Flood models: the need for an integrated approach

Andy C. McIntosh, Tom Edmondson, and Steven Taylor

Any scientific understanding of the biblical Flood must address the hydrology and sedimentation that occurred during the Flood and in subsequent years as the earth settled down. A number of scientific models previously proposed for the Flood are summarised and assessed. Further progress will require an integrated approach from many scientific disciplines. As well as the traditional contribution from the geological sciences, coordinated inputs from a number of other disciplines will be needed such as fluid flow, heat transfer, plate tectonics, vulcanology, planetary astronomy, and mathematics, in order to build a possible Flood hypothesis. Any model for the Flood can only be speculative. A coordinated approach will impact current Flood models that have accepted the sequential nature of the geological column and that have put the Flood/post Flood boundary far down in such conjectural reconstructions.

Introduction

Traditionally, for scientists operating from an evolutionary premise, the geological sciences have provided the chronological framework to allow other scientific disciplines to place their data in an historical context. The main principle of uniformitarianism has motivated research into present geological processes so that rocks these scientists regard as ancient can be interpreted in terms of such processes. In the last thirty years there has been a major shift in thinking amongst evolutionary geologists with the development of plate tectonics — all modern geological processes are now seen as part of a global interaction of plate tectonics, which itself has been adopted as the interpretative geological paradigm.

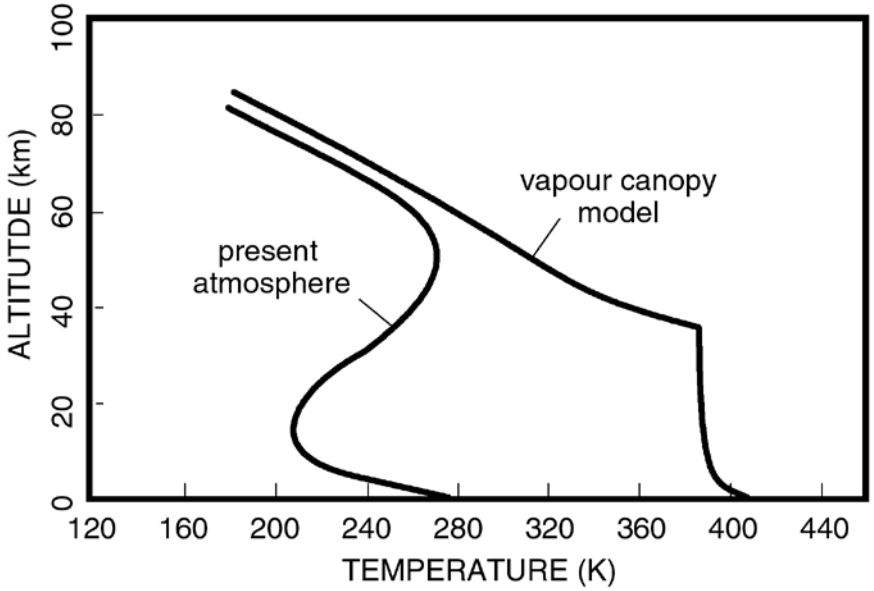
By contrast, scientists working from a creation perspective view all significant geological events within a biblical chronological framework. Nevertheless, there is still a need for scientific models of these events because the biblical record is not exhaustive, nor is it intended as a scientific treatise. In particular, creation scientists need to understand the biblical Flood by addressing the hydrology and sedimentation that occurred during the cataclysm and in the subsequent years as the earth settled down. Modern geological processes, while instructive, do not have the same standing as for long-age uniformitarian scientists. This is because geological processes during Creation and the Flood were different from what we observe today. So creationists have a greater need to develop an integrated approach from many scientific disciplines. As well as the geological sciences, inputs from many other disciplines are needed, such as fluid flow, heat transfer, plate tectonics, vulcanology, planetary astronomy, and mathematics. In this paper we summarise the current state of a number of scientific models that have been proposed to describe the world-wide Flood and to integrate our understanding of science from the biblical perspective.

The vapour canopy model

The vapour canopy model of the Flood is the one that has held greatest sway in scientific creationism since serious research began in the 1960s. The book *The Genesis Flood* by Whitcomb and Morris,[1] first published in 1961, and Whitcomb's later *The World that Perished* (1996) explain this view.[2] The vapour canopy theory is that the earth's atmosphere was surrounded by a water vapour blanket that collapsed at the onset of the Flood. Dillow has extensively explored this concept theoretically.[3] This model has led the field for a number of years, but has difficulties in accounting for the large amount of catastrophic upheaval in the earth at the beginning and through the Flood year.

Catastrophic upheaval is evident, for instance, at the Old Red Sandstone rock formation from Loch Ness to the Orkneys in Scotland where an area 2500 m deep and 160 km across, contains countless fish, buried in contorted and contracted positions, as though in convulsion.[4,5] There is all the evidence of catastrophic burial by processes (it would seem) of greater power than that provided by the vapour canopy theory. Although there may be some substance in these objections to the vapour canopy proposal, it should be noted that this model of the Flood, though it predicts late drowning of creatures by rising floodwaters, should not be regarded as tranquil. Indeed in this model, the rising waters would be extremely turbulent, and probably involve vast surging tidal waves. Nevertheless it is still difficult to explain the major fossil strata by this method.

Consequently some, such as Garner,[6] Garton,[7] Tyler,[8,9] and Robinson,[10,11] object, not only to the vapour canopy model of the Flood,[12] but also (more fundamentally) to the basic premise that the Flood caused most of the fossils. Their objection arises from their belief that the geologi-



Calculated vertical temperature profile for a vapour canopy model of the earth's atmosphere compared with the temperature profile today (after Rush and Vardiman).[50] Theoretical models of postulated pre-Flood vapour canopies are used to explore whether it is feasible to postulate significant quantities of water in the atmosphere above the earth. In this example, only 50 cm of precipitable water is stored but this raises the surface temperature of the earth to above 100 °C.

cal column represents a real time sequence (though on a fast time-scale of the one-year Flood followed by many post-Flood disasters). Because there is evidence deep in this geological column that many animals were alive on land, and yet are buried above waterborne sediments, they propose that most of the geological column was deposited after the Flood. Thus, they propose that the Flood removed all trace of land air-breathing creatures and that most of the fossils found on the earth were buried by post-Flood catastrophes. Known as the 'European Flood model', we have sought to show in a companion article[13] that biblically, this is greatly straining the straightforward meaning of Gen. 6–9. Here we seek to show that to regard the geological column as a true chronological record is at best a questionable assumption. We agree with Froede that there needs to be a complete rethink of how to interpret the geological layering so evident in the rocks.[14,15] Woodmorappe rightly points out that the way the supposed ten periods are assigned can be quite subjective.[16] In this paper we question whether we really yet have any firm grasp of the way all the strata have been laid down. Even the basic notion that 'bottom is oldest' is not proven.[17]

One of the major difficulties raised by Flood models of fossilisation (including the canopy theory) is the problem of dinosaur nest sites within the fossil record. These certainly pose quite a difficult problem to solve in the context of Flood sedimentation.

Garner points out that the eggs are obviously in neat patterns, suggesting that they have to be regarded as *in situ*, and cannot be accounted for by sediments deposited elsewhere and transported in before final fossilisation.[6] Garton shows that there are dinosaur tracks all the way from the Cretaceous to the Tertiary and Quaternary rocks.[7] He concludes that this must be evidence of post-Flood activity. Tyler believes the vast chalk deposits (usually taken to be the crushed remains of marine shells) need decades to form and also concludes that the Cretaceous is post-Flood.[8]

Because of such evidence, critics of Flood fossilisation in general, and the Whitcomb and Morris model of the Flood in particular, have maintained that the Flood/post-Flood boundary is low down in the geological record, in the Paleozoic, as explained by Tyler.[9] (This geological column term is used simply for communication purposes. The order of the strata may well be incorrect for reasons outlined later.) Such critics have maintained that all Flood models which attribute most fossils to the Flood, are incorrect, and propose that the Flood left no trace whatsoever of **all** air-breathing land creatures — the so called 'blot out' theory.

In a companion paper,[13] we give important biblical reasons why fossils are the most natural evidence expected from the Flood. However these authors are right to criticise the vapour canopy model if it does not provide enough sedimentation to achieve such a vast thickness of fossil-containing strata. This is why we discuss other models in this paper, which, we believe, yield a more plausible picture of the Flood year.

The hydroplate model

The hydroplate theory has the advantage of explaining great devastation in the first 40 days. This theory for the catastrophic formation of the sedimentary rock layers during the Flood has been proposed by Dr Walter Brown (former chief of Science and Technological Studies at the Air War College, and Associate Professor at the U.S. Air Academy).[18–20]

The main proposal for the origin of the Flood waters is massive catastrophism in the first 40 days of the Flood. (We agree with the European Flood proponents that the initial devastation was exceedingly great, but we dispute that there remains no evidence of the *mabbul* and its effects on creatures in the geological record.) The Brown hypothesis[18,20] is that the Earth's crust was fractured (maybe by an impact), releasing vast subterranean waters (the *'fountains of the great deep'*) under great pressure into the atmosphere, perhaps as high as 30 km. Brown's model essentially deals with water, but in the following continental drift phase

includes volcanic activity[21] as a result of the fast tectonic movement caused by the widening rupture in the earth's crust. Thus he states:

> *'In some regions, the high temperatures and pressures formed metamorphic rock. Where this heat was intense, rock melted. This high pressure magma squirted up through cracks between broken blocks, producing other metamorphic rocks. Sometimes it escaped to the earth's surface producing volcanic activity and "floods" of lava outpourings such as we see on the Columbia and Deccan Plateaus. This was the beginning of the earth's volcano activity.'*[22]

Brown states further:

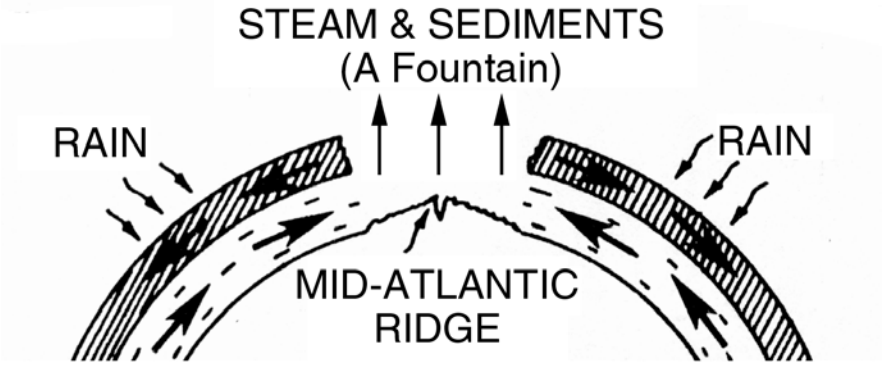
> *'Shifts of mass upon the earth created stresses and ruptures in and just beneath the earth's crust. This was especially severe under the Pacific Ocean, since the major continental plates all moved toward the Pacific. The portions of the plates that buckled downward were pressed into the earth's mantle. This produced the ocean trenches and the region called the "ring of fire" in and around the Pacific Ocean. The sharp increase in pressure under the floor of the Pacific caused ruptures and an outpouring of lava which formed submarine volcanoes called seamounts.'*[23]

Thus the initial rupture of the earth's crust under this view would hurl rocks and sediments in gigantic muddy fountains of water which then lead to intense precipitation (consistent with Gen. 7) for the 40 day period. These fountains would eventually be followed by many large volcanic eruptions in the 'Ring of Fire' around the Pacific, all with the force of Krakatoa. This volcano exploded in 1883 sending rocks and dust into the atmosphere to a height of 55 km. The explosion was so intense that it could be heard 4,600 km away. Dust fell at a distance of 5,327 km ten days after the explosion,[24] and a tsunami (tidal wave) 30 metres high travelled right across the Indian Ocean at 720 km/h.[25] Similarly, during the Flood, on top of the water borne sediments, and sometimes mixed with them, vast layers of magma would be poured out or catastrophically exploded into the atmosphere.

The rain in the first 40 days of the Flood involved not only the return to the earth of the jets of superheated steam ejected into the atmosphere (which would partly fall as hail and snow), but great quantities of rock debris as well. Many fossils could have formed within the first few weeks of the Flood in this model. In the next 110 days, further vast layering, scouring and re-layering of the continents would occur under the ravages of the Flood waters. The final catastrophic drainage of the waters occurred at the end of the continental drift phase when, after massive tectonic upheaval, the land eventually re-appeared as the earth's crust found a new equilibrium. It is significant that Gen. 8:3 speaks of the waters *'returning from off the earth'* (literally '**going and returning**' in the Hebrew).

Some have criticised the rupture phase of the hydroplate model with its vast quantities of hot steam ejected at enormous speeds into the atmosphere, causing immense rainfall. However, the 'explosive mixing of water and lava'[10] targeted by these objections, is very possibly how the *'windows of heaven'* were opened as described in the Flood account.

Within the context of the hydroplate model, it is entirely feasible that many creatures would flee in vain to survive. We would expect to find fossil evidence of this, such as tracks in mud subsequently covered quickly by sediment.[26] Furthermore, since it was a full year before Noah came out of the Ark, there is certainly room within the Genesis account for some late-Flood and post-Flood disasters as the waters receded. Thus the Grand Canyon may well have been formed when a vast natural inland lake (left behind after the Flood receded) burst its banks and scoured out the canyon. In this process, vast quantities of silt and debris would be carried to the Pacific coast-line.[27] Brown,[18] describing the aftermath of the hydroplate catastrophe, agrees with Austin that the Grand Canyon formed in this way. The Toutle Canyon was observed to form catastrophically in a similar manner, but on a much smaller scale, after the Mount St Helen's eruption in 1980. Such catastrophic processes may account for the burrows of small marine creatures in rocks at one horizon, but which are now covered by further sediments.

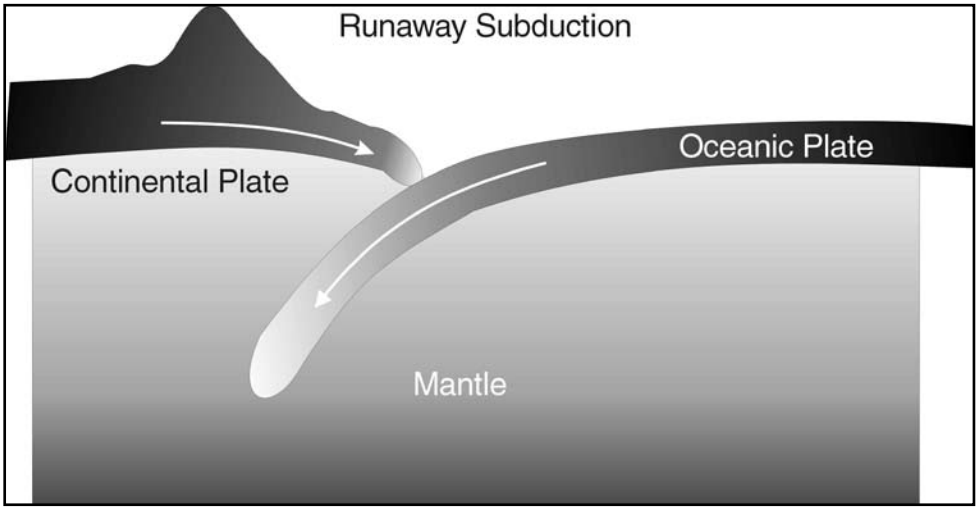


Recoil phase of the hydroplate model for the geological events of the flood (from Brown).[51] *Rupture of the crust allows steam and sediment to be ejected as a fountain into the atmosphere, returning to the earth as rain. The continents start to move apart.*

Catastrophic plate tectonics and runaway subduction

The theory of catastrophic plate tectonics (CPT) was initiated by Baumgardner,[28] and later developed in conjunction with other creation scientists.[29] Reed *et al.* provide a good review of plate tectonics as interpreted within a catastrophic framework,[30] but make the point in their conclusions that the original driving mechanism behind continental plate displacement

and subduction is not known. CPT theory starts with the assumption that the Flood was initiated when slabs of oceanic crust broke loose and subducted along thousands of kilometres of pre-Flood continental margins. It is suggested that subducting slabs of material locally deformed and heated the mantle, locally lowering its viscosity. With lowered viscosity, the subduction rate increased — and this in turn caused the mantle to heat up even more. This, it is argued, led to a thermal runaway instability, and allowed subduction rates of metres per second. Baumgardner shows that rapid, large-scale subduction would furthermore initiate global-scale flow of the mantle beneath the earth's crust. This in turn would cause strong convection currents in the earth's outer core and explain how geomagnetic reversals took place.[31,32] Magnetic reversals of course had been thought to have taken place slowly over millions of years on the evolutionary geological timescale. However, the extension by Humphreys of the CPT theory of Baumgardner to account for the earth's magnetism gives an underlying cause for the quick reversals. In that evidence for rapid reversals has been discovered in thin lava flows, the magnetic field deductions from CPT theory gives considerable confidence in the theory of continental plate collision and subduction as being a primary mechanism for major global upheaval during the Flood.



Runaway subduction of the oceanic plate into the earth's mantle drives metres-per-second motion of the rigid lithospheric plates in the catastrophic plate tectonic model of the Flood.

It is only recently that the implications of the mathematical modelling of CPT have been successfully understood. It was necessary to solve numerically the stiff partial differential equations governing the behaviour of silicate rock material, taking full account of the large dependence of effective rock viscosity on temperature and strain rate. The highly nonlinear relationship between viscosity and stress implies that the effective viscosity decreases sharply once the material is subjected to a strong shear stress. This liquefying effect increases dramatically as the temperature increases, even though it may only be at 60% of its melting temperature. An important feedback mechanism then comes into play. As the cold upper boundary layer of the earth's mantle sinks into the hot mantle underneath (due to the liquefying stress), it heats the mantle locally. This reduces the viscosity even further, thus allowing the plate to sink faster. The two effects (strong shear stress and the peeling away of the upper cool boundary of the mantle) effectively reinforce each other, and consequently thermal runaway begins. As Baumgardner states in his paper:

> *'A compelling logical argument in favor of this mechanism [subduction] is the fact that there is presently no ocean floor on the earth that predates the fossiliferous strata. In other words all the basalt that comprises the upper five kilometers or so of today's igneous rocks has cooled from the molten state since sometime after the Flood cataclysm began.'*[28]

He then asks where the pre-Flood seafloor went. The model convincingly suggests the answer that the original sea-floor was catastrophically subducted, so that we now have a relatively new sea-floor — formed as igneous flows from the earth's mantle deposited in very thick (five kilometres or so) layers at the bottom of the present-day oceans.

The hydroplate theory previously discussed and CPT are usually regarded as mutually exclusive. But this need not be so. There is considerable room for volcanic activity during the continental drift phase of the hydroplate theory.[33] The breaking of the earth's crust (possibly by an impact) may well have released large volumes of subterranean waters into the atmosphere, and led to the rapid movement of the broken continental plates from the impact centre. Subsequently, a subduction mechanism may then have taken over from the initial catastrophe, driving continuous upheavals in the earth's mantle under the seas, and sustaining the disaster for the rest of the Flood year.

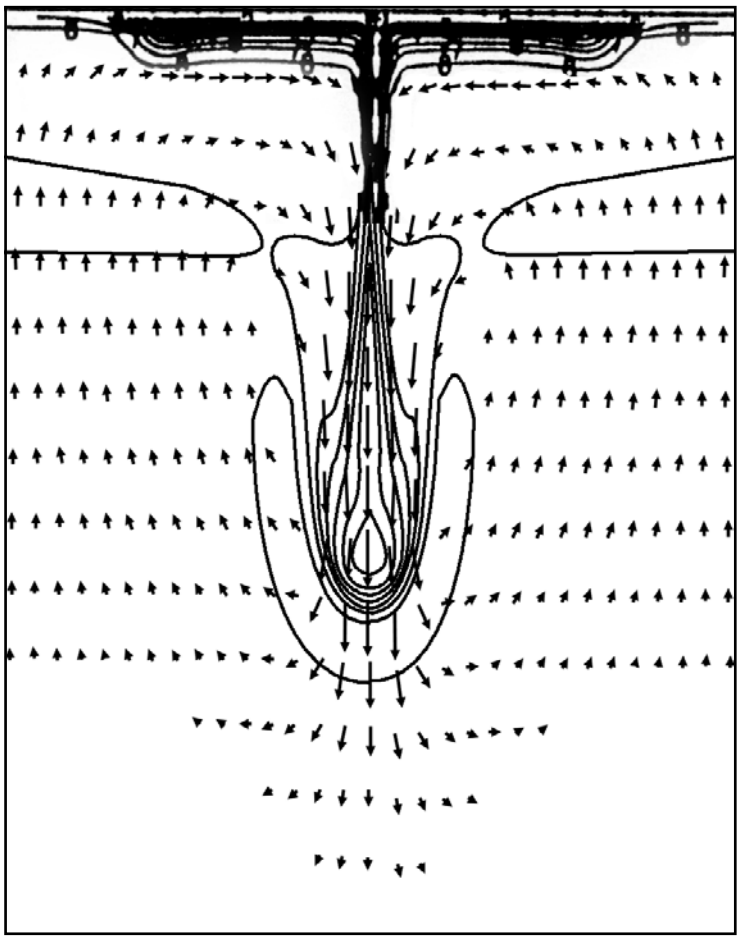
The importance of research in sedimentology

Guy Berthault has produced some landmark research into sedimentology. First on a small scale, but more recently on a larger scale, he has studied the deposition of heterogeneous mixtures from flowing water.[34] His results indicate that different sediment layers do not deposit one after the other in a vertical direction, but all at the same time horizontally.[35] Applying these findings to the Grand Canyon, the different layers would have been deposited under

strong water currents and laid down horizontally, *not* vertically. Thus many of the layers of the canyon would have been deposited simultaneously, and do not necessarily represent different periods of time. If proved, this has immense implications for the whole theory of sediment formation world-wide. Clearly we must avoid saying that all sediments were laid down this way. The vast coal seams would be one example of deposition in a non-flowing environment. However Berthault's sedimentology experiments have overturned previous belief that layers form one after the other in stages. Such surprising results may help us understand why the apparent order of the so-called geological column is reversed in some parts of the world.

Furthermore it is interesting to note that the preliminary results of the work by Baumgardner and Barnette support Berthault's basic premise.[36] They considered the simplified problem of a shallow, homogeneous and inviscid fluid (water) flowing over a rotating sphere. Their fully transient solution to this problem produced some unexpectedly fast flowing regions of strong cyclonic gyres with velocities of 40–80 m/sec. The effect of such fast flowing currents on deposits of material carried with the water is not yet understood, but this shows that there is a great deal to be done with heterogeneous flows where the shallow water assumption is lifted. Generic studies, both experimental and numerical, are needed.

A method for classifying rock formations without direct appeal to the geological column (with collapsed time-scales) has been proposed by Walker.[37] This method advocates different types of flood formations as the waters rose and subsided. The hydroplate method or Baumgardner's approach can both be used as possible driving mechanisms for the Flood within such a classification.



Temperature profiles associated with subduction of oceanic slab into the mantle of the earth (from Baumgardner).[52] Computer models of the earth's mantle demonstrate the conditions that would be necessary to initiate runaway subduction.

A possible Flood fossilisation scenario

It is vital to remember that no one theory is probably entirely adequate to reckon with all the data, but nevertheless, one can speculate about possible answers to perceived problems. For example, Garner has rightly pointed out the difficulty with certain basalt flows appearing 'late on' in the supposed geological column.[38] Since these seem to require a sub-aerial environment, one can understand his conclusion that the post-Flood boundary must be earlier than the basalts. Thus with the water drained from the land, the subsequent volcanic activity in the Mesozoic and Cainozoic would be sub-aerial. But if we accept the hydroplate model of the initiation of the Flood, then the first 40 days would involve immense destruction consistent with the Paleozoic (some even include most of the Precambrian[39]) record. The waters of the oceans were still rising, parts of the land were still not covered entirely by water — there may even have been a brief lull. Certainly this is not inconsistent with the account in Genesis 7:17–24. In the next 110 days, immense volcanic upheaval occurred on the land masses, but still not all the land was finally covered. At the same time, upheavals of the land masses were also occurring, so that some of the land that had been covered was exposed, albeit briefly — of the order of weeks.

It is conceivable that dinosaur tracks could have been made in this time. Garton rightly points out that these dinosaur tracks go right through the Mesozoic and into the Cainozoic.[7] Under our scenario, tracks in the Mesozoic are consistent with ground still being available at the late stage of the 150 days. Some tracks may already have been made earlier, just after the 40 days' initial onslaught, and then pushed upwards when the mountains rose. Similarly, tracks showing no sign of chaotic motion in the Pyrenees in Spain[40] may also be at the late stage of the 150 days, again pushed upwards as the mountains rose. Finally the waters with vast amounts of debris and sediment overpowered these large creatures which, not surprisingly are buried in the same part of the strata as the later tracks and usually

'higher' up the column. We do not claim that such a scenario explains everything. There is a vast amount of work still to be done to understand the mechanisms involved. But we suggest that a willingness to expect and look for the unusual is always important for advance in scientific research.

Dinosaur tracks and nests during the Flood?

Egg-laying by dinosaurs in Mesozoic strata,[6] well above what appears to be the initial fossils of marine creatures in the lower strata, challenges the view that most of the fossils were formed by the Flood. Robinson gives further evidence of other apparently *in situ* fossils including plant roots in the Jurassic as well as marine fossils apparently *in situ* right up through Cretaceous into Tertiary rock.[11] Robinson argues against the vapour canopy model, stating:

> *'The sudden death of the dinosaurs and other animals at the end of the Cretaceous is a phenomenon for which the received Flood model [i.e. the vapour canopy model of Whitcomb and Morris] has no explanation.'*[41]

However, the model suggested by Robinson, Garner, Garton and others involving many post-Flood catastrophes gives no real answer either to the sudden death of dinosaurs in the Cretaceous. Their post-Flood fossilisation hypothesis, in our view, becomes a serious scientific problem.

Marine fossils are found high up in mountains in the Alps, often deposited with great violence (as suggested by the Jurassic marine fossils at lower altitude on the North East Coast of Yorkshire near Whitby). The burial of large dinosaurs, by their thousands in Alberta and Montana,[6] South Dakota, Kansas and Colorado[42] with vast continental sedimentation (in some places thousands of feet thick) would not be possible without causing gigantic upheaval in other parts of the earth. It seems inconceivable that post-Flood disasters could deposit such thick strata without causing violent effects all round the world. The scale, depth and the sheer number of fossils argues strongly that these must be part of the Flood. Rather than forcing the interpretation of *mabbul* to mean the removal of all possible evidence of any creatures (the 'blot out' theory — to allow suggested post-Flood activity), it seems wiser to question whether we have properly understood the scientific evidence.

In his article, Robinson states that Oard's post-Cretaceous model for the Flood/post-Flood boundary is '*not a straightforward interpretation of Scripture'*.[43] He argues that the position on the geologic column whereby the Flood killed the dinosaurs is '*a paradigm constraining the interpretation of Scripture'*. However, the alternative position he advocates, of entirely blotting out all animal remains without trace is, in our view, forcing a tenuous meaning on the word *mabbul*. This and the requirement of post-Flood disasters on a continental scale are leading to a much greater difficulty in the natural interpretation of Scripture.

We suggest that the burial of the dinosaurs by Flood waters is consistent with the evidence. We have suggested, as one option, that the dinosaurs and their nests were buried late in the Flood. Other scenarios could be possible. For example, sea creatures may have been buried by vast submarine landslides,[44] which were then pushed above sea-level in the first few days of the Flood. At the same time, sediments containing dinosaurs buried in the early stages of the Flood may have then been transported only a short distance across the newly exposed submarine deposits. It seems clear that some dinosaurs must have been buried by catastrophic waterborne sediment, at least in the case of the Mongolian examples of burial in the Cretaceous layers.[45]

A third option, and possibly the most plausible view, for the occurrence of dinosaur tracks late in the strata is that advocated by Garton.[46] He suggests that large creatures (including dinosaurs) were trapped in the floating Carboniferous forests. The evidence for these vast islands of vegetation carried by the heaving seas seems to be particularly strong.[47] Garton maintains that these creatures swarmed the inhospitable land in the final stages of the Flood. (In that he allows a few creatures to have survived the first 40 days, we presume he does not regard the 'blotting out' to be fully comprehensive.) This option explains the apparent anomalies and suggests that there may have been some protection from the initial inundation from above in the early stages of the Flood. Scheven's excellent work on floating mats of vegetation seems to explain the Carboniferous coal measures very ably. It is conceivable that as these mats struck land, the continued pounding of the seas as the waters rose to their maximum height could cause violent deposition of sediments with vast ocean waves criss-crossing the continents. The waters at this stage were not necessarily tranquil. In fact, this is most unlikely. Great geological activity seems to have been going on still, even though the rains had stopped. The bringing up of the mountains and the sinking of the valleys (Psalm 104:8 *'The mountains ascend, the valleys descend'*) occurred immediately after the earth was finally covered (Psalm 104:6).[48]

It is therefore entirely conceivable that further giant mudslides trapped the dinosaurs as the rafts struck land in the final stages of the 150 days, or that some escaped onto land, only to be buried as the rising waters finally covered the land. The burial of birds in the later strata is all consistent with the final stages of the 150 days, where no land was available.

Conclusion — an integrated approach needed

It is important that all scientific disciplines be utilised to understand the possible processes of the Flood. It is not only geology that should be considered. Hydrodynamics also must play a part in understanding sedimentation processes. Berthault has rightly stated *'Determination of initial hydraulic conditions from sedimentary structures, result-*

ing from sedimentological data is, therefore, a research priority.'[49] Today, in the experience of the lead author (in fluid dynamics and thermodynamics research), a **multi-disciplined** approach is usually needed before scientific advances can be made in the understanding of complicated and unusual phenomena. Progress is not generally possible when it is insisted that only experts of one discipline can solve the underlying physics of a particular problem.

The modelling of the flow of heterogeneous mixtures with the full laws of conservation of energy, mass, momentum, is one of the greatest challenges that computational fluid dynamics has faced. A very careful and thorough approach is demanded when the particle size of the material carried with the water varies widely. The problem involves materials of different densities, different viscosities, with very large variations in local Reynolds number (convection divided by viscous diffusion) and hydraulic conditions. Furthermore, boundary layers have to be modelled with particular attention to the possible change from turbulent to laminar flow. The experiments of Berthault have already clearly shown that surprising lamination can occur in the sediment deposits from such flows. These conditions now need to be modelled by fluid dynamicists and mathematicians, so an understanding of the larger picture can emerge by carefully constructed mathematical models.

On the larger scale modelling of solid earth geophysics, we acknowledge the impressive work already under way with the investigations of Baumgardner and Barnette.[36] Interaction between geologists and other scientists (particularly those researching in fluid dynamics), is essential if there is to be progress in Flood geology, beyond (the not unnecessary) basic description of what rocks and fossils are found at particular locations. Only as there is greater *interaction* between the relevant scientific disciplines will some of the unanswered problems of the biblical Flood models be solved.

References

1. Whitcomb, J.C. and Morris, H., *The Genesis Flood,* Presbyterian and Reformed Publishing Company, Phillipsburg, 1961.
2. Whitcomb, J.C., *The World that Perished,* Revised Edition, Baker, 1996.
3. Dillow, J.C., *The Waters Above: Earth's Pre-Flood Vapour Canopy,* Revised Edition, Moody Press, Chicago, 1982.
4. Milton, R., *The Facts of Life — Shattering the Myth of Darwinism,* 4th. Estate, London, pp. 85–86, 1992.
5. Trewin, N.H., Mass mortalities of Devonian fish — the Achananas Fish Bed, Caithness, *Geology Today,* pp. 45–49, Mar/April, 1985.
6. Garner, P., Where is the Flood/post Flood boundary? Implications of dinosaur nests in the Mesozoic, *CEN Tech. J.* **10**(1):101–106, 1996.
7. Garton, M., The pattern of fossil tracks in the geological record, *CEN Tech. J.* **10**(1):82–100, 1996.
8. Tyler, D.J., A post-Flood solution to the chalk problem, *CEN Tech. J.* **10**(1):107–113, 1996.
9. Tyler, D.J., Flood models and trends in creationist thinking, *Creation Matters* **2**(3), 1997.
10. Robinson, S.J., Was the Flood initiated by catastrophic plate tectonics? *Origins* **21**:9–16, 1996.
11. Robinson, S.J., Can Flood geology explain the fossil record? *CEN Tech. J.* **10**(1):32–69, 1996.
12. Other objections to the vapour canopy model concern the latent heat of such vapourisation — see Vardiman, L., An analytical young-earth flow model of the ice sheet formation during the 'ice age'; in: *Proceedings of the Fourth International Conference on Creationism,* Pittsburgh Pennsylvania, pp. 561–568, 1994, and Vardiman, L., A conceptual transition model of the atmospheric global circulation following the Genesis Flood; in: *Proceedings of the Fourth International Conference on Creationism,* Pittsburgh Pennsylvania, pp. 569–580, 1994.
13. McIntosh, A.C., Edmondson, T. and Taylor, S.C., Genesis and catastrophe: the Flood as the major biblical cataclysm, *CEN Tech. J.* **14**(1):101–109, 2000.
14. Froede, C.R., Sequence stratigraphy and Creation geology, *Creation Res. Soc. Quart.* **31**(3):138–147, 1994.
15. Froede, C.R., A proposal for a Creationist geological timescale, *Creation Res. Soc. Quart.,* **32**(2):90–94, 1995.
16. Woodmorappe, J., The geologic column: does it exist? *CEN Tech. J.* **13**(2):77–82, 1999.
17. Berthault, G., *Experiments in Stratification,* Sarong Productions, Jersey, video, 1999.
18. Brown, W., *In the Beginning: Compelling Evidence for the Creation and the Flood,* 6th (special) edition, Centre for Scientific Creationism, Phoenix, Arizona, 1996.
19. Selbrede, M.G., Dr Walt Brown's Hydroplate Theory, *Chalcedon Report* (Sept.), pp. 37–45, 1998.
20. Brown, W., *The Young Age of the Earth,* Alpha productions, video.
21. Brown, Ref. 18, pp. 86–92.
22. Brown, Ref. 18, p. 88.
23. Brown, Ref. 18, p. 91.
24. McWhirter, N. (ed.), *Guinness Book of Records,* Guinness, London, p. 61, 1983.
25. Whitcomb and Morris, Ref. 1, p. 264.
26. Morris, J.D., *The Young Earth,* Master Books, p. 95, 1994.
27. Austin, S.A., *Grand Canyon: Monument to Catastrophe,* ICR, Santee, California, 1994.
28. Baumgardner, J.R., Runaway subduction as the driving mechanism for the Genesis Flood, in: *Proceedings of the Third International Conference on Creationism,* Creation Science Fellowship, Pittsburgh, Pennsylvania, pp. 63–76, 1994.
29. Austin, S.A., Baumgardner, J.R., Humphreys, D.R., Snelling, A.A., Vardiman, L. and Wise, K.P., Catastrophic plate tectonics: a global Flood model of Earth history; in: *Proceedings of the Third International Conference on Creationism,* Creation Science Fellowship, Pittsburgh, Pennsylvania, pp. 609–622, 1994.
30. Reed, J.K., Bennett, C.B., Froede, C.R., Oard, M.J. and Woodmorappe, J., An introduction to modern uniformitarian and catastrophic plate tectonic concepts, *Creation Res. Soc. Quart.* **33**(4):202–210, 1996.
31. Humphreys, D.R., Has the earth's magnetic field flipped? *Creation Res. Soc. Quart.* **25**(3):130–137, 1988.
32. Humphreys, D.R., Physical mechanisms for reversals of the earth's magnetic field during the Flood; in: *Proceedings of the Second International Conference on Creationism,* Creation Science Fellowship, Pittsburgh, Pennsylvania, pp. 129–142, 1990.
33. Brown, Ref. 18, pp. 82–92.
34. Berthault, G., Genesis and historical geology: a personal perspective, *CEN Tech. J.* **12**(2):213–217, 1998.

35. Julien, P.Y., Lan, Y. and Berthault, G., Experiments on stratification of heterogeneous sand mixtures, *Bulletin of the Society of Geology,* France, **164**(5):649–660, 1993.

36. Baumgardner, J.R. and Barnette, D.W., Patterns of ocean circulation over the continents during Noah's Flood; in: *Proceedings of the Third International Conference on Creationism,* Creation Science Fellowship, Pittsburgh, Pennsylvania, pp. 77–86, 1994.

37. Walker, T., A biblical geological model; in: *Proceedings of the Third International Conference on Creationism,* Creation Science Fellowship, Pittsburgh, Pennsylvania, pp. 581–592, 1994.

38. Garner, P., Continental flood basalts indicate a pre-Mesozoic Flood/post-Flood boundary, *CEN Tech. J.* **10**(1):114–127, 1996.

39. Hunter, M.J., Is the pre-Flood/Flood boundary in the earth's mantle? *CEN Tech. J.* **10**(3):344–357, 1996.

40. Garton, M., The real lifestyle of the dinosaurs, *Origins* **24**:14–22, 1998.

41. Robinson, S.J., Dinosaurs in the Oardic Flood, *CEN Tech. J.* **12**(1):55–86, 63, 1998.

42. Taylor, J., *Fossil Facts and Fantasies*, Mt Blanco Publishing Co., ch. 4, pp. 36–47, 1999.

43. Robinson, Ref. 41, p. 57.

44. Snelling, A.A., Catastrophic sedimentation: giant submarine landslides, *CEN Tech. J.* **12**(2):135–136, 1998.

45. Snelling, A.A., Waterborne gravity flows buried Mongolian dinosaurs, *CEN Tech. J.* **12**(2):133–134, 1998.

46. Garton, Ref. 7, p. 97–98.

47. Scheven, J., The Carboniferous floating forest — an extinct pre-Flood eco-system, *CEN Tech. J.* **10**(1):70–81, 1996.

48. It has been argued that Ps. 104:6–9 is referring to the third day of the Creation Week. However the context of Ps. 104:8–9 is of a perpetual decree that the waters 'may not pass over' (Hebrew *abhar*). The parallel passages Is. 54:9 and Jer. 5:22 use the same word (*abhar*) and refer to the Rainbow Covenant concerning the sea not being allowed to cross over the boundary of the shore. Thus there is a good case that although Psalm 104:1–5 is referring to Creation, Psalm 104:6–9 is speaking of the Flood. Whitcomb, Ref. 2, p. 40–41. See also Taylor, C.V., Did mountains really rise according to Psalm 104:8? *CEN Tech. J.* **12**(3):312–313, 1998, and discussion in *CEN Tech. J.* **13**(1):68–71,1999.

49. Berthault, Ref. 34, p. 216.

50. Rush, D.E. and Vardiman, L., Pre-Flood vapor canopy radiative temperature profiles; in: *Proceedings of the Second International Conference on Creationism,* Volume 2, Creation Science Fellowship, Pittsburgh, Pennsylvania, pp. 231–245, 1990.

51. Brown, W.T., The fountains of the great deep; in: *Proceedings of the First International Conference on Creationism,* Volume 1, Creation Science Fellowship, Pittsburgh, Pennsylvania, pp. 23–38, 1986.

52. Baumgardner, J.R., Runaway subduction as the driving mechanism for the Genesis Flood; in: *Proceedings of the Third International Conference on Creationism,* Creation Science Fellowship, Pittsburgh, Pennsylvania, pp. 63–75, 1994.

Andy McIntosh is Reader in Combustion Theory at the University of Leeds in the Department of Fuel and Energy, researching into fluids, explosions, ignition, and heat transfer. He read Applied Mathematics at Bangor University, North Wales, completed his Ph.D. in Combustion Aerodynamics in 1981, and obtained a D.Sc. in 1998. Author of many articles on combustion and fluids, Andy speaks widely on Creation, and authored the book 'Genesis for Today'.

Tom Edmondson holds degrees in music from Trinity College of Music (London University) and also a degree in history and philosophy from the Open University. Together with his wife he did linguistic and translation work among the Ejagham people of SE Nigeria and SW Cameroon with Wycliffe Bible Translators for a number of years. He is a founding member of the Bradford Creation Science Group.

Steven Taylor is a Reader in the Department of Electrical Engineering and Electronics at Liverpool University. His Ph.D. thesis was concerned with the inductively coupled plasma oxidation of silicon. He has published over 100 papers in refereed journals and conferences in the field of silicon microelectronics, plasma processing and ion physics. He is currently Chairman of the UK Dielectrics Club and formerly a member of the Program Committee of IEEE Semiconductor Interface Specialist Conference.