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OCCASIONAL PAPERS

1

Geology and the Flood

Paul Garner

..... demonstrating the accuracy of the Bible through historical and scientific scholarship .....

The Genesis Agendum

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Geology and the Flood

Paul Garner

Introduction

First of all, let me say how pleased I am to have been invited to give this presentation this afternoon[1]. It is a pleasure to be associated in this way with The Genesis Agendum project.

As some of you may be aware, the last year has seen some exciting developments in UK creationist geology and this afternoon I would like to share some of these with you. Perhaps the best way of approaching this is to present to you a reasoned scientific case for the Flood from geology, incorporating the model that is being advanced by a number of us here in the UK. We will be looking at a number of ways in which the biblical record can be correlated with the geological record. To do this, we need to go back to the Bible to ensure that we have a good understanding of what it tells us about the Flood.

The Bible describes a global catastrophe unique in the history of the earth. The English word, 'Flood', doesn't really convey the enormity of the event we are considering today. In the Hebrew the word is 'mabbul' and it is used only of the Noachian Flood. Similarly, the Greek New Testament scriptures have a unique word to refer to this event — 'kataklusmos' — from which we derive our English word 'cataclysm'. Genesis 7:19 tells us that "all the high hills under the whole heaven were covered" — a phrase that stresses the worldwide nature of this awesome event, ruling out any possibility that we are dealing with a mere local inundation. Such an event would have left a global geological signature — in other words, we should be able to identify the Flood in the rock record beneath our feet.

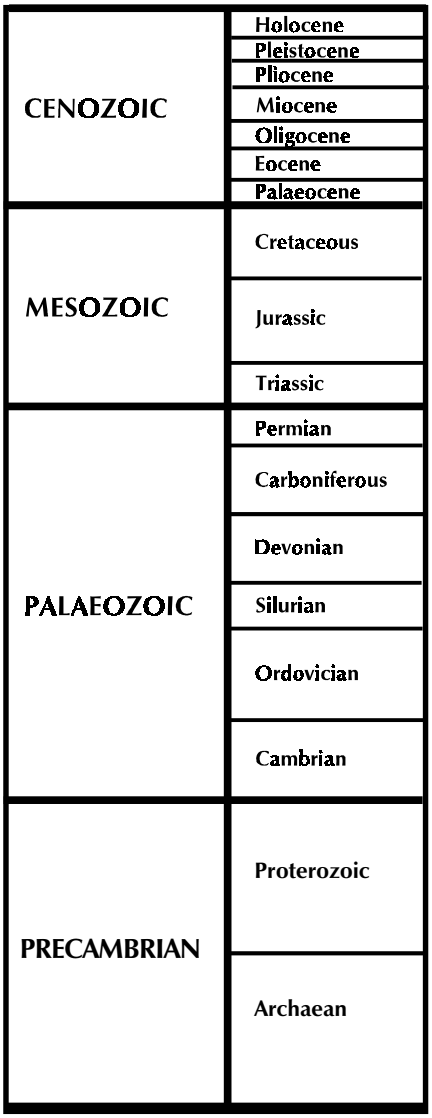

Figure 1: Standard geological column.

The geological column

Before we can begin looking for correlations between the record of earth history in the Bible and the record in the rocks, we must first agree on what the record in the rocks is. Figure 1 shows the standard geological column that you will find in textbooks. The question we must ask ourselves is whether this column is a genuine reflection of what geologists find in the field.

A most important point to make is that the essentials of this column were put together well before Darwin published *Origin of Species* and evolutionary theory became widely accepted. The pioneering geologists of the eighteenth and nineteenth centuries — many of whom were Christians, catastrophists, and creationists[2] — recognised patterns in the rock sequences with which they were familiar. They recognised that there were successions of rock types. For instance, the Carboniferous is well known for the widespread development of coal, the Permian and Triassic for the widespread development of red beds, and the Upper Cretaceous for the common development of Chalk (Ager 1981, pp 1-14). These characteristic rock types occur in a consistent order the world over. Superimposed on the rock succession, the early geologists recognised a fossil succession. Fossils do not appear randomly in the geological record. There is an orderly succession in terms of the first appearance of major fossil groups: single-celled creatures, multi-celled creatures, invertebrates, fish, amphibians, reptiles, mammals and birds. There are many reasons for doubting the conventional view that this succession is an evolutionary sequence, but I do not intend to discuss them here as that is not within the remit of my lecture (I will briefly discuss our proposed non-evolu-

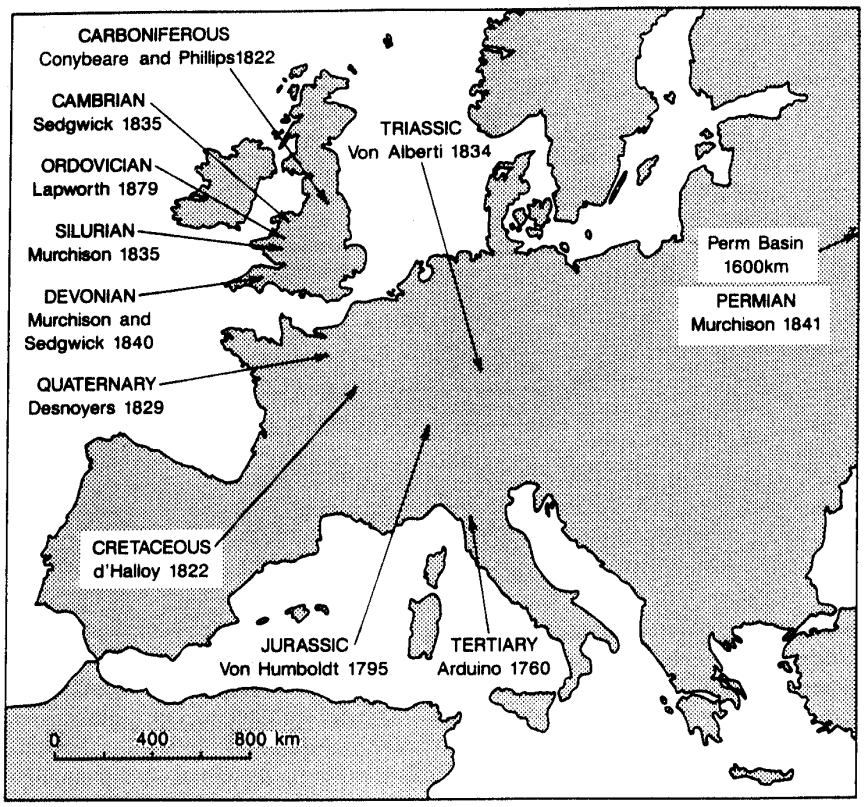

Figure 2: The development of the geological column. Most of the systems making up the column were defined during a period of about 50 years in the first part of the nineteenth century, prior to the publication of Darwin's *Origin of Species*.

tionary explanation for this sequence later). The point that is significant is that the fossils do appear in an ordered succession. We do not find trilobites in the same layers as the dinosaurs, for instance.

These basic facts about the record were recognised by the early geologists nearly 200 years ago (see Figure 2). Decades of field work since then by thousands of geologists has corroborated the findings of those men. The essentials of the geological column can be checked out and validated by those who have a mind to do so. The geological column is, I believe, a reasonable representation of field evidences (Robinson 1997).

Constraining the time scales for deposition and erosion

The next issue to address is how long it must have taken to lay down the rocks that are the basis for this column. If the young-earth time scale is correct, we should find overwhelming evidence that the history of our planet has been dominated by rapid and catastrophic events. Indeed, this is what we find. Let us take a brief look at just some of the evidence in favour of geological catastrophism.

Turbidites

On 18 November 1929 the Grand Banks earthquake struck the coast of New England and the Maritime Provinces of Canada. The earthquake caused a large mass of sediment to move down the continental slope into deep water in the Atlantic Ocean. As the slurry travelled along it snapped 13 transatlantic cables on the sea floor. From the times at which these cables were snapped scientists worked out that the flow was moving at up to 80 km/h (50 miles per hour) and travelled over 800 km (500 miles) in a little over 13 hours. The layer of sediment that was deposited by this flow covered more than 260,000 km^2 (100,000 miles^2) and, was 0.6-0.9 m (2-3 feet) thick. Geologists call flows like this turbidity currents, and the resultant sediments are called turbidites. Thousands of layers, previously thought to have been laid down slowly in shallow water, are now recognized as turbidites laid down rapidly in deep water.

Conglomerates and breccias

Conglomerates and breccias are rocks made up of pebbles and boulders that have been cemented together. The size of the pebbles and boulders tells us that powerful water currents were needed to form these layers. Some contain boulders so large that they have been called megabreccias (Chadwick 1978). Geologists think that many conglomerates and breccias were laid down during hurricanes, typhoons, or storms. A conglomerate on the Welsh coast, once thought to have taken five million years to be laid down, has been reinterpreted as a storm deposit laid down in only minutes or hours (Ager 1986).

Cross-bedded sandstones

Within beds of sandstone it is common to find inclined layering called cross-bedding. Cross-bedding is formed as sand dunes migrate across the sea floor under the influence of powerful water currents. Single cross-beds form today in the Mississippi River in less than one minute (Nevins 1971). Cross-bedding is often therefore a sign of rapid deposition. Some cross-bedding is so enormous that it staggers the imagination. The Coconino Sandstone of the Colorado Plateau, for instance, averages about 96 m (315 feet) in thickness and covers an area of around 518,000 km^2 (200,000 miles^2). It contains cross-beds up to 9 m (30 feet) thick, which would have required a water depth of about 90 m (300 feet). The current velocity needed to form these sand dunes would have been between one and one-and-a-half metres (three and five feet) per second (Austin 1994). Fast-flowing water 90 m (300 feet) deep over an area almost twice the size of the US state of Colorado is a catastrophe by almost any standard![3]

Fossils

Fossils are remains or traces of animals and plants preserved in sedimentary rocks. Rapid burial is usually needed to preserve a creature as a fossil. Take fish, for instance. Experiments show that fish decay and become dismembered by currents and scavengers in a matter of days or weeks, even in oxygen-poor conditions. Yet the geological record contains many layers with millions of well-preserved fossil fish. A famous example is the Old Red Sandstone of Scotland. Trewin (1985) draws attention to a specimen from Caithness which shows a large fish (*Glyptolepis*) fossilized in the middle of a meal! The tail of a smaller fish can be seen clearly, protruding from the mouth of the larger fish. In fact, many similar specimens are known from several localities around the world (Vetter 1990). In some cases, fish have been buried and fossilized so rapidly that even the delicate soft tissues have been preserved. The Santana Formation of Brazil contains fish whose gills and muscles are so perfectly preserved that geologists believe they were fossilized within five hours of death! The foremost expert on these Brazilian fossils, Dr. David Martill (1989), has called this 'the Medusa effect', after the creature of Greek mythology who could turn people to stone instantly with her stare.

Fish are not alone in their striking testimony to rapid burial and fossilization. Extinct marine reptiles such as ichthyosaurs, which tend to be preserved in muddy sediments, have been found with even their skin preserved as a black carbon film around the skeleton. A great deal of mud is needed to bury a creature as large as an ichthyosaur. How rapidly was this mud deposited? An ichthyosaur found at Holzmaden in Germany was fossilized while giving birth! Three baby ichthyosaurs can be seen within the rib-cage of the mother, and a fourth had just been born (see cover photograph in Carroll 1988).

Another extraordinary find was of two duelling dinosaurs - a *Velociraptor* and a *Protoceratops* — discovered during an expedition to Mongolia in 1971. The positions in which the animals were excavated indicates that the *Velociraptor* had jumped onto the *Protoceratops* and was in the middle of attacking it when both animals were buried and fossilized (Calais 1989; Halstead 1975 p 80).

More evidence of rapid burial comes from the study of fossil trilobites — an extinct group of marine arthropods. They look superficially like woodlice, and were able to roll up in a similar way for protection (Nield and Tucker 1985, p 17). Many trilobites are found fossilized in this position; I have two in my own collection. This tells us that these animals were buried alive while trying to protect themselves.

Fossil crinoids (sea-lilies) also give us excellent evidence for rapid burial. Crinoids are made up of small calcium carbonate plates, called ossicles, that are held together by soft tissues. When the creature dies, the soft tissues quickly decay and the ossicles begin to break apart. Experiments and observations of modern crinoids show that dead sea-lilies completely break up in a matter of days, even in still water (Liddell 1975; Meyer 1971). Well-preserved and intact crinoids, such as those found in the Jurassic rocks of Dorset, must therefore be specimens that were buried in sediment while the creatures were still alive or very soon after death.

Were there long time gaps between layers?

Many professional geologists have come to recognize the impressive evidence for catastrophism in the geological record, although most of them still believe that the earth is over four-and-a-half billion years old because of radiometric dating methods. But this leaves them with a big problem. If the rocks were often laid down rapidly, then where are the missing millions of years?

The answer, according to these geologists, is that the missing time is represented by gaps in the geological record when no sediments were being laid down or when erosion removed sediments that had previously been laid down. These geologists place great emphasis on the role of erosive events in forming the geological record. The late Dr Derek Ager, a former President of the Geologists' Association, put it like this:

> "... the history of any one part of the earth, like the life of a soldier, consists of long periods of boredom and short periods of terror." (Ager 1981, pp 106-7)

If the idea that the earth is billions of years old is to have any credibility, then the missing millions of years *must* be in the gaps. But does this idea stand up to scientific examination?

There are places where there is evidence for the passage of time between layers. For instance, there are documented cases of colonized sea-floors (hardgrounds) throughout the geological record (Wilson and Palmer 1992). They are quite common in Ordovician, Jurassic, and Cretaceous rocks. Hardgrounds are places where sedimentation ceased, the sea-floor

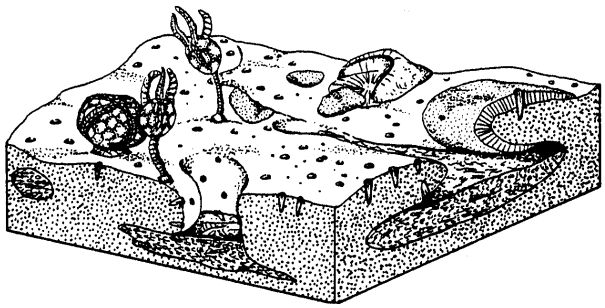

Figure 3: Reconstruction of a Middle Ordovician hardground community with boring and encrusting organisms. Adapted from Brett and Liddell (1978).

became hardened, and burrowing and boring creatures like clams, worms, or shrimps colonized the hardened surface (see Figure 3). Obviously, hardgrounds like these require time to develop. What are creationists to make of them? Do they invalidate the idea of a young earth?

Creationists need to investigate the problem of hardgrounds much more thoroughly than they have done to date. However, here are some preliminary thoughts. The first point to make is that the time represented by these hardgrounds is relatively short — only months, years, or decades — not thousands or millions of years! The time required for the formation of hardground surfaces is compatible with a young earth. Secondly, it is significant that hardgrounds are much less common in the older Palaeozoic rocks than in the younger Mesozoic and Cenozoic rocks. Palaeozoic hardgrounds also tend to be less well-developed and less mature than younger hardgrounds. These trends can best be explained by the idea that the Palaeozoic rocks were laid down more rapidly than the Mesozoic and Cenozoic rocks. Mesozoic and Cenozoic hardgrounds are more common and more mature because these rocks were laid down in the centuries after the Flood when there was more time available for the formation of hardgrounds.

Powerful evidence against long time gaps (thousands or millions of years) in the geological record is provided by what geologists call paraconformities. Paraconformities are places where huge amounts of time are thought to have passed, yet there is very little physical evidence to show it. Remember that the top of each layer must once have formed the sea-floor (or land surface) before it was covered up by the next layer. We know that if a layer forms the sea-bed or land surface for a substantial period of time it is very vulnerable to damage. For instance, it will be exposed to erosion. The very next tide or rainstorm will begin to scour the sediment away. More importantly, the seas teem with living creatures that burrow into the sediment, excavating it, to build dwelling places or to feed. This process is called bioturbation. Bioturbation is an extremely effective way of destroying layering in sedimentary rocks, by mixing up the sediment and homogenising it. It is easy to find modern-day examples of this. Hurricane Carla laid down a distinctive layer of sediment off the coast of central Texas in 1961. About twenty years later, geologists returned to this layer to find out what had happened to it. Most of the layer had been destroyed by living creatures burrowing into it and disturbing it, and where the layer could still be found it was almost unrecognizable (Morris

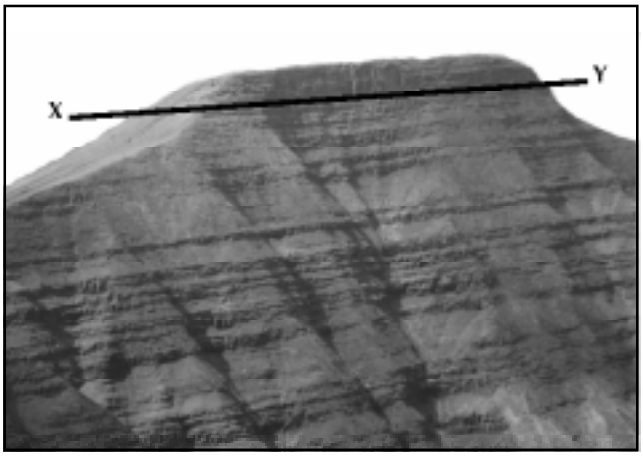

Figure 4: The north face of Pen y Fan, Brecon Beacons, South Wales. Conventional geologists postulate a time gap of 10 million years at the interval marked X-Y.

1994). It is difficult to imagine a layer of sediment surviving intact for more than a few centuries at the very outside.

In the geological record there are many instances where the junction between two layers is supposed to represent a gap of millions of years. If this were true then there ought to be ample evidence of erosion and disruption at these junctions. What does a close examination of these gaps and the adjacent layers tell us? Let us consider a few examples of real-life rock sequences.

Figure 4 shows the north face of Pen y Fan in the Brecon Beacons, South Wales. Along the line marked X-

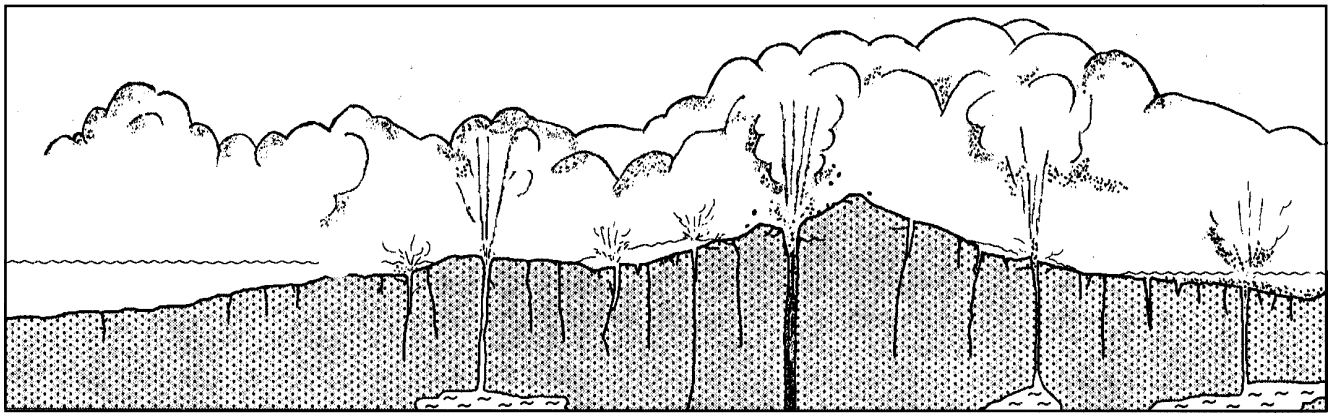

Figure 5: A reconstruction of the events of the first day of the Flood (from Robinson 1996 p 45). The Flood began with the breaking up of the fountains of the great deep, accompanied by torrential rain.

Y there is a claimed gap of 10 million years (Garton 1993). Geologists think that the layer below X-Y was a land surface exposed to erosion before it was buried by the sediments above (Dineley 1992, pp 186, 200; Cocks 1993). The illustration shows that the junction is flat and smooth. There is little evidence of prolonged exposure as a land surface — note the monotony and the continuity of the layers, all intact.

From Dead Horse Point in Utah it is possible to observe dramatic canyon erosion by the Colorado River. Exposed there are two major gaps in the geological sequence — one thought to represent 10 million years, and the other 20 million years (Roth 1988). The 10 million year gap has been traced over 250,000 km^2 (100,000 $miles^2$). Sandwiched between these two gaps are deposits of the Moenkopi Formation, a sequence of continental deposits (important, because on land a layer is more vulnerable to gully and channel erosion). Yet again, there is no evidence of a prolonged period of erosion along the tops of these layers. They are quite flat and featureless.

Many other examples of paraconformities like these have been described (Roth 1988). One well-known geologist admitted:

> "The origin of paraconformities is uncertain, and I certainly do not have a simple solution to this problem." (Newell 1967, p 364)

The obvious answer is that the time spans represented by these gaps in the sedimentary record were very much shorter than most geologists assume.

Contrary to the popular notion that geological processes are extremely slow and gradual, we have seen that the history of the Earth has been dominated by catastrophism. Furthermore, the idea that millions of years can be accommodated in the gaps between sedimentary layers does not stand up to critical scientific examination. These facts are consistent with the creationist view that our planet has had a short but dynamic history.

Can Flood geology explain the geological record?

It is one thing to show that there are problems with the conventional view of earth history, but as creationists we cannot afford to stop there. It is incumbent on us to present a sound alternative theory that accounts for the data more cogently. So I want to consider now whether Flood geology has the potential for explaining the geological record in a convincing fashion.

The horror of the Flood is all too often understated, even in creationist literature. For lack of modern analogues, we find it difficult to imagine. In particular, we often make the mistake of de-emphasizing the suddenness of the onset of the Flood. According to Genesis 7:24 the waters "prevailed" from the very first day, and it seems clear from reading the account that the greatest destruction of the Flood took place in the first 40 days. In fact, the Flood proper really only lasted 40 days (Genesis 7:17), the remaining 330 days being the after-effects.

The Bible describes the events of the first day of the Flood like this:

> "In the six hundredth year of Noah's life, in the second month, the seventeenth day of the month, the same day were all the fountains of the great deep broken up, and the windows of heaven were opened." (Genesis 7:11)

According to this passage, the Flood began with the fountains of the great deep breaking up, accompanied by torrential rain. An important question confronts us here: what were these fountains of the great deep? A study of the Hebrew indicates that these were pre-Flood terrestrial springs, issuing forth subterranean waters to irrigate the ground (Hasel 1974). Genesis 2:6 indicates that this was how the earth was watered

before the Flood. In other words, there appear to have been vast underground water sources beneath the pre-Flood continents.

The Flood was initiated by the breaking up of these fountains of the great deep, releasing vast quantities of possibly superheated water onto the continents. Such an event would have been accompanied by the most catastrophic earthquake, volcanic and tectonic activity (Figure 5). Genesis 6:13 and 9:11 tell us that the Flood did not passively cover the earth, but destroyed the earth. As the continental crust broke up, the pre-Flood land surfaces were destroyed. Any pre-Flood hills were levelled. The heat released would have baked the crust, producing metamorphic rocks. Much of the water from the fountains may have been ejected high into the atmosphere, to fall again as rain. This was the time at which the Flood was at its most violent. Nothing would have survived on the land. This is one of the reasons why it is so hard to explain the order of the fossil record as a result of the different escape abilities of people and animals as they fled to the hills for refuge.[4] The continents were being scoured down to their roots — there were no hills to which men and animals could flee! It is difficult to imagine how any terrestrial creatures could have survived the Flood in its initial fury.

The biblical text indicates that all the land-dwelling air-breathing animals were obliterated during this early phase of the Flood. For instance, God said to Noah:

> "For yet seven days, and I will cause it to rain upon the earth forty days and forty nights; and every living substance that I have made will I destroy from off the face of the earth." (Genesis 7:4)

The text goes on to tell us:

> "And all flesh died that moved upon the earth.....All in whose nostrils was the breath of life, of all that *was* in the dry *land*, died. And every living substance was destroyed which was upon the face of the ground, both man, and cattle, and the creeping things, and the fowl of the heaven; and they were destroyed from the earth....." (Genesis 7:21-23)

It is interesting that the Hebrew word translated "destroyed" in these verses is "machah", the same word used in Psalm 51 in which David is pleading with God to "blot out" his transgressions. When God blots out our sin he remembers it no more. It is as if our sin had never existed. In the same way, the forceful nature of the text in Genesis indicates that the destruction of the land-dwelling air-breathers was total. We should remember again the violence of the Flood. The original land surface was being stripped away, there was widespread volcanism and metamorphism, physical dismemberment by buffeting waters, abrasion and pulverisation by sediments, and chemical decomposition. No trace of the land-dwelling air-breathers — not even in fossil form — was left.

Now let us turn to the geological record. One striking feature of the record is the complete absence of any fossils of air-breathing land animals — or traces made by them — either in the Precambrian or in Lower Palaeozoic rocks. Terrestrial air-breathers do not begin to appear in the record until the Upper Palaeozoic. The European Flood model proposes, therefore, that the Precambrian and Lower Palaeozoic represent the complete wiping out of the prediluvian world during those first few terrible days of the Flood. As scripture indicates, the land-dwelling air-breathers were completely obliterated with no remaining trace.

It is significant that separating the Precambrian from overlying younger rocks is an extraordinarily widespread erosion surface. In the words of one 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." (Olson 1966 p 458)

As the subterranean water chambers emptied, the land was levelled, and the oceans began to inundate the continents. The resulting erosion surface — the so-called 'Great Unconformity' — marks the rapid incoming of the sea after the collapse of the fountains of the great deep. Immediately above this erosion surface we commonly find Cambrian sediments which indicate deepening water — a basal conglomerate or boulder bed, followed by sandstones, and then shales and limestones (Ager 1981 p 11). These Cambrian sediments are very widespread, indicating that the Lower Palaeozoic represents a time of unprecedented continental inundation by marine waters. Figure 6 shows the distribution of Upper Cambrian sediments across the United States and southern Canada. This shows the extent of the inundation of this continent at that time — only the Transcontinental Arch remained above water, and that too was flooded by the Late Ordovician.

Let me quote Dr T H van Andel (1994), a Cambridge University geologist, in his book *New Views on an Old Planet:*

> "Regarding the early Palaeozoic in this bright light, we find a wet world, its continents inundated

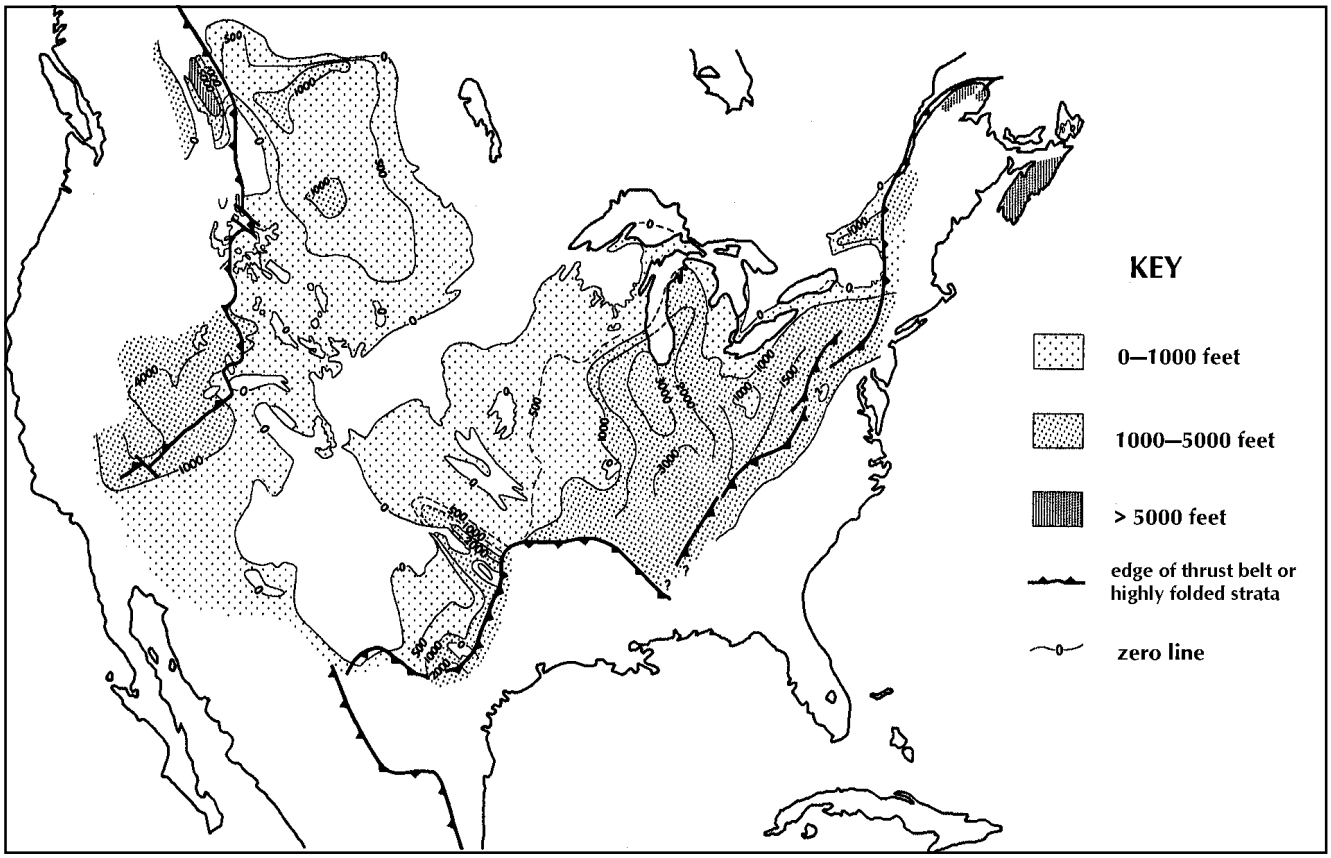

Figure 6: Distribution of Upper Cambrian deposits across the United States and southern Canada (from Robinson 1996 p 40). Only preserved strata are shown, and thicknesses therefore represent minimum values.

> far more than they have ever been since then, and the rise of the sea continuing. Before this rise ended, very little land remained above water." (p 179)

It is likely that in the Precambrian all the pre-Flood land was underwater as a result of the breaking up of the fountains of the great deep. The Lower Palaeozoic represents a marine inundation, the ocean waters sweeping over the continents as they foundered.

We now come to the issue of where the Flood ends in the geological record. If the continents were under water during the Precambrian and Early Palaeozoic, then at what point does the rock record begin to show signs that the Flood waters are receding?

The post-Flood world

While the beginning of the Flood was a sudden geological event (the breaking up of the fountains of the great deep), its ending was gradual and protracted. Noah stepping off the Ark was not a geological event that can be pinpointed in the rock record. The land was dry enough in the region where the Ark became grounded for Noah and the animals to leave the vessel, but many other parts of the world may have been still under water. The after-effects of the Flood must have lasted for centuries — a catastrophe of the magnitude of the Flood does not end abruptly with the world suddenly returning to calm and equilibrium. Why did Noah and his descendants need the promise of the rainbow? God knew that there would be times when they would doubt His promise never again to destroy the earth in a Flood. The "world that then was" (2 Peter 3:6) had perished and the harsh new world was not an easy place in which to live. Post-Flood catastrophism creates problems for us in deciding where to draw the line in the fossil record to mark the Flood/post-Flood boundary. However, there are various lines of evidence that help us make a division in the record between Flood and post-Flood rocks. Let us look briefly at a few of these.

Submersion of the continents

I noted earlier that geological evidence indicates the maximum flooding of the continents — by subterranean terrestrial waters — occurred in the Precambrian, followed by an incoming of marine waters as the continents sank in the Early Palaeozoic. From that time onwards, the geological evidence indicates that flood-

ing was never so extensive again (Figure 7). Evidence indicating the substantial re-emergence of dry land begins to appear in the Devonian. The end of the Palaeozoic and the beginning of the Mesozoic is characterised worldwide by continental red-beds (e.g., windblown sands) of the Permo-Triassic, and extemely low sea-levels correlating well with the drying out of the land after the Flood (Genesis 8:13).

In these turbulent post-Flood times there was major tectonic activity still going on. Convincing geological evidence indicates that towards the end of the Flood, the continental plates had collided to form a supercontinent, which geologists call Pangaea. This was providential in that it paved the way for the rapid recolonization of the Earth by the animals preserved on the Ark. It appears that in early post-Flood times, this supercontinent began to break up. Hot magma rising at the mid-ocean ridges buoyed up the oceanic crust, displacing ocean water onto the continents. This led to the re-inundation of some continental areas after the Flood. I understand that this proposal may make some creationists uncomfortable. After all, don't we read that God promised Noah that he would never again destroy the earth with a Flood? But let us put this post-Flood activity into context. The maximum submersion of the continents below water after the Early Palaeozoic was during the Late Cretaceous, and even then there was still plenty of dry land. I quote Van Andel (1994):

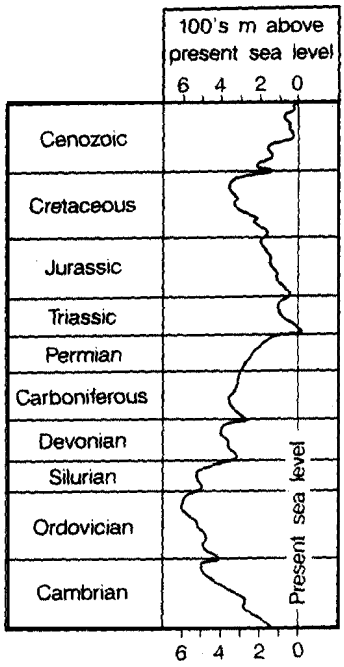

Figure 7: Eustatic sea level curve derived by estimating the area of continental flooding. There are two major peaks of flooding — one in the Lower Palaeozoic and a lesser one in the Upper Cretaceous. Adapted from Hallam (1984).

> "During the Cretaceous, the inundation of the continents reached an extent not seen since the early Palaeozoic, and in the end little more than half of the present land area remained above the waves." (p 183)

God kept his promise! — never again did the waters destroy the earth with a Flood.

Continental flood basalts

To illustrate this point further, let us look at continental flood basalts (CFBs). These are remarkably widespread lavas that dwarf any known today. They are called CFBs, not because geologists think they formed during the Flood, but because of their vast extent — they are truly floods of lava. Hundreds of cubic kilometres of basalt were erupted in just days or weeks. The significance of these particular basalt flows is that they appear to have been erupted on dry land, and can be distinguished from lava flows formed under water. They can therefore give us crucial evidence for the existence of large tracts of dry land in the past, and help us decide when the continents were flooded and when they were above water.

Figure 8 shows the distribution of CFBs throughout the geological record. One example is known from the Proterozoic, and another from the Lower Cambrian (although this is not certain). Then there is a gap in the record where no CFBs are known. They reappear in the Mesozoic, and examples are known throughout the Mesozoic and Cenozoic. This distribution is striking and needs to be explained. I suggest that CFBs are absent from the Palaeozoic because the continents were under water at that time (Garner 1996b). It was only in the Mesozoic, with the re-emergence of dry land that CFBs were able to form. This indicates a Flood/post-Flood boundary somewhere around the end of the Palaeozoic.

Vertebrate tracks

Let us now consider the incidence of fossil tracks in the geological record. Living animals can walk and leave footprints; dead animals cannot. We have already emphasised the suddenness and violence of the Flood. The Bible describes the total annihilation of all the pre-Flood air-breathers in the first 40 days of the Flood. We should expect, therefore, to find no evidence of living land animals (e.g., footprints) in Flood layers, but we would expect to find plenty of evidence of living land animals in post-Flood layers, after the animals had stepped off the Ark and begun to repopulate the earth. We can therefore look at the distribution of footprints in the geological record to help us identify Flood rocks.

Figure 9 shows the distribution of tracks (Garton 1996). The Lower Palaeozoic layers are barren of tracks. Amphibians and reptiles characterise the Upper Palaeozoic, reptiles the Triassic, and dinosaurs (with some birds) the later Mesozoic. In other words, the tracks of air-breathing land animals lie on top of thousands of metres of sediments that contain no tracks. This distribution can be understood if the Flood ends in the Upper Palaeozoic. This would explain why tracks are absent from the Lower Palaeozoic — these are Flood rocks laid down at a time when all the land creatures had perished. It would also explain why the tracks of terrestrial creatures characterise the Mesozoic — these are post-Flood animals descended from those on board the Ark. The amphibian and reptile tracks in the Up-

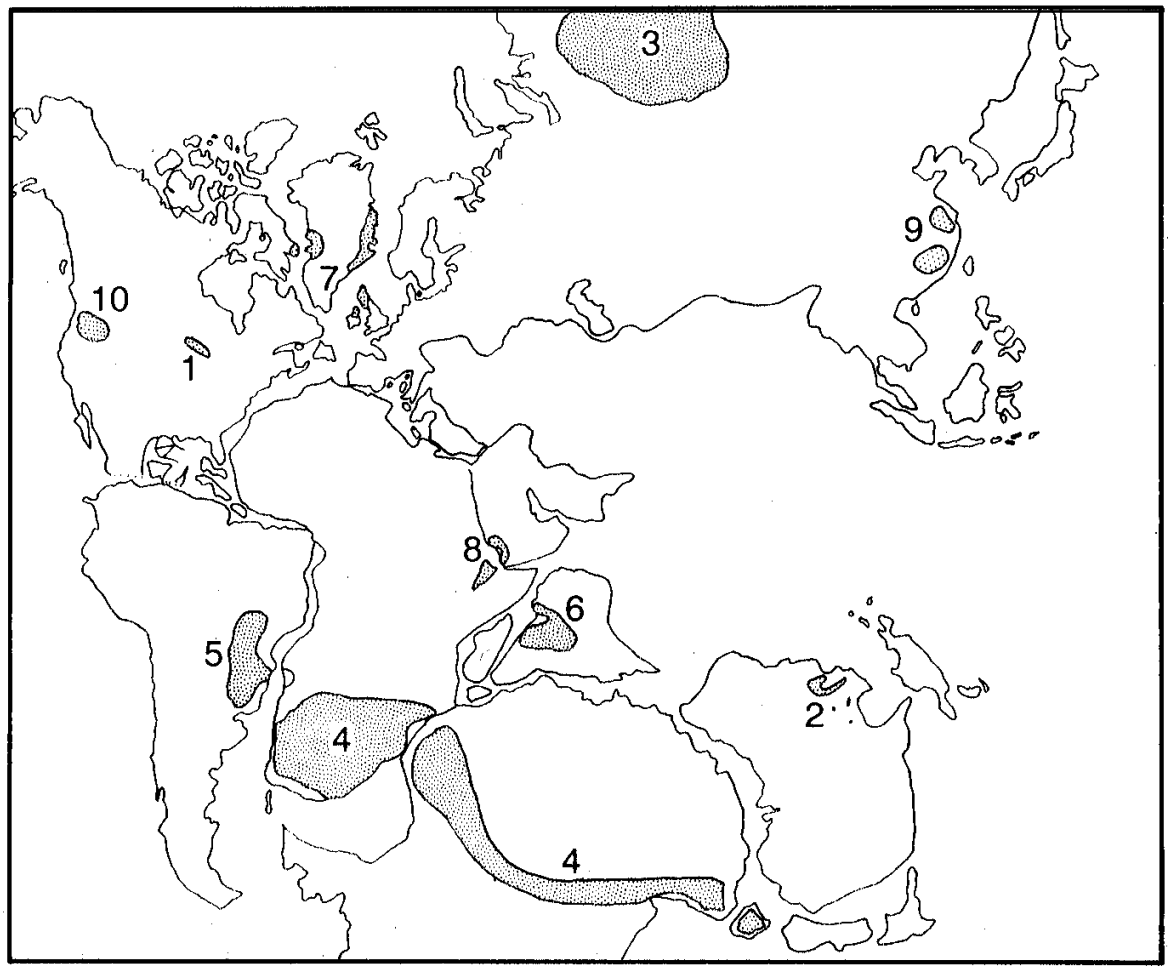

Figure 8: Map showing the distribution of the major continental flood basalt provinces (from Garner 1996b p 118): (1) Keweenawan Province, (2) North Australian Province, (3) Siberian Province, (4) Karoo-Antarctic Province, (5) Paranà-Etendeka Province, (6) Deccan Province, (7) North Atlantic Tertiary Province, (8) Ethiopian Province, (9) Eastern China Province, (10) Columbia River Province.

per Palaeozoic appear to be those of semi-aquatic creatures that were able to survive outside the Ark (Robinson 1996, pp 52-53).

Dinosaur nests

One of my contributions to the current debate about where the Flood/post-Flood boundary is located was a review of the data on dinosaur nesting sites (Garner 1996a). While the presence of bones does not necessarily tell us whether an animal was alive or not when it was buried, dinosaur nests, like tracks, are obviously made by *living* dinosaurs. These nests are found at multiple levels throughout the Mesozoic sediments (such as the example (Figure 10) from Egg Mountain, Montana), and like the tracks they overlie thousands of metres of sedimentary rock that does not contain dinosaur remains of any kind. These are facts that any creationist model of earth history must be able to explain.

If we plot the distribution of nests on the geological column, we find that they occur, not haphazardly throughout the column, but from the Triassic onwards. There is also an apparent increase in the numbers of eggs and nests found throughout the Mesozoic, with the largest concentration occurring in the Upper Cretaceous sediments. Again, this non-random distribution of nests points to a Flood/post-Flood boundary before the Triassic.

Pattern of the fossil record

Earlier I mentioned the orderly succession of fossils — particularly the widely known vertebrate succession — in the rock record. If — as creationist geologists in the UK have proposed — all the air-breathing vertebrates were destroyed in the Flood, then the fossil record of the air-breathers must be post-Flood. Most scientists, of course, think that this succession is an evolutionary sequence — reptile, mammal, bird and finally man. Can we explain the succession of terrestrial vertebrates in the fossil record based on a creationist post-Flood model?

I'm not going to look at this in great detail, but in his paper in the *Technical Journal,* Steven Robinson (1996) examined this question and if you'd like more information please consult that paper. However, I will make a few preliminary comments.

To a first approximation it is possible to explain the order of first appearance of land-dwelling, air-breath-

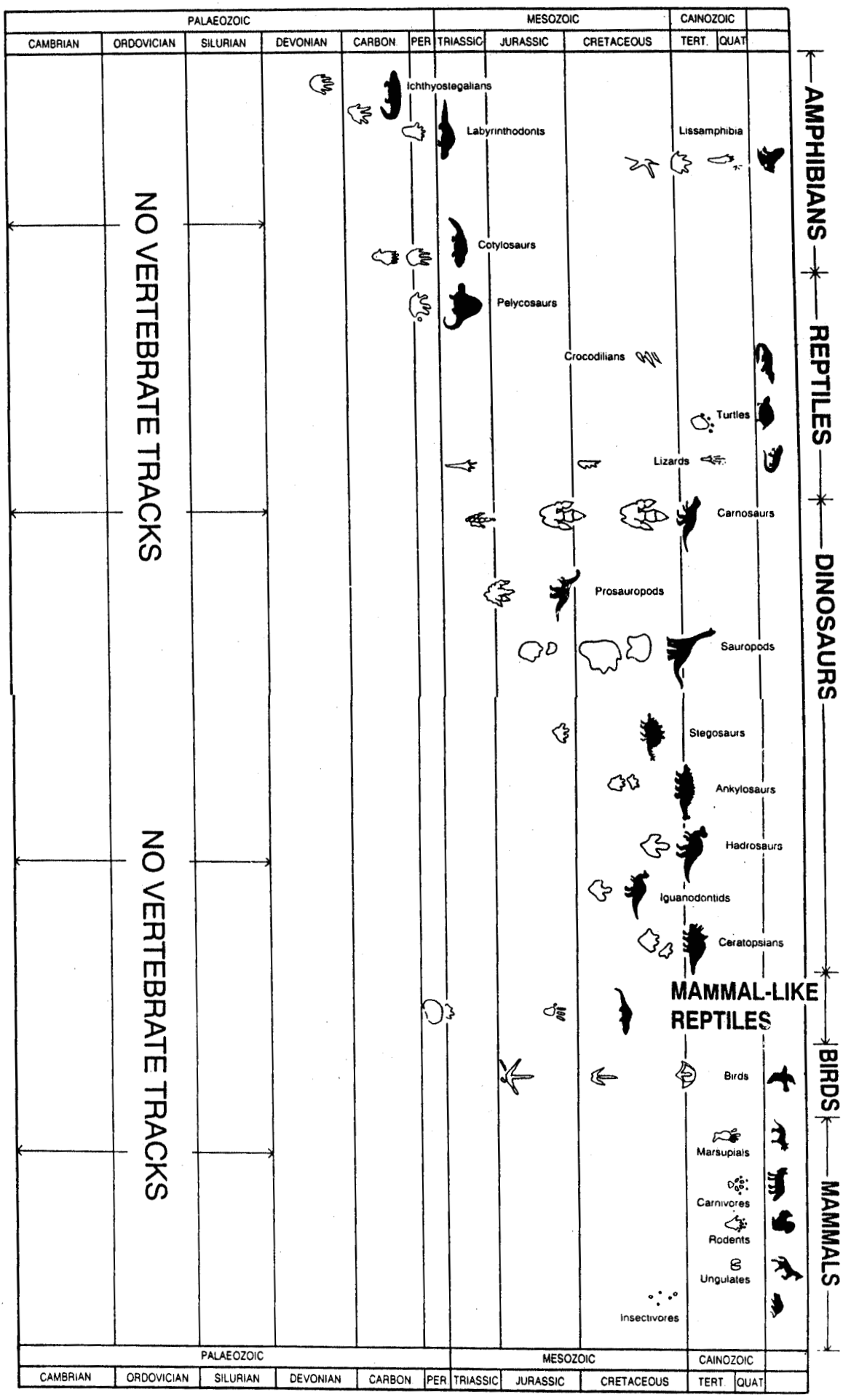

Figure 9: Stratigraphic distribution of vertebrate fossil tracks (from Garton 1996 pp 84-5). Note the lack of tracks in the Lower Palaeozoic.

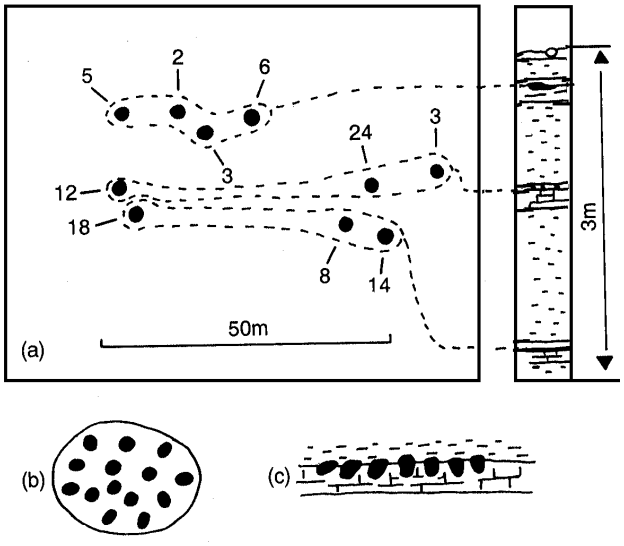

Figure 10:
(a) Map and vertical section of Willow Creek Anticline locality, Egg Mountain, Montana, showing a number of egg clutches attributed to a hypsilophodont-like ornithopod dinosaur. The clutches occur on at least three different horizons in a three-metre (10-feet) section. Values represent the number of eggs per nest, broken lines enclose clutches found on single horizons.
(b) Typical clutch arrangement viewed from above.
(c) Egg clutch viewed from the side showing the partial burial of the eggs in siliceous carbonate sediment.
From Garner (1996a p 103).

ing creatures on the basis of dispersal rates and reproductive rates after the animals came off the Ark. Take the dinosaurs, for instance. The earliest dinosaurs — in the Triassic — are bipedal reptiles that would have been capable of travelling long distances rapidly. It is no surprise, therefore, that these are the first to appear in the fossil record. There are three important trends throughout the dinosaur record:

(i) *increasing number of fossils*, reflecting the increasing number of animals as they multiplied,

(ii) *growing diversity of dinosaur types*, reflecting

(a) the increasing likelihood, as they multiplied, that particular types would be buried, and

(b) post-Flood variation within the kinds,

(iii) *increasing body size*, reflecting 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 (Paul 1994). For instance, it is estimated that in about 40 years a sauropod dinosaur could have produced up to 4,000 eggs. In addition, it is thought that the juveniles grew very rapidly. The reproductive output of dinosaurs is thought to have equalled or exceeded that of rodents, and was much higher than large mammals like elephants. This would explain why dinosaurs appear in the fossil record before the mammals, which do not appear in significant numbers until the Cenozoic. Calculations show that elephant reproduction rates, for example, are such that we should not expect to find these creatures fossilized in the first 200 years after the Flood because the population numbers would have been too small (Robinson 1996 pp 63-4). The first indisputable elephant fossils are found in the Eocene, which accords very well with this model, in which the Mesozoic and Cenozoic represent the first two or three centuries after the Flood.

So it appears that the Flood/post-Flood boundary is somewhere in the Upper Palaeozoic[5]. This conclusion does not rest on any single piece of evidence, but is corroborated by a number of independent lines of evidence that all point in the same direction.

Conclusion

Scripture is quite clear that in the days of Noah there was a Flood of waters which engulfed the entire earth and destroyed every creature that lived on it. This testimony is supported by Flood traditions all over the world. The geological record also supplies abundant evidence of a worldwide cataclysm. Nevertheless, we must hold our scientific models lightly. We must be willing to subject our models to criticism and peer review. We do not present this model of earth history to you as the final word on the subject. It is a summary of our current thinking, and will need to be reviewed, critiqued and, if necessary, modified.

Our concern is not simply to show that the theory of evolution is an inadequate explanation of the fossil record, but to develop a sound, scientific alternative to that theory. It is vitally important that creationists apply themselves to the development of a young-earth view of geological history that is in harmony with both the scientific evidence and scripture. This is important not only for the academically or scientifically minded, but it is vital if we are to have any impact in the secular world. There is a message in the rocks — a message of judgement, of God's abhorrence of sin — that is for all mankind. These issues of Flood geology — touching as they do on fundamental issues of man's origin and destiny — are crucial as we seek to expand the creationist ministry, take the hope of the Gospel out into the world, and see men and women saved.

Notes

[1] Text of a lecture delivered at the autumn meeting of The Genesis Agendum at Baden-Powell House, London on Saturday, 30 November 1996.

[2] Albeit they were old-earth creationists.

[3] It might be objected that these calculations are invalid since the Coconino Sandstone is usually regarded as an aeolian (i.e., windblown) deposit. However, there is compelling palaeontological and geological evidence against an aeolian interpretation and in fa-

vour of an underwater origin (Brand 1979; Brand and Tang 1991; Visher 1990).

[4] This was one of the proposals of Whitcomb and Morris (1961 pp 270-88) to explain the order of the fossil record.

[5] It has recently been suggested that the boundary may be as low in the geological column as the Silurian (Steven J Robinson, personal communication, 1997).

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