — just one geological system later (Table 3).[116]

In the post-Cretaceous model, as in the pre-Permian model, the coal measures cannot represent *in situ* forests, because together with the intercalated (marine) sediments they commonly occur stacked one on top of the other. Moreover, they lie on top of marine deposits which show that the sea had reached the land long before — at the latest by the Ordovician.

The Mt St Helens catastrophe is an inadequate analogy, not least because freshly uprooted trees float, and as those on the surface of Spirit Lake demonstrated, it takes years for floating trees to become so saturated that they sink to the bottom.[117] Consequently, if one's Flood model requires that the mats of ripped-up vegetation were deposited in the middle of the Flood year, an explanation has to be found for why they sank within months, before even the carcasses of reptiles, birds and mammals. The problem is particularly acute in relation to the evidence that much of the vegetation in the Permo-Carboniferous seams was originally aquatic rather than terrestrial. As Scheven has noted, the aerated structures and radial arrangement around the main stems indicate that the plants were designed to float.[118,119] Far from being less buoyant than the vegetation of Tertiary coal seams, they were more buoyant.

Another problem with the Spirit Lake analogy is the thickness of the deposits. Thirty-foot (10 m) seams are not uncommon, particularly at the Cretaceous-Eocene level; one very pure seam in the Powder River Basin of Montana (Palaeocene) is over 200 ft (about 60 m) thick. Since the pieces which make up a waterlogged mat of vegetation do not sink to the bottom all at once but little by little, each seam would have to represent an uninterrupted episode of deposition lasting months, even years. The seams themselves, however, indicate that they were each deposited within days, since they contain little or no admixture of sediment and any intercalated layers (partings) are generally pure sediment. How should one explain this dearth of sedimentation, while between the seams there are often thick successions of limestone, shale, sandstone and clay? How could, in places, up to 200 seams be formed in the course of one stage of the Flood year, when by any process akin to Spirit Lake's just one seam of average thickness would take months to form?

The answer, so far as the Permo-Carboniferous is concerned, must be that the measures represent forests of aquatic vegetation — thick platforms of interlocking roots and entangled debris, covering thousands of squares of miles —which were grounded as the waters continued to drain off the land after the Flood year. Successive currents washed the vegetation (including flotsam) into deepening offshore basins, while prograding sediments from the land spread out under the water and thereby anchored the forests.[120] Subsidence within the basins could have been the effect of several factors: the downward pressure of the massive deposits now weighing on the Precambrian basement (isostatic adjustment), the continuing consolidation and compression of those deposits, and the elevation of other land nearby (orogenesis). Soon after a raft of vegetation became anchored in shallow-water sediments, the progressive sinking of the sediments pulled the vegetation below water level in advance of the next prograding cycle.

Such processes clearly require time. Within the 800 m thick succession of Pennsylvanian deposits in the Eastern Interior Basin of Illinois and Indiana no less than 51 separate delta advances have been distinguished.[121] Together with other evidences of time in the Upper Carboniferous, the cyclothems cannot be satisfactorily explained as the deposits of a few months.

Coal is not the only rock-type of the Carboniferous to show the characteristics of shallow water and rapid ebbing and flowing. Howe and Williams draw attention to the repeating interbeds of sandstone, siltstone and shale in the Haymond flysch in Texas.[122] Supporting Flores' interpretation that these represent a very shallow environment which continually received pulse-like influxes of sediment, the authors suggest that they developed during the intense draining of inland seas around the end of the Flood. Likewise Williams *et al.* refer the Upper Devonian strata of the Appalachian Plateau to the last stages of the Flood or even immediately after the Flood, and note the similarity between the Haymond Formation and the flysch beds of Pennsylvania's Lock Haven Formation.[123] Speaking of the cyclothems which characterise many Carboniferous coal

GEOLOGICAL COLUMN	GENESIS FLOOD NARRATIVE	COMPARISONS AND COMMENTS
Precambrian	Pre-Flood	Breakup of Earth's crust
Cambrian	Heavy rain (Genesis 7:11,12) Subterranean waters released (Genesis 7:11)	Erosion and deposition of pre-Flood ocean sediments. Formation of the great Precambrian/Cambrian unconformity Burial of benthonic animals
Ordovician	Rising water (Genesis 7:20)	Upward coarse to fine grading of sediments
Silurian	High water (Genesis 7:24)	Deposition of thick shale and limestone
Devonian	Tidal and wave action (Genesis 8:3)	Cyclothems: rhythmic deposition of sediments
Mississippian	Water covers all the land (Genesis 7:20)	Formation of coal. Burial of lowland forests, trees of greater density and/or less buoyancy
Pennsylvanian		
Permian	Rain stops, wind starts (Genesis 8:1,2)	Cross-bedded sandstones
Triassic	Mountains rise (Genesis 8:5)	Moving continents
Jurassic	Waters start to recede (Genesis 8:5)	Mountain-building (tectonic) activities
Cretaceous		Major erosion of emerging mountains. Guyots
Palaeocene	Ravens and doves released (Genesis 8:8–12)	Burial of reptiles Formation of coal. Burial of upland forests, trees of less density and/or more buoyancy
Eocene		Burial of mammals
Oligocene	Water continues to drop (Genesis 8:13)	Sediments accumulate along continental margins Less dense and less well indurated strata
Miocene		Major volcanic activity
Pliocene	Ark abandoned (Genesis 8:14,15)	Localised sediments and valley fills
Pleistocene	Post-Flood	Post-Flood erosional reworking of surface sediment
Recent		Post-Flood climatic changes (glaciation)

Table 3. *Coffin's summary of his interpretation of the geological column, an elaboration of the interpretation proposed by Whitcomb and Morris. The comments (third column) are not in harmony with the Genesis narrative (second column): for example, the 'burial of lowland forests' in the Carboniferous implies that the water had not yet reached the 'upland forests' buried in the Tertiary.*

beds, Woodmorappe writes:

> *'The basic sedimentary, stratigraphic, and tectonic properties observed in cyclothemic rock provide a picture of the recessional aspects of the Flood.'*[124]

It is noteworthy that in many places Devonian strata constitute the uppermost rocks of the Appalachian Plateau.[125] Elsewhere the record ends with the Lower or Upper Carboniferous, for example in Virginia, Indiana and Tennessee. Far from showing increasing inundation, the Devonian was the time when the Appalachian Mountains began to be uplifted — a process which continued into the Triassic. Drainage off the emergent slopes resulted in the formation of coarse-grained meander-belts below, above and at the same level as the coalfields immediately west of the Appalachians, until the conditions for sedimentary deposition in the area ceased.[126] Similar drainage channels have been reported from the British coalfields.[127]

Emergence as a Result of Orogeny

The first major phase of mountain-building after the Precambrian is known as the Caledonian orogeny. In different parts of the world this occurred at different times, but altogether it spanned the period from Late Cambrian to Late Devonian. Most of the upheavals took place under water, in the course of continuous diastrophism from volcanic eruptions and colliding landmasses.

The uplands on which the Ark came to rest on the 151st day may also have been a product of this uplift. According to geological sections of the Ararat region, pre-Carboniferous Palaeozoic rocks underlie the whole area, and often remain uncovered until the Late Cretaceous.[128] Apart from isolated instances of Late Palaeozoic rocks, the time from the end of the Devonian to the Late Cretaceous is unrepresented: Triassic, Jurassic and Early Cretaceous are absent entirely. The most natural explanation for this absence is not that deposits from those times were eroded but that they were never laid down at all, because the region was above water. There is no reason to dissent from the standard interpretation of Mesozoic rocks that they mostly represent episodes of genuine transgression and regression, that is, fresh episodes of flooding.

The same point may be made in relation to other mountain ranges which rose during the Caledonian orogeny. The classic case is of course the Highlands of Scotland, where the youngest rocks are post-orogenic granites of late Silurian to early Devonian age and the Old Red Sandstone, which spans the entire Devonian. Unlike the granites, the sandstones are confined to low-lying areas, principally around the Orkney Islands, Caithness and the Moray Firth. The only rocks later than the sandstone are some Jurassic deposits along the coast of Sutherland and patches of red sandstone on the south side of the Moray Firth, which — on the basis of reptile remains — are assigned to the Permo-Triassic.[129]

South of the Highland Boundary Fault and north of the Southern Uplands Fault lies a large graben known as the Midland Valley (see Figure 8).[130,131] Here Ordovician and Silurian sediments are succeeded by the Old Red Sandstone, Devonian lavas and tuffs. These faults developed towards the end of the Ordovician and controlled the deposition of the 7,000 m thick Old Red Sandstone, for immediately north of the graben it is completely absent, whereas to the south it penetrates only the coastal area east of Selkirk.[132] Just as in the Highlands, the pattern of sedimentation strongly suggests that the mountainous land was above sea level when the Devonian sandstone was laid down. Indeed, the Highlands appear to have remained above sea level from the Devonian to the present day.

There are no Mesozoic rocks even in the graben. Above the sandstone follow Carboniferous oil shales, a vast spread of basaltic lava and a typical series of coal measures. Non-fossiliferous red beds conclude the Carboniferous and the whole succession: large-scale, cross-bedded 'dune' sandstones. Apart from possible remnants of Permian volcanism, the only later rocks are dykes from the Tertiary period.

The Scandinavian highlands, which belong to the same orogenic belt as the Scottish Highlands (and, on the other side of the Atlantic, as the Appalachians), afford an even simpler illustration of the point. These mountains, it is generally recognized, have been above sea level since the end of the Silurian.[133] In Norway Devonian rocks are restricted to a small patch of coast 80 miles (130 km) north of Bergen. While Devonian deposits doubtless once fringed a much greater part of the coast and have since been eroded away, there is no reason to think that they were ever deposited far inland. Outside the Oslo region Permian rocks do not occur at all, and the only Mesozoic rocks consist of Late Jurassic and Early Cretaceous sediments — preserved thanks to downfaulting — on the island of Andoya. The rest of Norway's Jurassic and Cretaceous lies in the North Sea.

The Old Red Sandstone is the result of Siluro-Devonian erosion of the areas uplifted in the Caledonian orogeny, the primary agent of erosion being the draining of the waters which had previously covered them. The direction of palaeocurrents shows that the Old Red Sandstone of Caithness and Orkney accumulated from drainage off land to the west.[134] In South Wales the lower Old Red Sandstone includes metamorphic clasts which must have come from the Caledonides — the Scottish Highlands or the 'mountains' of Northern Ireland.[135] Later in the Devonian the currents were interrupted by uplift of the Welsh Caledonides, which lie between South Wales and Scotland, and these then replaced the earlier source areas. Snowdonia and much of the Welsh interior were now above water, and as with the Scottish Highlands, there is no reason to suppose that they ever ceased to be above water. The uppermost rocks in Snowdonia are Ordovician; in other places they are Silurian or Ordovician.

Likewise the uppermost rocks of the Pennine region are Carboniferous: Lower Carboniferous in the north passing into Upper Carboniferous (Westphalian) as one approaches the Lancashire coalfield. That is, from Scotland southwards there is a consistent trend of marine regression. There is no evidence that these uplands were ever covered by the sea after the Carboniferous. Further south, traversing England from Shropshire to London, the uppermost rocks are Triassic, Jurassic, Cretaceous and Eocene, in that order. Here too most of the land is believed to have been above sea level in Permian times, following uplift towards the end of the Carboniferous. In most places an unconformity separates the Carboniferous from the Mesozoic. The Carboniferous limestone around Bristol was exposed to the air until the Late Triassic. By that time pluvial erosion had formed caves and fissures into which small animals fell, including *Morganucodon* and some of the earliest dinosaurs, entombed by the transgressions of the Late Triassic and Early Jurassic.[136] In Somerset, Jurassic oolite rests with angular unconformity upon the same Carboniferous limestone. The top 50cm of the limestone is densely burrowed by polychaete worms and the mollusc *Lithophaga* — organisms which by the secretion of chemicals burrowed into solid rock. Above it, cemented to its surface, is a crowded, *in-situ* oyster bed. The assemblage implies a considerably longer period than the few weeks permitted by the post-Cretaceous model.

The uplift towards the end of the Carboniferous and continuing into the Lower Permian was part of a second phase of mountain-building (though scarcely distinct from the first) known as the Hercynian, or Variscan, orogeny. During this phase, the continental plates which had rifted apart in the first weeks of the Flood came together to form the Pangaea supercontinent, and as they collided, they became compressed, causing extensive uplift and upheaval. Among the mountain ranges originating from this time are the Alleghenian belt in the Appalachians, the Ouachita belt in Texas, the Hercynian belts in Europe (that is, all the mountain ranges of non-Scandinavian Europe except the Apennines) and the Mauritanian belt in North Africa. Some of the uplifted areas were subsequently flooded again in the Jurassic and Cretaceous, as renewed tectonism split Pangaea apart. Hot magma surging up from the rifts spread out to form new ocean floors, displacing huge volumes of water by reason of its buoyancy. At no point in the Mesozoic, however, is there evidence that the whole Earth was flooded.

THE END OF THE FLOOD

Whereas the Noachian Flood began suddenly, at a definite moment, and therefore, at least in principle, should be capable of being identified with a definite point in the geological record, its ending was gradual and protracted. The day on which Noah went forth from the Ark was not a geological event, and one cannot be precise about where that day falls in the geological record, always supposing that the record admits of such precision. Indeed, geologically

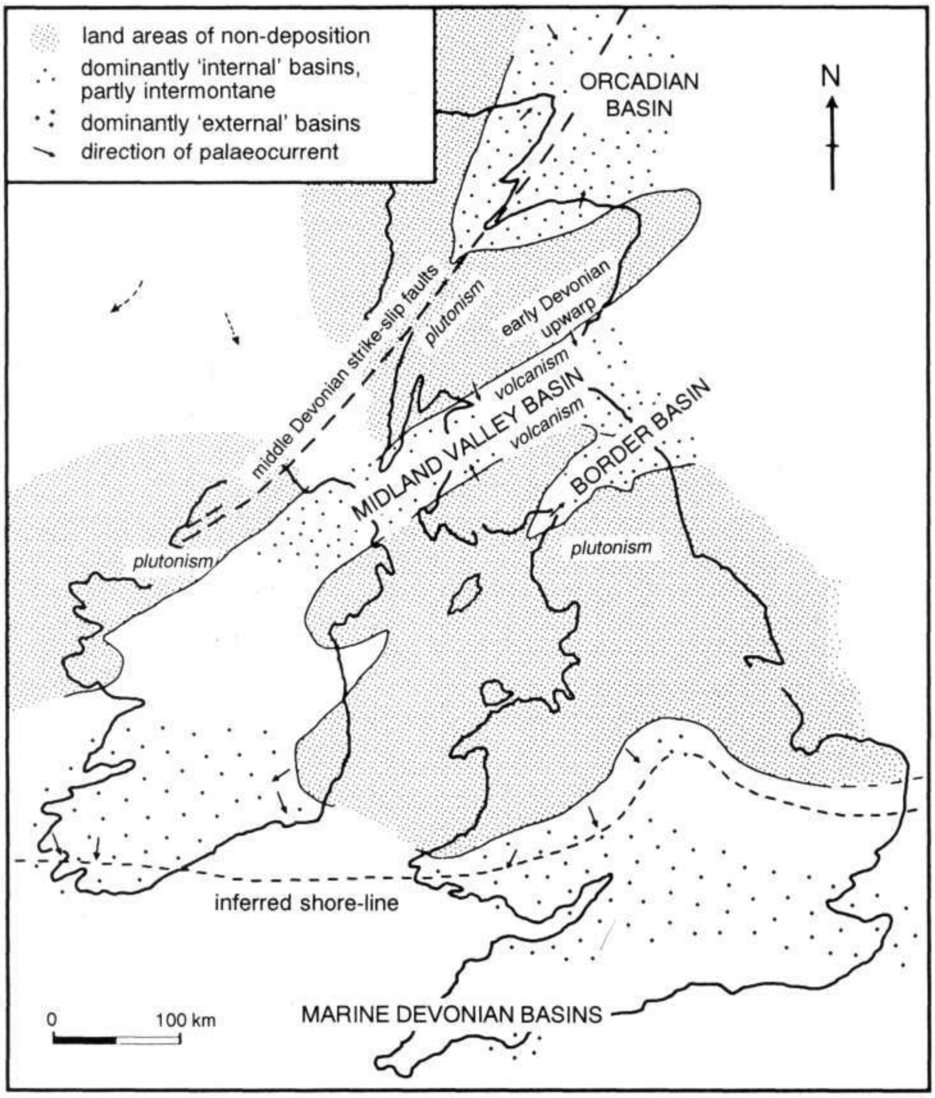

Figure 8. Deposition of Britain's Old Red Sandstone during the Late Devonian, corresponding to the regressive phase of the Flood. The sandstone was eroded and redeposited as the waters drained off the emergent land. Palaeocurrent directions, distribution patterns and upwarping of land areas are not compatible with the hypothesis of incipient transgression. (Sources: Anderton et al. *and Cope* et al.*)*

the Flood or its after-effects — depending on how one defines its end — continued for many years. After a cataclysm of such magnitude, it could hardly have been otherwise.

As Wiseman demonstrated long ago, the account of the Flood in Genesis 6:9b-10:l is that of the sons of Noah; an eye-witness account, based on what the survivors of the Flood actually observed.[137] If this is clear from the colophon at 10:1a, it is also clear from such details as the (minimum) 15-cubit depth of the water over the highest land, which was almost certainly inferred from the draught of the Ark. While the mountain tops were first sighted on the first day of the tenth month, in other regions some may have emerged before the tenth month. The return of the dove which the survivors released from the Ark enabled them to infer that *'the waters were still on the face of the whole earth'*, since if water still covered much of the Ararat region, it was also likely to cover the more low-lying regions further off. By contrast, when the dove was sent forth a third time and failed to return, they could affirm only that the land was dry in their vicinity. *'Noah . . . looked, and behold, the face of the ground was dry'.* (Genesis 8:13) The eye-witness nature of the account is emphasised. Unlike verse 9, this verse does not speak of the 'whole' Earth, and indeed, given the varying degrees of uplift, subsidence and dislocation which different parts of the Earth had undergone during the Flood, it could not be that the Earth which was then dry was precisely the same in extent as existed at the beginning. The Hebrew word *erets* can mean either 'land' or 'earth'. When the text says *'the waters were dried from off the earth'*, this should be understood as meaning that the waters had drained from the Ararat region — what Noah could affirm from his own knowledge — rather than that the Earth everywhere had become dry. Equally, we do not know the precise extent of the pre-Flood land; if subcontinents such as the Canadian shield were originally submarine platforms, it could have been much smaller than the area encompassed by the present subaerial continents.

Some of present North America was still under water at the end of the Lower Carboniferous (as also at the end of the Cretaceous), so that sedimentation there continued into the Upper Carboniferous and beyond with little intermission. Genesis does not require us to deny this, or to deny the evidence of water-deposited Permian strata elsewhere in the world. Whether the red beds of this period were formed by sedimentary action or aeolian action, or a combination of both, is a matter of geological and palaeontological assessment and is rarely easy to determine.

More decisive for establishing the existence of dry land are the places where there appears to have been no deposition. In Scotland and Norway deposition after the Silurian (not just in the Devonian) seems to have depended entirely on topography. The same is true of central and eastern parts of the United States. In this respect there is something of a general contrast with the pre-Permian record. The lack of sedimentation, for example, between Cambrian Muav and Lower Carboniferous Redwall in the Grand Canyon appears to be due not to any uplift of that region during the Middle Palaeozoic but to a drop in current strength, perhaps coupled with exhaustion of sediment sources and followed by a drop in water level.

The tracks in the Coconino Sandstone of the Grand Canyon illustrate a related point. The formation belongs to the Permian system, more than halfway up the geological record, and according to Brand,[138139] some of the tracks appear to have been made by tetrapods moving up the slopes of sand waves under water. Because of the angle of the cross-beds, which indicate dune heights of 10-18 m, Austin *et al.*[140] have concluded that the tracks were formed under 54 m of water by amphibians attempting to reach higher ground during the Flood. The current speeds are estimated to have been over 90 cm per second.

Amphibians do not live at depths of 54 m, however! To account for their presence at the bottom, it seems more plausible to suppose that the amphibians were previously in shallow water and subsequently became engulfed by deeper water, on successive occasions; probably they did not make the evenly spaced footprints until the currents decreased and the water level dropped (if the prints were indeed made under water).[141] At the base of the Cocolnino there is evidence of time having passed, sufficient for 600 m of sandstone, shale and limestone to have accumulated elsewhere in Arizona, between the underlying Hermit Formation and the Coconino.[142] The Hermit Formation itself shows low-energy shallow-water deposition, comprising 100 m of thin siltstone layers alternating with very fine sand and clay. Reptile or amphibian footprints are also found in these rocks.

If the Hermit and Coconino Formations represent the deposits of Flood waters as they encroached upon the land, how is it that immediately beneath the Hermit Formation we find sediments thousands of feet thick which must also be ascribed to the Flood? If the Permian marks the point in Arizona where the sea transgresses onto the land, why are the deposits beneath the Permian not all considered pre-Flood deposits? In practice, Austin *et al.* argue that the Flood waters reached Arizona as early as the Lower Cambrian.[143] The Hermit and Coconino Formations must therefore have been laid down after Arizona was submerged, and the presence of tracks at those levels is more problematic than they suppose.

Once it is accepted that the Earth was completely submerged by the Upper Ordovician (at the latest), subaerial surfaces thereafter must be taken as marking a stage when the Flood waters were ebbing. But in order to determine more precisely where the Flood year ended in the record we must also have regard to the palaeontological evidence, particularly in relation to the period after the Flood year. The following criteria would appear to be crucial for distinguishing that period:

(1) There must be an absence of land-dwelling animals.
(2) It must have been possible for the animals released from the Ark to colonise every continent.

(3) There must be evidence of gradual revegetation.
We shall consider these in turn.

Absence of Land-Dwelling Animals

Because every kind of land animal (including birds) had been wiped out, the Earth after the Flood had to be repopulated with animals preserved on the Ark. Noah stepped onto an Earth barren of such life, and it would be many decades before the more distant lands might host populations sufficiently numerous for catastrophic events to petrify unlucky individuals in the fossil record.

Neither the beginning of the Tertiary nor any juncture thereafter corresponds with this situation. Not even a small part of the Tertiary record is empty of land-dwelling animals, still less the whole of it. On the contrary, the abundance of terrestrial fauna of very diverse types throughout the Cainozoic shows that the post-Flood boundary must be placed a considerable time before that era. On Ellesmere Island, for example, just 500 miles (80 km) from the North Pole, remains of lizards, constrictor snakes, tortoises, alligators, tapirs and flying lemurs are dated to the Palaeocene and Eocene.[144-146] The oldest marsupials so far discovered come from the Early Palaeocene of Bolivia,[147] the oldest ground sloths from the Oligocene — also in South America.[148] How, if the Flood ended after the Cretaceous, could these slow-moving animals have reached places so distant from the Ararat mountains so soon after they left the Ark?

There are also many instances of faunal lineages which pass through the supposed Flood boundary uninterrupted, including birds, snakes, lizards, crocodilians, platypuses and ant-eaters. How did some of these animals not become buried until the very close of the Flood? And how was it that they continued to be buried, in increasing rather than diminishing numbers, immediately thereafter? How could snakes have crawled from the Ark all the way to North America without any time intervening? Across the boundary there is phylogenetic continuity on each and every continent.

The absence of many other kinds of slow-moving creatures before the Tertiary — such as shrews, moles, hedgehogs, sloths — is also problematic for the post-Cretaceous model. Whereas Whitcomb and Morris expected that generally the Flood should have buried the smaller and slower-moving animals before the larger and faster-moving ones, in reality many slow-moving animals made their first appearance in the fossil record long after the more mobile ones, at a point where the Flood is supposed either to have been in its closing stages or to have ended completely. On the other hand, some of the fastest animals, including the cheetah, do not appear until the end of the Tertiary (see Figures 9 and 10).[149-150] Mehlert, for one, puts the Flood boundary early in the Miocene, because that was when *'the vast global depositions common to previous periods and eras seem to have ceased'.*[151] But if the various sorts of cat could be preserved in the sporadic depositions which are assigned to the period immediately after the Flood, why was not a single cat fossilised in the global deposition of the Flood itself? The earliest cat fossils are Oligocene. Similar observations could be made of most other mammals.

One has also to take into account the animals which appear in the Cretaceous for the last time. It is by no means obvious that the dinosaurs suddenly disappeared from the record at the end of the Cretaceous because they were wiped

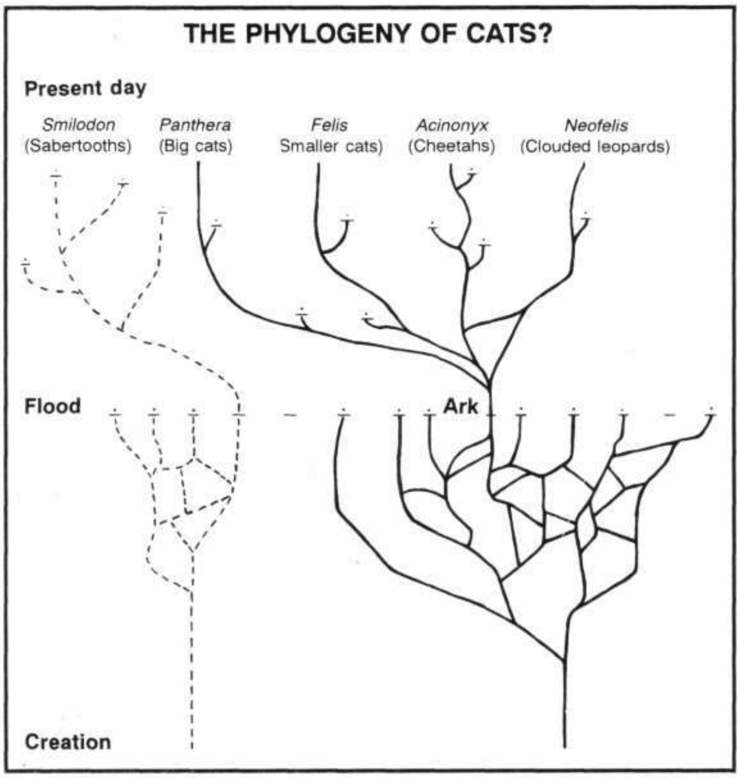

Figure 9. Mehlert's proposed history of cats since the Creation (above) typifies the confusion engendered by the post-Cretaceous model. Mehlert considers that the Flood ended probably early in the Miocene. However, the first cats appear in the Oligocene, that is, the previous 'epoch', and not in the Ararat region but in North America. Even if one put the end of the Flood immediately after the Cretaceous, one would have to allocate a substantial span of time — over a hundred years — to the period between the release of the first cats from the Ark and the first chance fossilisation of their descendants in the Oligocene. Moreover, it is very questionable whether the first cats in the fossil record (for example, Dinictus,*) are the direct ancestors of those which appear later. Mehlert's suggestion that all extant cats descended from* Dinictus *is groundless, and all the lines which connect the different families should be dotted. Similarly, all lines beneath the Flood boundary should be dotted, since there is not a single fossil of a cat before the Oligocene, let alone the profusion of forms shown in the diagram. Mehlert's belief that 'the* forms below the line delineating the Deluge would have mostly been buried and fossilised' *does not accord with the facts, that is, the total absence of cat fossils before the Oligocene. By contrast, if one puts the end of the Flood in the Carboniferous, extant cats and the sabre-tooth cats may be regarded as having descended from the same stock.*

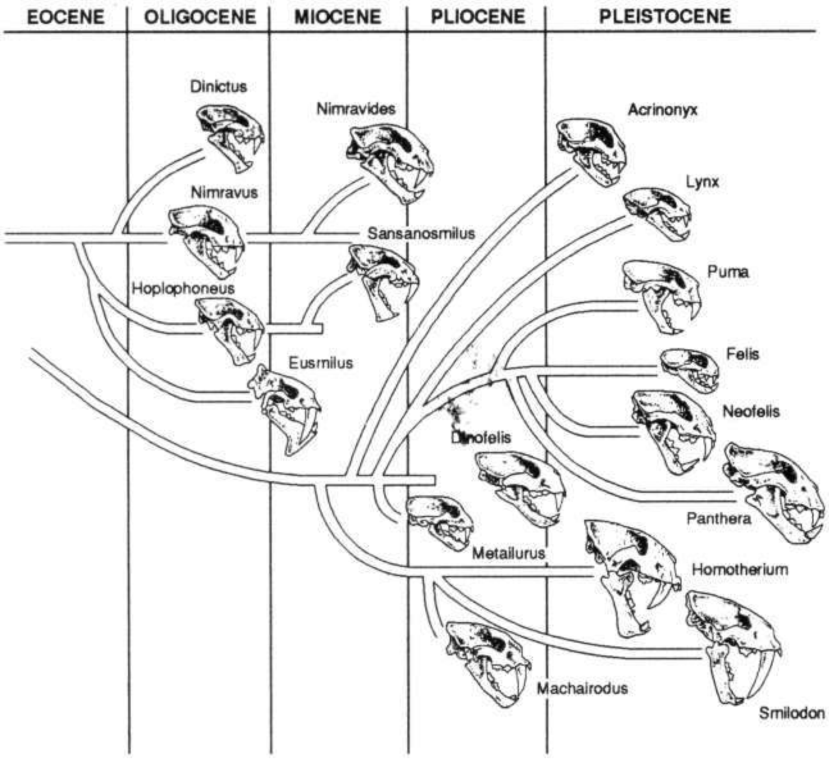

***Figure** 10. An alternative phytogeny, adopted from Benton. In this view all known cats except the marsupial* Thylacosmilus *of South America, whose fossils occur in Late Miocene and Pliocene contexts, stem from a common ancestral stock in the Cretaceous or earlier. Since there are sabre-toothed forms in each of the four main groups, it seems unnecessary to postulate two different kinds of placental cat (as Mehlert does). Although Benton refers to the phylogeny as 'evolution', the record does not suggest a progressive increase in new genetic information but rather a process of genetic drift, that is, differentiation of a parent gene pool as cats multiplied and dispersed. The primeval cats were, if anything, more truly 'cat' than their distant descendants. Note that because it is a matter of subjective evaluation whether a particular fossil represents a distinct species, there may in reality have been fewer cat species than are shown in the diagram. For the same reason there may have been fewer extinctions than shown.*

out in the Flood.[152] If they were overwhelmed at an early stage of the Flood, why were their bodies not buried at an early stage (if at all)? How does one explain the patterns within the dinosaur record itself— their increasing diversity, sizes and populations? Why is one obliged to reject the explanations which are otherwise offered for their extinction, such as the global effects of the bolide which gouged out a crater 200 km across on the coast of northern Yucatan, or the dust thrown up by the vast outpourings of lava in India? Since the end of the Flood was not an event as such, why should it have coincided with their almost instantaneous extinction? And if the purpose of the Ark was to preserve all land-dwelling creatures, why does the fossil record not show a single survivor in the post-Flood world?

These problems can be satisfactorily answered only if the Flood year is understood as ending much earlier, before the Permian. According to the chronology advocated by this author,[153] the Flood took place c.2970 BC and the Jurassic commenced c.2900 BC, so that the Upper Carboniferous, Permian and Triassic periods would have occupied approximately 70 years. The fossil record left by the reptiles in those 70 years is outlined in Figure H.[154-155] The crucial question is: is the record consistent with such an interpretation?

It is immediately evident that the first reptiles appear well before the end of the Carboniferous. They cannot, therefore, have descended from the animals which were preserved in the Ark and which, according to the model proposed, ought not to appear until the Permian or later. Were these reptiles inhabitants of the dry land, so that they would have perished without trace at the beginning of the Flood and their appearance here is anomalous? Or is it possible that they survived the Flood outside the Ark? But how could they have survived outside the Ark, when it is unlikely that even amphibians — if they lived in and around inland waters — could have survived its onslaught?

The answer appears to be that the amphibians and reptiles from before the Middle Triassic were originally inhabitants of the aquatic forests. These Late Palaeozoic animals always occur among or in the vicinity of coal deposits,[156] and apart from the ichthyostegids are confined to Europe and North America.[157] The amphibian *Crassigyrinus,* for example, was discovered in the disused mine heaps and quarries of Scotland.[158] The reptiles *Hylonomus* and *Paleothyris* occur in the mid-Carboniferous coals and interbedded mudstones and sandstones of Nova Scotia, very often preserved in the fossilised stumps of the lycopod *Sigillaria.*[159] The earliest appearing reptile, *Westlothiana,* comes from the Lower Carboniferous coal of East Kirkton in the Midland Valley.[160]

If these animals survived the Flood on aquatic forests, this would explain why millepedes, snails, spiders and beetles (of which there are millions of species) are found on every continent of the post-Flood world. Such creatures on the land would undoubtedly have perished at the same time as all other animals had they not had their own arks on the water. There is one reported occurrence of two centipedes in the Upper Silurian, along with marine fauna, from a thin siltstone layer just above the Ludlow Bone Bed in Shropshire, England;[161] they are not *in situ,* and the rocks from this point show signs of spasmodic emergence.[162] Apart from this, the earliest myriapods, dragonflies and so on are found in Devonian and Carboniferous coal deposits, again often in tree stumps.

The reptiles of the Lower and Mid Permian, such as the pelycosaurs from the Early Permian red beds of Texas and

Oklahoma, are usually much bigger creatures than those of the Carboniferous. When the forests which had been their habitat ran aground on the flats of the new world, they were able to escape, or ride out, the final insweepings of the tides and establish some sort of existence on the land. Many of them were carnivorous, feeding on fish, or on fellow reptiles. Their long tails and splayed legs — like the anatomy of crocodiles — suggest that they were not uncomfortable in shallow water.

Then towards the end of the Permian many of the amphibians and reptiles which had flourished or at least survived after the Flood died out and in other parts of the world were succeeded by new types of reptile, many of them also short-lived. Most of the new types — *Lystrosaurus, Moschops,* the dicynodonts, *Lycaenops* and so on — have been found fossilised in the Karoo Basin of South Africa. The only other region where such animals occur is European Russia.[163] At a time when much of the world was desert, it is not likely that they arrived in South Africa from the Ararat area. Rather, their close association with the vast coalfields of South Africa suggests that they arrived from the sea, transported on forests which (having been detached from their pre-Flood anchorages) did not touch ground until the beginning of the Permian or later. These southern forests had their own distinctive fauna as well as their distinctive flora, and footprints on the rocks overlying the coals show that the reptiles escaped from them alive.[164]

Neither the amphibians and reptiles which appeared in the Lower Permian, nor the reptiles which appeared in the Upper Permian, survived long. They were not designed for the terrestrial habitats which they were now forced to colonise, and those habitats were continually changing. The factors commonly adduced in the search for explanations of the 'Permian crisis' are all relevant. This was the time when the continents into which the original land had broken up during the Flood began to fuse together again, reducing or eliminating the shallow seas around their coasts. Everywhere the land was drying out. Sea levels were falling, and apparently fell at the fastest rate just when the extinctions were occurring. Moreover, there can have been very little for the reptiles to live on once the forests were buried. Many may have starved to death soon after they landed. The high temperatures which seem to have prevailed during the Permo-Triassic may also have been greater than they could tolerate, and of course there was little shade.

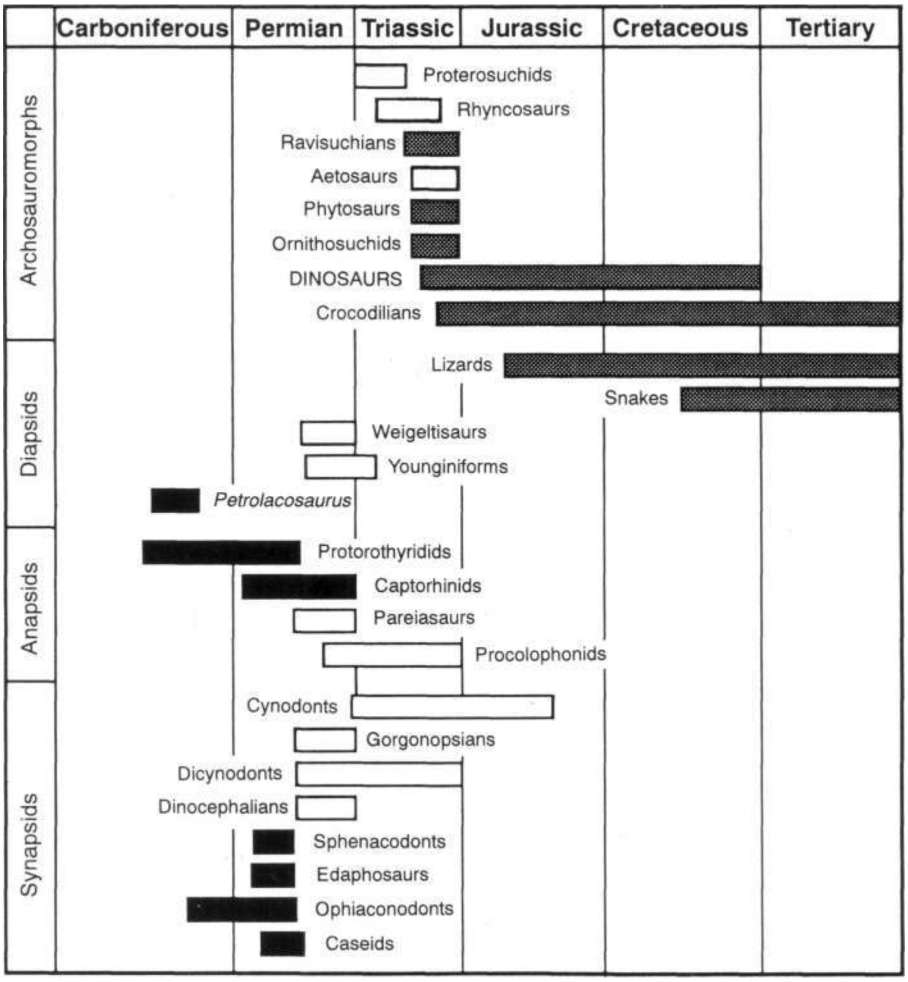

Figure 11. *Major groups of non-marine reptiles in the Palaeozoic and Mesozoic fossil record. Note in particular-*
(1) There are no reptiles before the Carboniferous.
(2) First appearances in the Mesozoic are followed with increasing frequency by further appearances in each group (not illustrated).
(3) There is a coincidence of last appearances and first appearances in the mid Triassic, and a coincidence of last appearances at the end of the Permian and end of the Triassic.
A successful theory must be able to explain these non-random features. Contra Whitcomb and Morris, the succession overall does not reflect either increasing size or increasing mobility. On the other hand, the phylogenetic connections postulated by evolution theory contravene the morphological and geographical discontinuities and thus also fail to explain the non-random features. In this paper it is suggested that the three phases of reptile radiation arose from
(i) primarily northern-hemisphere fauna that inhabited the floating forests grounded during the Carboniferous (shaded black),
(ii) primarily southern-hemisphere fauna that inhabited the floating forests grounded during the Permian (unshaded), and
(Hi) terrestrial reptiles which descended from the Ark (shaded grey).
(Sources: Benton and Romer).

The pterosaurs (flying reptiles) and birds such as *Archaeopteryx* may also have been survivors from the floating forests. It would indeed be surprising if such ecosystems had not sustained certain kinds of avian life. Calais has drawn attention to the presence of bird tracks in the Grand Canyon's Hermit Formation.[165] The earliest pterosaurs come from the Late Triassic (for example, northern Italy) and like the later examples from Jurassic and Cretaceous times they were fish-eaters.[166] Possibly *Archaeopteryx,* which was found in offshore sediments together with shellfish and other marine animals, was a diving bird.[167]

Opportunities for Animal Migration

The animals released from the Ark were to *'breed abundantly on the earth, and be fruitful and multiply'* (Genesis 8:17). It is therefore appropriate that they should have begun to spread abroad while the continents were united, in the Upper Permian and Triassic, rather than after they had split apart, as they largely had by the end of the Cretaceous.

One does not have to postulate far-fetched mechanisms of dispersal for which there is little or no evidence. Whitcomb and Morris consider the problem:

> *'On the assumption that the animals of the present world trace their ancestry back to those within the Ark, how can we explain the fact these marsupials and monotremes are found nowhere in the world except in Australia?'*[168]

Their solution was to suppose that the animals crossed overland from Ararat to Asia and thence to Australia via a land-bridge. There is, however, no evidence of such a land-bridge with Asia (though indeed New Guinea was once joined to Australia). On the contrary, the geological evidence shows that Australia — during the Permo-Triassic — was attached to Antarctica, which itself was attached to India and southern Africa. These continents began to split apart during the Jurassic, with Australia migrating eastwards over what is now the Indian Ocean. By the Cretaceous Australia already had its distinctive fauna. Fossils of the platypus and spiny ant-eater, for example, occur in Lower Cretaceous deposits, and obviously their presence cannot be explained by a putative land-bridge with Asia in the Pleistocene. Similar arguments apply to the fauna of Madagascar.

According to the fossil record the crocodilians which inhabited Niger during the Lower Cretaceous were either identical or closely related to the crocodilians which inhabited Brazil, as were many other types of animal. As Africa and South America drifted apart, however, their respective populations — each with a slightly different gene-pool— increasingly diverged.[169] In the light of such 'vicariant' speciation during the Cretaceous and Tertiary it makes no sense to argue that the Flood year did not end until after the Cretaceous.

Addressing the problem of how animals reached North and South America, Oard, who believes the Flood ended late in the Tertiary, invokes the existence of a land-bridge joining Siberia and Alaska during the Pleistocene.[170] This is acknowledged to be difficult, and the objection that the climate at that latitude was too cold for migration is hardly satisfied by pointing out that mammoth bones have been found on the floor of the Arctic Ocean. Much more relevant evidence would be the bones of bison, armadilloes, alligators and the like. In any case, why should the numerous and enormously diverse animals of North and South America — animals that were suited to many different climates and habitats, and which in reality would have fled each other's company — all have headed from the Ararat mountains to the tip of chilly Siberia?

> *Even small mammals, like the shrew and meadow mouse, apparently traveled the long distance from Mount Ararat to North America over this land - bridge.'*[171]

Apparently? One unfounded hypothesis is hung upon another. Even were this the route taken, how many generations would have passed before such mice, beginning from one pair of animals, completed those thousands of miles? And how does one account for the evidence that sloths and numerous animals migrated not from North to South America, but from South to North America? Recent studies have concluded that, following the formation of the isthmus which joined the two continents in the Pliocene, about 16 mammals families crossed from north to south and about the same number from south to north.[172] Should these studies simply be disregarded? And how should one account for the essentially continuous phylogenies of animals that go all the way back from the Pleistocene to the Eocene and earlier?

The extremities to which the post-Cretaceous model seems compelled to resort are seen in the explanations offered by Woodmorappe.[173]

> *'If, soon after the Tower of Babel incident, the inhabitants of the Middle East knew (i. e., from advance parties) that remote areas of the earth lacked vertebrates, they had that much more motivation to take many animals with them as they scattered all over the globe.'*

A difficult chronology is made worse by having to wait over a century after the beginning of the Miocene (where Woodmorappe puts the Flood boundary) before this speculation can even begin to operate. As for advance parties, are we really to imagine them going all the way to Siberia and back to the Middle East in order to report on the dearth of — one can only guess — ostriches . . . rattle-snakes? Are we really to imagine that the men of Babel kept a zoo of such animals? Woodmorappe asserts that they were responsible even for the fauna of Madagascar, which, however, was already numerous enough in the Miocene to have left discoverable fossils. Colonists from the Ararat region, he says, used the island as a major stopping point. This too is mere speculation, incapable of explaining anything.

Gradual Revegetation

Pangaea during the Permian appears to have been a desolate and, as sea levels fell, increasingly dry continent. The predominant sediments are sandy — for example, the red beds of Texas, Great Britain and Germany — having been apparently heaped up in steep cross-bedded dunes by winds. Animal fossils, whether marine or terrestrial, are scarce, and the overwhelming majority of the plant fossils are those from the coal fields. That is, they represent pre-Flood vegetation which continued to be washed into shallow-water basins on the margins of Pangaea after the Flood year. Nearly all plant fossils that do not occur in the coals (for example, the earliest conifers)[174-176] also show an allochthonous origin. The only known exception earlier than the Carboniferous are the homosporous plants of the Rhynie Chert (probably Lower Devonian), which, however, may have grown extremely quickly. Apart from the much reduced incidence of coal, a similar situation persists through the Triassic. There is no evidence of post-Flood terrestrial forests before that period.

The 'Petrified Forest' is part of the Chinle Formation of Arizona and is of Triassic age. As Hoesch points out, the silicified logs — all in a horizontal position, with the roots, branches and bark broken off — cannot be the remains of an *in situ* forest but must have been brought in by water.[177178] Within the diluvialist framework there are three possibilities. The debris represents:

(i) pre-Flood vegetation grounded during the Flood,
(ii) pre-Flood vegetation grounded after the Flood,
(iii) post-Flood vegetation.

The first is precluded by the existence of animal tracks and vast amounts of fossilised dung (coprolites) in the Chinle Formation.[179] Moreoever, the formation was once overlain by other Mesozoic deposits, so that it is difficult to see how a mass of logs could have sunk to the bottom all at once, while the area was still submerged. Of the two other possibilities the second — pre-Flood vegetation grounded after the Flood — seems the more likely by reason of the maturity of growth. Most of the logs belong to the genus *Araucarioxylon,* a gymnosperm which appears in the Palaeozoic under the name *Dadoxylon*[180] and is similar to the Gondwana coal plant *Glossopteris.*[181] Along with the evidence of water transportation,[182] the similarity suggests that *Araucarioxylon* might have been a type of semi-aquatic tree which continued to flourish for a time in the post-Flood world.

Figure 12[183-184] illustrates a fairly typical development at the top of a coal sequence in eastern Australia. Here the uppermost coal bed is taken to mark the Permian-Triassic boundary, at which point the main constituent of the coal vegetation, *Glossopteris,* abruptly ceases, as do many other species. {*Glossopteris* fragments recur higher up.) Only four genera and one species of macrofossil plants (distinct from spores) survive the boundary — three per cent of the total. One of these, the seed fern *Dicroidium callipteroides,* occurs in shales just 19 cm above the uppermost coal, and although physically distinct from the compacted forest beneath, may have been debris of similar origin. This would also apply to the other macrofossils (the conifer *Voltziopsis,* for example) and to the spores, which show a much smaller reduction in species diversity and much greater continuity across the boundary. Since the spores are not matched by a roughly equivalent number of macrofossil species, it may be that not all the spores originated from the macrofossils, but that some originated from species which are not preserved, and were never present, in the Basin.

Deposition took place on a region-wide scale, with each formation probably marking a single depositional event. The 7 million years allocated to this phase of the Triassic seem highly improbable. On the other hand, the presence of deeply weathered 'palaeosols' and of terrestrial reptiles which left their footprints on some surfaces indicates that we are dealing with a sequence spanning much longer than the few days allowed to it by the post-Cretaceous model.

Any post-Cretaceous Flood model would presumably seek to understand the *Glossopteris* vegetation as having been buried by rising Flood waters. But by what mechanism could it sink from the surface of the waters to the sea bottom in so short a time? How far, in fact, had the waters risen, such that they could have dislodged a great mass of aquatic vegetation, yet not have reached further than the ecological zone of seed ferns just above the shoreline? How does one account for the absence of shellfish, and for the presence of reptilian footprints but virtual absence of the reptiles' bodies? Where is the pre-Flood shore? What does one make of the enormous depth of Palaeozoic deposits below the Triassic? How does one account for the fact that the Sydney Basin was the product of a concurrent orogeny immediately to the north-east?[185]

If this example from eastern Australia is typical, it may be that much of the flora of the Permo-Triassic originated from the floating forests, and that the concentration of plant extinctions in the Upper Permian reflects the burial of the forests and the inability of most of their unique flora to adapt to the terrestrial environments upon which it became grounded: only a few types of plant survived.

The basic pattern of plant appearances in the fossil record is shown in Figure 13.[186] Most land plants before the Cretaceous were gymnosperms. It is suggested that the horsetails, ferns, lycopods (club-mosses) and some gymnosperms originated from the grounded forests, whereas the cycadeoids, caytoniales, conifers and gnetales, which do not appear until the Middle Triassic, grew from water-borne seeds that originated from pre-Flood terrestrial trees.

The non-appearance of angiosperms (including most deciduous trees and all flowers and grasses) before the Cretaceous is one of the most striking features of the fossil record.[187] Being immobile organisms, they cannot have escaped to higher ground. Sometimes their flowers are preserved in fine detail, at odds with the theory that they were plucked by cataclysmic floods and remained in the water for months. Whitcomb and Morris pass over the

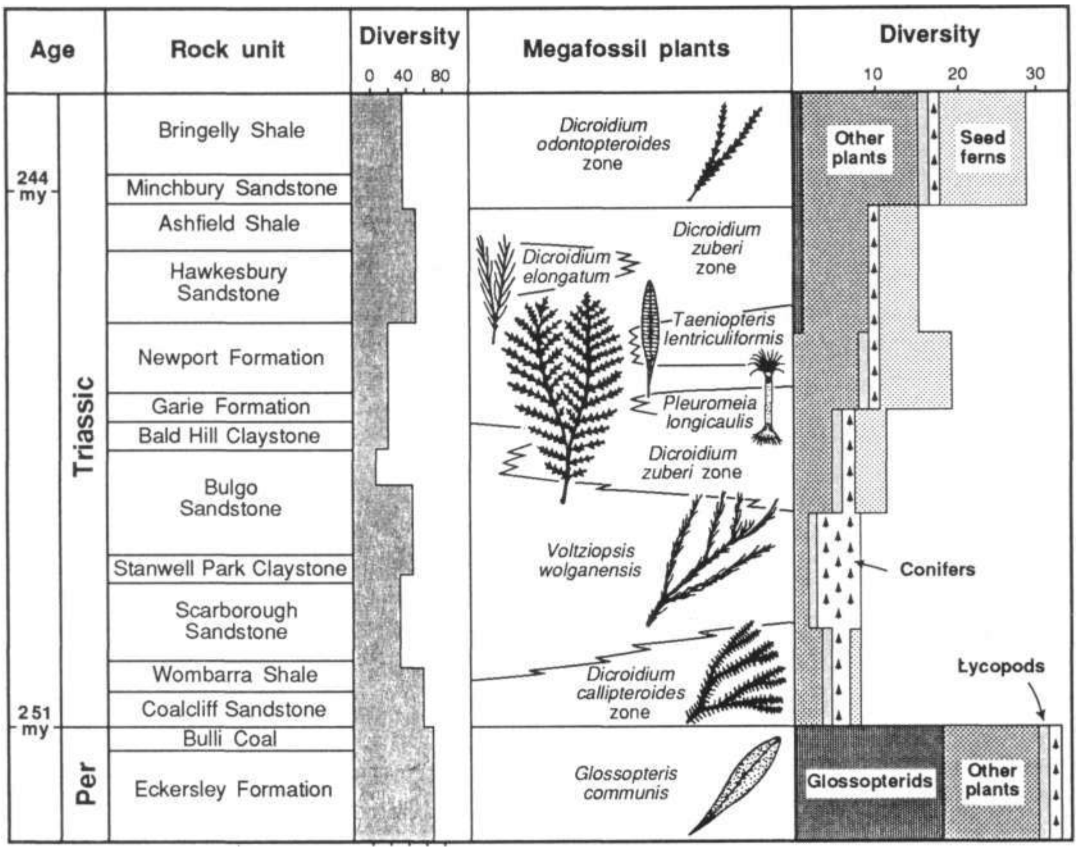

Figure 12. *(a) Changes in fossil flora across the Permian-Triassic boundary within Sydney Basin, Australia. First column shows ages as determined radiometrically; fourth column shows diversity of pollen and spore species; sixth column shows diversity of leaf species. The drastic reduction in megafossil diversity at the boundary is clearly associated with the last occurrence of coal. (After Retallack.)*

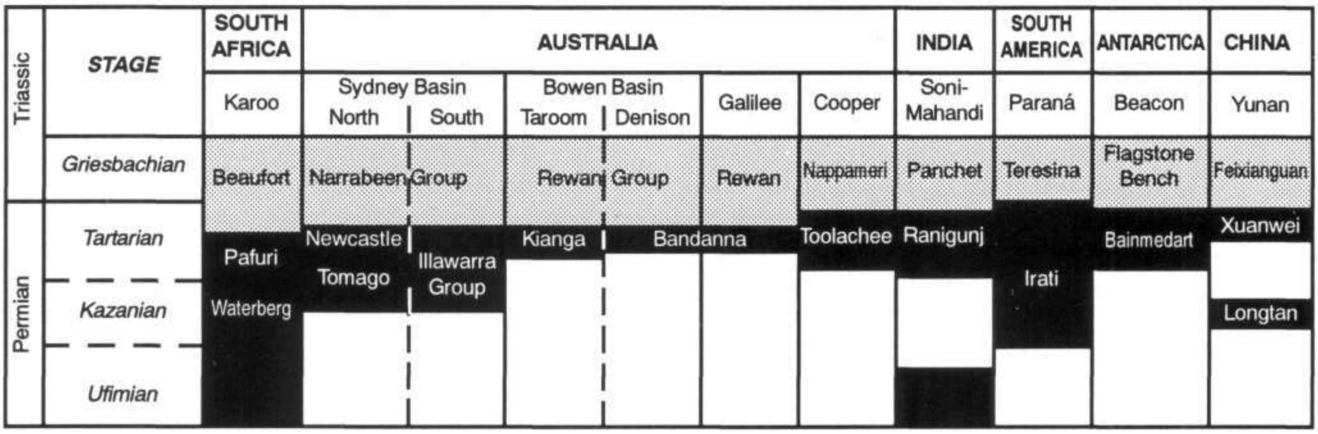

Figure 12. *(b) Stratigraphic columns of foreland basins from six continents across the Permian-Triassic boundary. Black areas represent coal formation, shaded areas formations without coal. (Compare Figure 3.) The vast majority of Permian coals were formed on Pangaea 's margins and are associated with orogeny and uplift. (After Faure* et al.*)*

problem posed by the late appearance of the angiosperms, as do other creationists who might be expected to have given it consideration. Nor do they deal with the problem that there is no worldwide interruption in the angiosperm or gymnosperm record after the Cretaceous, corresponding with the *tabula rasa* of the immediately post-Flood world.

The priority of the gymnosperms may be explained partly by the fact that most gymnosperms propagate themselves by wind pollination, whereas most angiosperms are pollinated by insects. The Flood had destroyed birds and

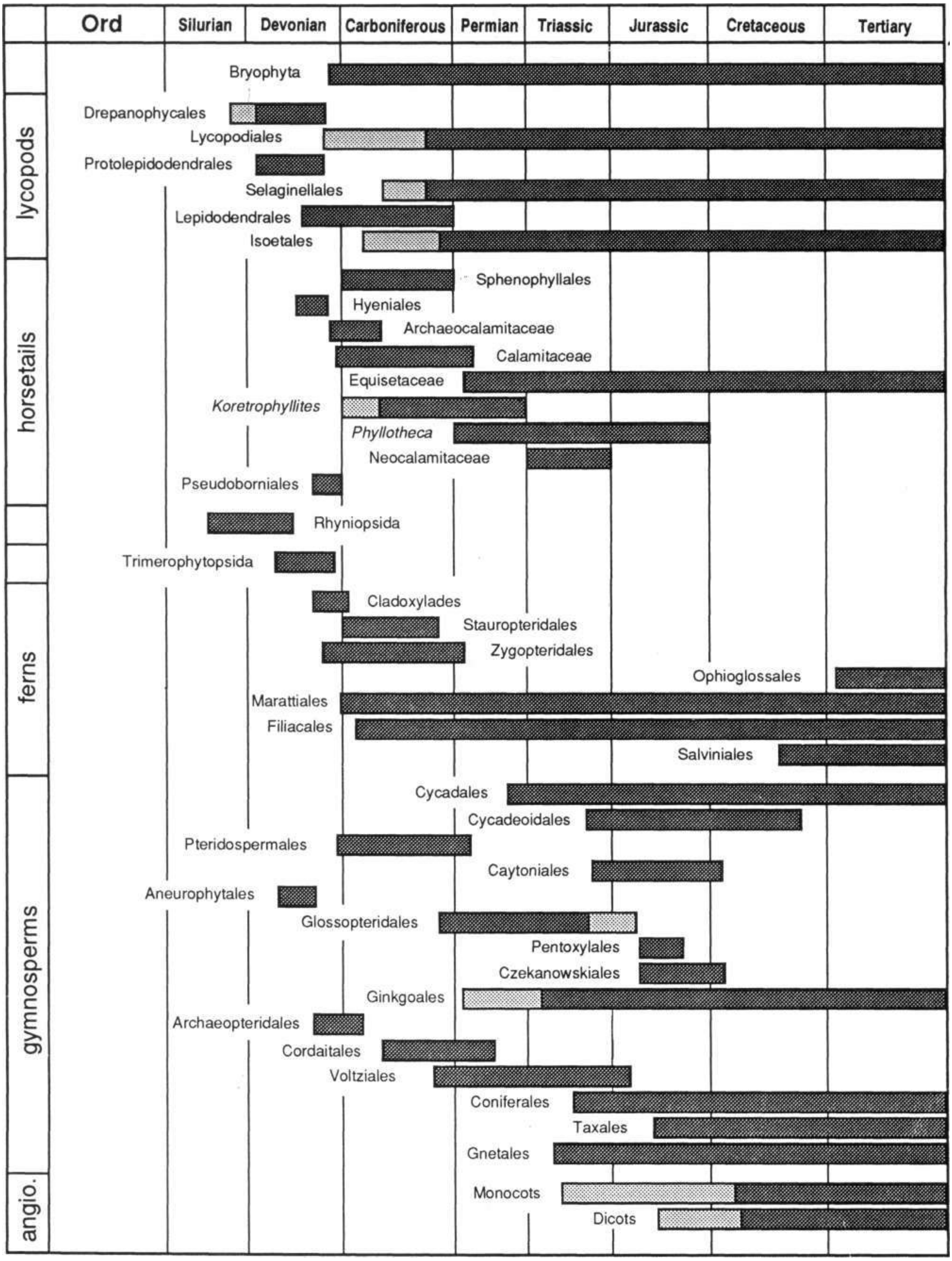

***Figure 13.** Distribution of major plant groups in the fossil record (after Stewart and Rothwell). Dark shading: well-attested; lighter shading: evidence equivocal.*

animals alike: *'every flying thing according to its kind, every flying thing of every* [type of] *wing'* that was upon the face of the ground (Genesis 7:14, 23). Hence, since it would have taken many years before pollinating insects attained sufficient numbers and geographical spread (beginning from the Ark) to facilitate angiosperm propagation, gymnosperms ought to appear in the record before angiosperms. Note, however, that a few angiosperms — at least today — are wind-pollinated, and some of the ancient gymnosperms may have been pollinated by beetles.

The earliest fossilised bees and wasps, as also ants, termites, butterflies and moths, come from the Cretaceous.[188-189] It may be inferred, therefore, that these insects spread and multiplied from the Ark. Some of these too are exquisitely preserved. Among the insects recovered from the Wealden of southern England were dragonflies, crickets and wasps that still showed details of eye lenses, wing colour and veining.[190] In the pre-Permian model the first appearance of bees and wasps almost simultaneously with the first angiosperms need not be written off as a coincidence.

Table 4 summarises the proposed chronology of the Flood in relation to the geological column.

THE MESOZOIC

The general character of the Mesozoic, worldwide, is of periodic transgressions and regressions of the sea over generally low-lying but above-water continents. The primary evidence for this view, in which we need depart from the orthodox interpretation only as regards the span of time allocated to the era, is (1) the pattern of sedimentation in the continental interiors, (2) the positive evidence of above-water land in those interiors, lithological (for example, subaerial basalts, discussed by Garner[191]) as well as palae-

GEOLOGICAL SYSTEM	MEGASEQUENCE	DAY	FLOOD STAGE	GEOLOGICAL FEATURES
Pennsylvanian	Absaroka		Immediately post-Flood	Coal measures: aquatic forests grounded in sinking basins. Earliest reptiles. Renewed flooding in places.
Mississippian	Kaskaskia	370	Regression	Craton-wide unconformity.
Devonian				Mass extinctions. Catastrophic drainage from emerging land. Mass burials of fish. Earliest amphibians. Earliest tracks. Craton-wide conformity. Earliest *in situ* plants.
Silurian	Tippecanoe	150	Marine Submersion	
Ordovician				Mass extinctions. End of worldwide transgression.
Cambrian	Sauk		Marine Transgression	Craton-wide unconformity; transgression wanes.
Vendian		40		Sudden appearance of marine invertebrates. Ediacaran fauna. Worldwide unconformity.
Riphean			Submersion	Worldwide rifting of supercontinent ('Rodinia'). Massive upheavals (Grenvillian and Gothic 'Orogenies'). Earliest continental flood basalts. 'Greatest Unconformity'.
....		1		

Table 4. *Summary of the proposed chronology of the Flood in relation to the geological column. The 'megasequences' are those proposed by Sloss for North America, with the Absaroka continuing to the end of the Permian. The beginning of the Flood is tentatively put around the Middle Riphean; that is, pending further research into the Precambrian the possibility of an earlier beginning is not discounted. The diurnal chronology is also tentative; for example, Day 40 does not necessarily coincide with the base of the Sauk.*

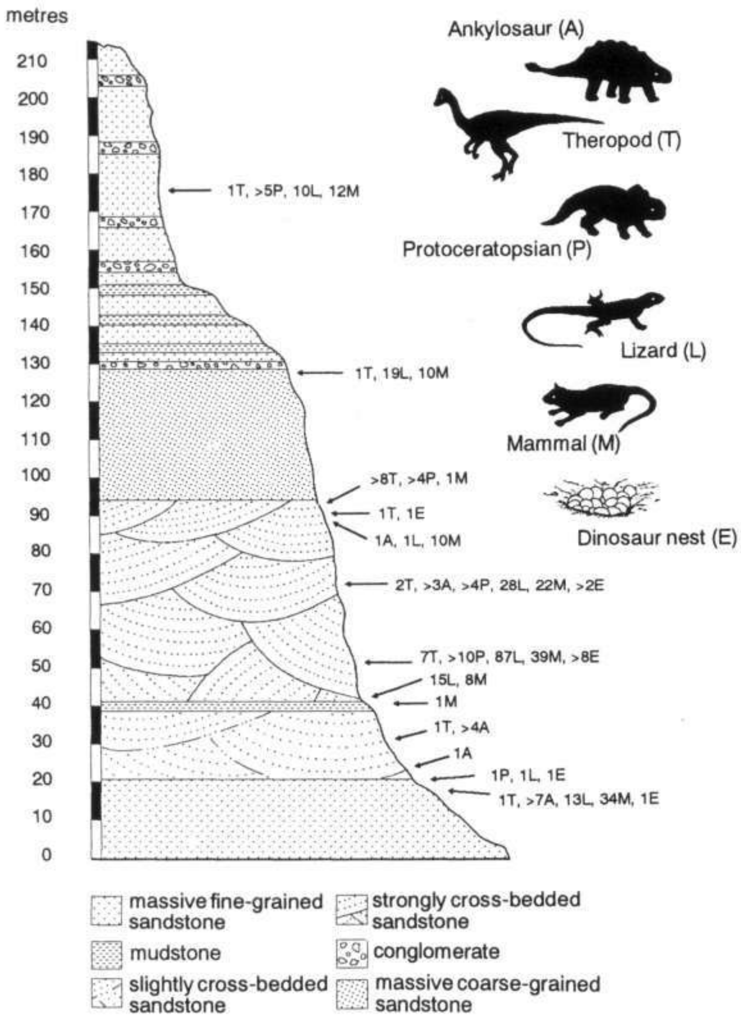

Figure 14. *Composite section of strata at Ukhaa Tolgod in the Gobi Desert, Mongolia (Upper Cretaceous), showing terrestrial fauna in terrestrial deposits (after Dashzeveg* et al.).

ontological, and (3) the thinning out of shallow-water deposits in the direction of inferred land areas, with corresponding faunal and facies changes. In this paper we shall touch only on the fossil evidence.

In situ Terrestrial Fossils

In situ organisms and structures are common enough in the Mesozoic to constitute a refutation of the post-Cretaceous model by themselves. Those relating to terrestrial organisms are particularly noteworthy, because they are just the sort of direct evidence one would look for in order to test whether certain rocks are Flood rocks. A few examples follow.

In the Jurassic of northern Europe plant roots are said to be 'prolific',[192] and not all can be dismissed as debris introduced with the sediment. Tyler has described six root horizons from the Middle Jurassic of Yorkshire, concluding that the *Equisetites* plants in question colonised the sediments as pioneer species; the passing of the upright roots through bedding planes was inconsistent with an allochthonous origin.[193]

The oldest reported termite nest lies on Triassic rock,[194] while others have been found in the Upper Cretaceous.[195] Dung balls made by dung beetles have been found as early as the Upper Cretaceous; the beetles themselves go back to the Permian.[196]

Dinosaur nests and eggs are not uncommon phenomena in the Upper Cretaceous and are known from as early as the Upper Triassic. The fossils of principal interest are surveyed by Garner.[197] Below, one example will be discussed at length for its geological context.

The recently reported assemblage from Ukhaa Tolgod, Mongolia, boasts the highest concentration of mammalian skulls and skeletons from any Mesozoic site (see Figure 14).[198] In an area of about 4 km^2 the remains of over 100 dinosaurs were found, also nest sites containing the first known theropod embryos, over 400 mammals and lizards, and several birds *(Mononychus).* Many of the skulls were almost complete, with lower jaws still in articulation and well preserved tympanic rings and ear ossicles — observations at odds with the idea that the animals originated from a Precambrian surface and were then buffeted about in the water, escaping deposition until just before the Flood ended. Post-mortem erosion of the bones was minimal. Some assemblages consisted of only one species, such as a group of five mammals near the top of the thickest sand unit shown in the diagram.

As mentioned earlier (p. 42), diluvialists need to take cognizance of the conditions which attended fossilisation.[199] Just as an intact crinoid stem is unlikely to have been transported far, so too with the innumerable instances where the complete skeleton of a land animal has been preserved in one place. The skeleton must have been articulated at the time of burial, before the connecting tissues had rotted, been scavenged or eroded. In fact, at Ukhaa Tolgod many of the poses suggested death struggles and hence no significant transportation.

Although some fossils were found in 'fluvial' facies (that is, mudstones), the vast majority occurred in aeolian deposits, and the most likely cause of death was sandstorms. The geological context cannot be reduced to the simplicities of the post-Cretaceous Flood model:

> *'The presence of fossiliferous aeolian deposits at these localities has inspired reconstructions of an arid or semi-arid desert habitat. However, dune deposits are not necessarily indicators of desert conditions. The sections at Ukhaa Tolgod, Bayan Mandahu and other localities suggest a complex and dynamic system involving dunes, interdune channels, streams and ponds as well as semi-arid palaeosol profiles of caliche and hardpan.'*[200]

The mudstones and moderately coarse conglomerates represent episodes of intermittent flooding over established land surfaces. There are no marine fauna. The lizards, small mammals and various dinosaurs are all consistent with the terrestrial character of the deposits in which they lie.

Dinosaur nests were found at no fewer than five levels. Recognising that dinosaur nests, eggs and tracks are subaerial phenomena, Oard has attempted to accommodate them within the post-Cretaceous model by hypothesising that the Mesozoic deposits where these are found were temporarily lifted above water while the Flood waters were still rising. Pregnant dinosaurs from elsewhere, initially escaping the Flood, chanced upon these sandbars and immediately laid, incubated and hatched their eggs before the waters returned and covered them with further sediment — all within a few months.[201] Most of the eggs at Ukhaa Tolgod, however, lay within rather than on top of the associated sandstone units, providing further confirmation that the cross-bedded sandstones were deposited by wind action. If each unit represented an episode of marine transgression, the pregnant dinosaurs would have had to hollow out a nest and lay their eggs in the middle of that episode under water — on at least five consecutive occasions. Moreover, three of the nest levels occur within the same unit, when according to Oard the land must have risen and sunk three times, although the unit itself shows no such oscillations. One dinosaur was overwhelmed by sand while she was still brooding.[202] The notion that this decidedly terrestrial animal must have continued to incubate her eggs under metres of sediment-laden water is not to be enjoined on any man.

Finally, it should be noted that the majority of the animals were buried in the strongly cross-bedded sandstones. The inference from this apparently non-random distribution is that the animals died within the sandstone itself, on account of the strength of the wind; they were not transported to this level after dying lower down in the geological column. Fewer burials occur in the only slightly cross-bedded unit because the wind at that juncture was weaker.

Living terrestrial and amphibian animals leave tracks, especially where the substrate is damp and soft (unlithified). Tracks occur in rocks of all ages from the Devonian onwards, in many places, and have been extensively discussed in the literature.[203] Garton surveys some important occurrences.[204] As noted above, adherents of the post-Cretaceous model explain the Permian tracks in the Grand Canyon, unsatisfactorily, as those of amphibians walking under water. Chaffin has advanced this explanation even in relation to Triassic dinosaur footprints.[205] Cascade Quarry, Virginia, where such tracks occur, has also yielded large numbers of insects, lizards, gymnosperms and even angiosperms, and according to Chaffin these represent the preservation of an ecological zone submerged during the Flood. It must, then, have been a very tranquil Flood in this region, since the water is depicted as only four feet deep at the time the tracks were made, despite the presence of 'massive layers of sandstone' and (at Culpepper Quarry, Virginia) 100 ft (about 30 m) of strata between one set of tracks and another. At this point the Flood waters are considered to have been still rising, and the explanation offered is that either the dinosaurs temporarily escaped to higher ground or, alternatively, they started from high ground and traversed sediments deposited on top of previous tracks.

No palaeo-topographical evidence is adduced to support these conjectures. Since the geology of the quarries indicates a basinal topography, one would like to know where the higher ground is discerned. It is difficult enough to imagine. How could the dinosaurs which laid the upper tracks have **started** from high ground when all the Phanerozoic deposits beneath them would have been laid down by the Flood before they got there? How could the tracks 100 ft lower down have been made by dinosaurs that escaped to higher ground when the imprinted deposits there too must have been Flood deposits (of an unmentioned but no doubt considerable thickness)? And how do these Triassic rocks relate chronologically to the Palaeozoic deposits to the east (the Appalachians, for instance)?

Chaffin supposes that the Triassic in Virginia was synchronous with, say, the Ordovician in another part of the United States and the Devonian somewhere else, asserting that *'the Triassic represents the preservation of an ecological zone not a timeframe'*. From a provincial standpoint this may seem tenable, since possibly there are no Palaeozoic deposits underneath the Mesozoic in this area. However, in the many places where there exists a substantial series of Palaeozoic rocks, the fauna and flora characteristic of the Triassic system always come after the fauna and flora characteristic of Palaeozoic systems, not, as one might expect, beneath them. Thus in Colorado, Utah and New Mexico the Upper Triassic is represented by the Chinle Group, which contains abundant evidence of dinosaurs that lived on the Triassic surface of that region, including nests,[206] coprolites and tracks. Beneath it are the Shinarump Conglpmerate, Moenkopi Formation and the entire depth of Palaeozoic strata exposed in the Grand Canyon. The idea that the multiple horizons of nests and tracks could have been made by dinosaurs during the Flood is unreasonable, whether one supposes that these were dinosaurs that escaped to higher ground (there is no higher ground; the Precambrian lies thousands of metres below) or whether one hypothesises that the Triassic deposits briefly emerged at an early stage of the Flood (as per Oard) and the dinosaurs somehow survived on an ephemeral sandbar until the whole earth was deluged in the Jurassic or later. How many times did the sediments have to surface above the water during the Flood in order to account for the tracks? There are reptilian tracks in the Jurassic Navajo Sandstone and dinosaur tracks in the Jurassic Morrison Formation, the Lower Cretaceous Dakota Group and Upper Cretaceous Mesaverde beds and Laramie Formation. In the latter case alone there are seven distinct horizons.[207] In a Cretaceous locality in China there are 160 successive horizons![208]

In situ Marine Fossils

Again, a few examples must suffice, serving also to illustrate the contrast with the Palaeozoic, which apart from the Ordovician contains few hardgrounds with *in situ* growths. This contrast also expresses itself in the lack of correlation between Palaeozoic assemblages and the type of sediment on and in which they are found. In the Mesozoic there appears to have been sufficient time for genuine 'communities' of fauna to colonise the substrates to which they were suited.[209]

The oyster bed at the unconformity between Carboniferous limestone and Jurassic oolite in Somerset has already been mentioned. The oysters — at least two generations of them — grew *in situ*, for they are cemented to the hardground in life, and the contours of their shells are adapted to those adjacent. Immediately beneath them were teeming numbers of serpulid worms, while borings of the bivalve *Lithophaga* at several closely spaced levels evidence several cycles of erosion and re-colonisation prior to the advent of the oysters. The power of the current which brought in the oolite was not sufficient to tear up the oyster bed.

The example from Somerset is far from unique. Fursich studied 36 hardgrounds and related phenomena from Jurassic localities (mostly Middle Jurassic) in England, France, Germany and Poland, the development of which — taken together — must have required many years to develop.[210]

The one-metre thick Starfish Bed which crops out east of Seatown, Dorset, is Lower Jurassic and has been traced over an area of 70 km^2. The bed is so named because of the high number of brittlestars it contains.[211] The uninjured condition of the starfish is also unusual. When Aronson examined a sample population, he could find not one specimen with a regenerating arm, whereas in a living population 70 per cent were found to have injured arms.[212] This indicated, along with the well-preserved state of the starfish, that they were buried virtually *in situ*, since after death the tissues connecting the skeletal parts of brittlestars are observed to disintegrate within days. Neither the lack of predation nor the time required for such a colony to spread over 70 km^2 appear reconcilable with a Flood setting. It seems better to understand the unchecked proliferation of the brittlestars as expressing the unstable and unbalanced conditions which must have prevailed for many years after the Flood. A long time is not required. In favourable conditions marine invertebrates are capable of multiplying prolifically, a single oyster, for example, being capable of spawning more than 100 million eggs. A modern example of how one species can rapidly predominate in a region is the spread of the Crown of Thorns starfish through the Great Barrier Reef, Australia.

By far the most common invertebrate in England's Corallian (part of the Upper Jurassic) is the bivalve *Nanogyra nana*, which formed clusters either on the substrate or on other shells. Shells covered with spat are quite common.[213] Scheven has discussed several other instances of *in situ* growths which cannot be confined to the maximum month or so permitted by the post-Cretaceous model.[214,215] Among these are the reef-like algal growths in the Upper Permian Zechstein limestone of western Germany and the *Placunopsis* crusts of the Middle Triassic Muschelkalk — the latter covering much of central Europe. *Placunopsis* was a tiny oyster-like bivalve which liked to attach itself to its own kind, thereby forming accumulations up to 60 cm thick. These seem to have grown in periods of extreme stillness which allowed the free-swimming larvae to settle on shells immediately next to them. The growth of the accumulations was later interrupted by fresh currents which spread the organisms abroad.

Puzzled by the general scarcity of brachiopods in the Corallian, Fursich[216] suggested that the free-swimming larval period of the articulate brachiopods was too brief (at most a few days) to enable them to colonise large areas. A source area near the border between Tethys and Europe's epi-continental sea was indicated by the continually decreasing abundance of brachiopods as one goes from Switzerland to England. Even if one allows just a few years for the Corallian (but postulating faster growth cycles owing to an abundance of nutrients and higher temperatures), explanations of this kind need not be ruled out. If, on the other hand, one attributes millions of years to the Corallian, the brief larval period becomes of no significance.

The Mesozoic record encompasses a vast succession of beds of enormous epifaunal, infaunal and lithological diversity. In the writer's opinion such diversity cannot be accounted for within a few months of the Flood year. To characterise the fauna as a single 'Tectonically Associated Biological Province' is a gross over-simplification, for dozens of distinct assemblages follow one another in the record, quite apart from the assemblages which are distinguishable laterally, that is, at one and the same level.[217] The issue is not whether the epifauna of a particular bed are *in situ* or transported — in the great majority of cases they are clearly not *in situ* — but how far they could have been transported. To suppose that the invertebrates were conveyed thousands or even hundreds of miles from original locations on the pre-Flood sea floor is not credible, for several reasons. Firstly, because actual evidence of long-distance transportation is minimal. Secondly, because there is no mechanism by which the fauna of many different contemporaneous ecological zones could end up stacked one on top of another. And thirdly, by the middle of the Mesozoic the original sea floors had all been destroyed as a result possibly of plate-tectonic subduction. This late in the Phanerozoic, all invertebrates must represent organisms which grew and reproduced after the Flood began.

In his study of the Capitan Limestone, Texas, Austin noted that the Mesozoic record seemed to be post-Flood, on the evidence of dinosaur tracks and subaerial lava flows.[218] He was also prepared to consider the possibility that the so-called Capitan Reef was a post-Flood structure, notwithstanding its Permian date. Among the evidences worth highlighting in the present context are the intact condition of many of the brachiopods and the abundance of fenestrate bryozoans, the latter being described as large fans with a lacy net-like frame and very fragile. Austin concluded,

> *'The fossil flora and fauna of "Capitan Reef" represent a shallow water assemblage which was not especially adapted to a wave or strong current environment. "Reef-forming" organisms which could bind sediments and build frameworks are either altogether absent or largely inconspicuous.'*

This would support his conclusion that the Capitan was not a true reef requiring hundreds of thousands of years for its formation. On the other hand, some of the fauna, if allochthonous at all, cannot have been transported far, in which case their origin is likely to have been a shallow-water environment (albeit temporary) in the vicinity. Hence, if there were temporarily stable environments in the vicinity, the Capitan area itself is likely to have been such an environment, and the largely inconspicuous reef-forming organisms observed may represent *in situ* growth of several years.

From Reptiles to Dinosaurs

According to Benton, most Early Triassic reptiles seem to have been associated with plants and coal deposits.[219] Hence, like the Permian reptiles, they are probably best explained as originating not from the Ark but from floating forests that continued to be viable ecosystems for some time after the Flood. The Middle Triassic saw the first appearance of bipedal reptiles with legs directly under the body, distinct from the splayed or bowed legs of their quadrupedal predecessors. The bipedal reptiles must have been capable of travelling long distances. The cynodonts, and *Proterosuchus* from the Early Triassic of Brazil, were probably among the last survivors from the floating forests. They survived the longest because they were the most mobile, in a world where food — both plant and animal — was scarce. The earliest dinosaurs, found in places as diverse as Germany, the western United States, Argentina and South Africa, were among the first animals to descend from those released off the Ark.

The dinosaur record, which continues right through the Jurassic to the end of the Cretaceous, shows three important trends. One is the increasing incidence of fossils, reflecting the increasing numbers of animals after the Flood as they multiplied. A second is the growing diversity of dinosaur types, reflecting (a) the increasing likelihood, as they multiplied, that particular types would be buried, and (b) the speciation from basic types which (it is implied by the morphology of some fossils) occurred as genetically rich populations became isolated from each other. The third trend is that towards increasing body size, culminating in the colossal sauropods of the Upper Cretaceous and reflecting both the slower reproduction rates of larger animals and the continuing growth of dinosaurs as they became older.

Recent studies have indicated that dinosaur reproduction rates were extremely high.[220] Preserved clutches commonly contain more than a dozen eggs. Some hadrosaurs laid between 18 and 24 eggs. In the course of 40 years it is estimated that a sauropod could have produced 500-4,000 eggs. In addition, the juveniles are thought to have grown very rapidly, at rates comparable with those of bird nestlings. The different reproduction potentials of viviparous and oviparous animals as a function of body mass are summarised in Figure 15.[221] There were, of course, no non-dinosaur predators to depress survival rates.

The number, diversity and geographical spread of dinosaurs in the fossil record is, I suggest, consistent with a chronology which puts the Middle Triassic approximately 50-60 years after the Flood and the end of the Cretaceous approximately 150 years after the Flood.[222] The rapid dispersal from the Ararat region would have been driven by the search for food. Vegetation cover in the early years must have been sparse, and both carnivorous hunters and their prey would have traversed great distances. Moreover, there was little in the generally flat topography of the continents to hinder rapid dispersal.

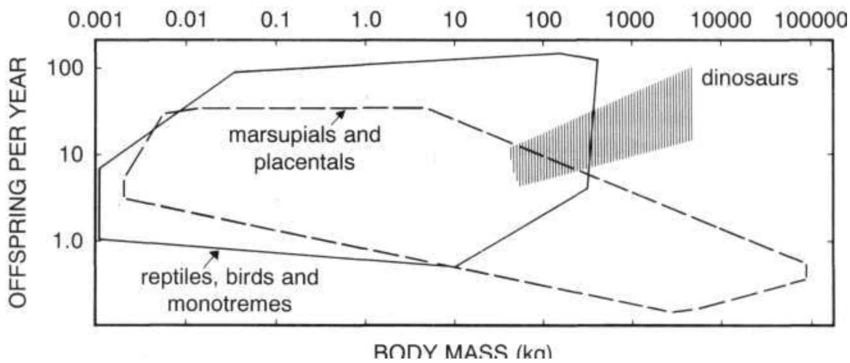

Figure 15. *Viviparous and oviparous animal reproduction rates (after Paul).*

From Reptiles to Mammals

It has been asserted that the 'mammal-like reptiles' — in particular the cynodonts (Figure 11) — constitute a good argument in favour of evolution.[223] This is not the case, as Mehlert has already shown.[224,225] The earliest mammal to be well preserved in the fossil record (if indeed it was a mammal) is *Morganucodon* (Figure 2), a shrew-like creature which supposedly descended from the dog-like tritylodonts, a sub-order of the cynodonts about 50 cm long. Not only are the alleged relatives very different in size and form, but they have even been found in the same cave! Mammalian fossils from the Jurassic and Cretaceous are extremely rare — not many more than would fit into a large top hat.

Why, then, should they be considered a more successful group than the cynodonts?

The sudden extinction of the dinosaurs and other animals at the end of the Cretaceous is a phenomenon for which the received Flood model has no explanation. In the pre-Permian model a partial explanation may be that dinosaur habitats, being located near the coasts, where most vegetation was, were destroyed in the Cenomanian transgression along with nesting grounds further inland. The model also permits recognition of several potential causes which have been identified by non-diluvialists, such as the asteroid which struck near the coast of Mexico, falling global temperatures and high levels of subaerial volcanism (which may have contributed to the fall in temperatures).

As already noted, mammals do not appear in significant numbers until the Tertiary, a pattern which may also be explained in terms of reproduction rates. The reproductive output of dinosaurs is believed to have equalled or exceeded that of rodents, and was much higher than that of large mammals.[226227] Mammals should therefore appear after dinosaurs and rodents.

An instructive example is the mammoth. Like most mammals, the mammoth has a visible and continuous genealogy extending (via other expressions of the proboscidean family) into the Oligocene. Figure 16[228] shows the pattern of radiation traced by its ancestors in the fossil record. By the end of the Pleistocene these animals had reached central North America, and may have numbered some 5,000,000.[229] On the basis that they stemmed from the same ancestors as elephants and stegodons which were alive at the time, we might estimate the total population of proboscidea at nearer double that number.

How long would it have taken a pair of animals from the Ark to reach 5-10,000,000? Present-day elephant reproduction rates vary considerably. According to Owen-Smith, female elephants can produce up to a dozen young in their lifetime,[230] but this number must be regarded as a theoretical maximum, since the period of fertility does not usually exceed 40 years (between the ages of 15 and 55), the gestation period is 20-22 months, and there is a period of anoestrus after birth lasting 1-2 years. According to Grzimek,

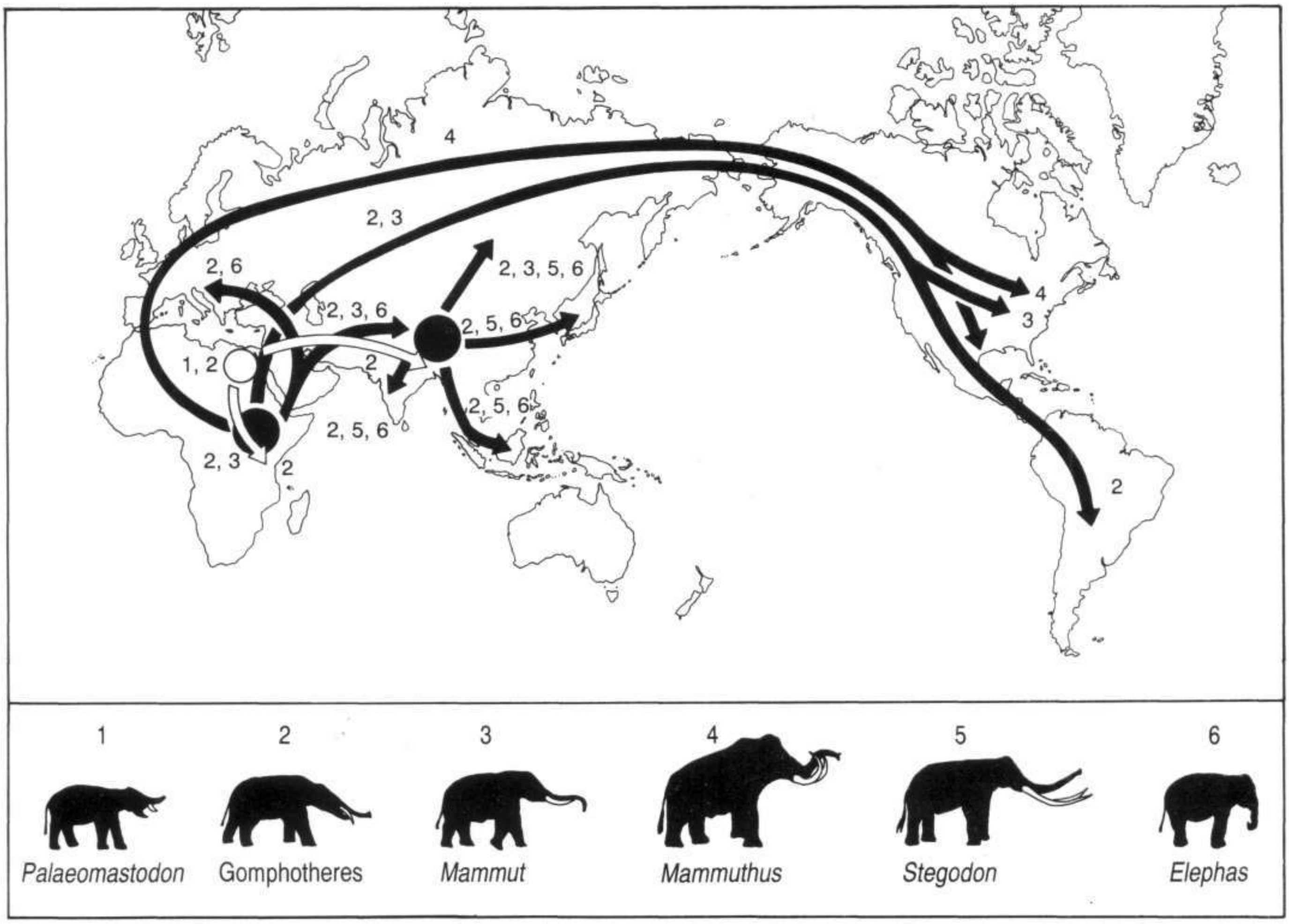

Figure 16. *The pattern of proboscidean radiation as deduced from the fossil record. Unshaded arrows represent dispersal during the Eocene to Oliogocene, dark arrows dispersal during the Miocene to Pleistocene. A pre-Eocene origin in the Ararat region is entirely consistent with this pattern. (After Shoshani.)*

'A cow bears an average of seven young in her life of which no more than three-quarters reach adulthood, about half of the calves are males. Thus a cow usually bears just two or three females that grow to adulthood. Elephants reproduce slowly, and herds that are dispersed require decades to recover'[231]

Sukumar's studies of the Asian elephant showed that females gave birth every 4.7 years on average, a rate comparable with that of the African elephant.[232] He also notes that computer models assuming the most favourable conditions put the maximum rate of increase at not more than about four per cent. On the assumption that conditions in the first centuries after the Flood were very favourable and that the reproduction rate was greatest while populations were small, Table 5 estimate the size of the total proboscidean population at 50-year intervals. It is clear that for the first two centuries populations would be too small, and concentrated in too small an area, for there to be much likelihood of an individual from that period turning up in the fossil record. In the next century, however, a four per cent annual increase produces a dramatic increase in numbers, consistent with the level of population evidenced for the later stages of the Ice Age.

As it happens, the first indisputable proboscidean in the fossil record, *Palaeomastodon*, occurs in the Late Eocene of North Africa. Thus a model which identifies the Permian to Tertiary periods with the first 200 years after the Flood is not only consistent with the mammalian fossil record, but can point to that record as strong evidence for the Flood theory in general. To hold that Eocene rocks were laid down during the Flood is to interpose an unnecessary obstacle to the theory.

Nor is it necessary to cast around for special reasons why man should not appear in the fossil record before the Pliocene. According to Woodmorappe, Snelling and John Morris[233-235] the most important reason may be that few vertebrate fossils of any kind have been found. Ironically, this suggestion comes straight from Darwinian apologetics. Elsewhere, to rebut the argument that transitional forms are not found in the record because it is incomplete or insufficiently explored, creationists have stressed the adequacy, even richness, of the fossil record.[236] Nor does it suffice to point out that few terrestrial vertebrates have been found, compared with marine vertebrates. Denton has shown that of the 178 families of terrestrial vertebrates alive today (excluding birds), 88 per cent have been found as fossils,[237] and among that 88 per cent is man, of whom more than 4,000 fossils have been found — all of them later than the Miocene and outside the area of Ararat and Babel.[238] If the small human population which lived between its dispersal from Babel and the threshold of historical times could leave more than 4,000 discovered fossils, and if many hundreds of other terrestrial mammal and reptile families could leave discoverable fossils all the way back to the Permian, why should the millions of human beings who lived before the Flood not also have left behind thousands?

The answer is that in reality no land-dwelling animals were fossilised in the Flood; they were utterly obliterated. Creationists should look again at that awe-inspiring unconformity beneath the Cambrian transgression and consider: what processes could have been at work that stripped the land bare and replaced it, in weeks, with water-borne sediments thousands of metres thick? What would have survived the colossal folding and cleaving, the massive volcanics, the burning heat which caused rocks to metamorphose? Let us look humbly and in awe at the evidence of God's wrath and holiness, and speak no longer of animals escaping to higher ground as the Flood waters slowly rose.

To explain the fossil record by reference to the global Flood memorialised in Genesis and numerous other traditions is a scientific theory because it is open to refutation. The post-Cretaceous version of that theory is falsifiable and, as long ago as Morton's papers, I submit, has been falsified. Its predictions are not borne out. Its fragile tower of mechanisms such as ecological zonation, hydrological sorting, the differential ability of organisms to escape the encroaching Flood waters, technically associated biological provinces and so on cannot be sustained.

'Every scientist knows that a position that endlessly multiplies assumptions, hypotheses, and rationalizations for non-fitting data is not a good position.'[239]

Nor is it a good position when one has to call for the data to be re-ordered before one can explain them. Froede writes:

'By creating and maintaining our own timescale we can determine how local sites "fit" into our young earth Flood model.'[240]

The inverted commas are just. Impugning the reality of the geological column — its fossil succession and the chronological significance of that succession — continues to be the refuge of a Flood model that does not work.

POPULATION	YEARS AFTER FLOOD
5 per cent growth	
23	50
263	100
3,016	150
34,584	200
4 per cent growth	
245,777	250
1,746,660	300
3 per cent growth	
7,657,187	350

Tables. *Estimated total population of Proboscids (elephants, mammoths and related extinct genera) in the first centuries after the Flood, assuming initial sexually mature population of two. Growth rates are per annum.*

CONCLUDING PROPOSITIONS

(1) The surface of the Earth before the Flood was a Precambrian surface (earlier than 1000 Ma in radiometric time) and was obliterated within the first 40 days.

(2) The sea poured over the inundated land as the subterranean reservoirs holding the great deep emptied, from the end of the Precambrian to the Upper Ordovician (see Table 4).

(3) There are no fossils of multicellular terrestrial animals in Precambrian, Cambrian, Ordovician and Lower Silurian rocks because *'every living thing that was upon the face of the ground . .. was destroyed from the earth'* (Genesis 7:23).

(4) Many Lower Palaeozoic fossil sequences are the result of successive transportation and burial of distinct ocean-floor communities in the course of marine transgression.

(5) Very few fish, compared with invertebrates, were buried in the Lower Palaeozoic because of their mobility and the wide availability of open water.

(6) The first geological and palaeontological signs of emergence occur in the Upper Silurian, an emergence which gave rise to the mass burials of fish in the Devonian. Currents affected by the emerging land brought in different fauna from higher latitudes.

(7) In North America the end of the Flood year probably corresponds to the craton-wide unconformity at the end of the Mississippian. In many regions, however, there is no such unconformity.

(8) Catastrophic deposition and deformation continued as after-effects of the Flood until the end of the Triassic.

(9) Renewed catastrophic deposition and deformation, ultimately also after-effects of the Flood, accompanied the disintegration of the supercontinent (Pangaea) in the Jurassic and climaxed in the mid Cretaceous.

(10) The amphibian and reptile fossils of the Devonian, Carboniferous and Permian systems represent the fauna of pre-Flood aquatic forests which became detached from their shallow-sea anchorages during the Flood and became grounded on the new land.

(11) Beginning with the Archosaurs, the terrestrial fauna of the Late Triassic to Tertiary period represent the recolonisation of the post-Flood world by animal stock from the Ark.

(12) The flora of the Late Triassic to Tertiary periods represent the revegetation of the post-Flood land.

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