

during the Flood and subsequent erosion during this same period of time removed a significant volume of volcanoclastic material. Oard presents a most compelling case—one in which I am in full agreement.

During the review of my article on Goat Mountain, I was asked why the stratigraphy of the John Day Country with its significant volcanic deposits would be interpreted by young-Earth creationist Stuart Nevins¹⁰ as post-Flood when I was interpreting a similar stratigraphic setting as Flood deposited. In my investigations of volcanic deposits found across Big Bend National Park, I came to realize that much of the volume of the original deposits had been eroded and removed. It became apparent to me that the timing of the volcanism coincided with erosion and not deposition. The amount of geologic energy required to erupt and emplace thousands of feet of volcanic strata over tens to hundreds of square miles and then erode significant volumes of the same strata appears to require a time during the Flood, not after¹¹ (Figures 1 and 2). Obviously, Oard¹² reached the same conclusion for the Rattlesnake Tuff.

It was noted in my Goat Mountain¹³ article that recent work conducted by Dr Steve Austin at Mount St. Helens¹⁴ seems to me to run counter to what Nevins¹⁵ had proposed for the John Day Country. I envisioned most (if not all) of the John Day Country volcanics as having been erupted and eroded during the Flood, a proposal that runs counter to the position taken by Nevins.¹⁵ He interprets the Rattlesnake tuff as a post-Flood deposit,¹⁶ while Oard is more in line with my thinking that it formed and was eroded during the Flood.⁹

Volcanic terrain in a young-Earth creationist framework

Young-Earth creationists are able to think outside the limited boundaries of uniformitarian interpretation when dealing with volcanic settings. The tremendous volcanic events that occurred during and following the Flood would appear to have no modern ana-

logue. We cannot adopt the ‘standard’ uniformitarian assumptions and expect to derive a sound and competent Flood framework in which to define volcanic settings.¹⁷ We must postulate and explore other interpretations regarding volcanic settings so that the short time frames in which we define the Earth’s brief history can be addressed. Independent of my own work on subaqueous volcanism, Mike Oard has reached similar conclusions, and has taken an important and necessary step toward redefining creationists’ understanding of volcanic processes with regard to welded ash flow tuffs in the John Day Country.

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- In 1998, several friends and I proposed that the Precambrian Pikes Peak Iron Formation (actually a banded iron formation) found in central Arizona, USA, was created during the Flood due to subaqueous volcanism. The ‘standard’ prograding delta interpretation, postulated by uniformitarian thinking, was not acceptable within the young-Earth Flood framework. See Froede, C.R., Jr., Howe, G.F., Reed, J.K. and Meyer, J.R., A preliminary report on the Precambrian Pikes Peak Iron Formation, Yavapai County, Arizona, *Creation Research Society Quarterly* 35:15–22, 1998.
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Dinosaur footprints, fish traces and the Flood

In his Perspectives article, Woodmorappe¹ draws attention to recent work² reinterpreting certain alleged dinosaur tracks as impressions left by rays. However, he adds several comments of his own that appear to us to be unwarranted and open to challenge.

First, Woodmorappe jumps far too quickly from the specific reported cases to general statements.

‘This admits the possibility that many “vertebrate track” surfaces in the fossil record do not require any subaerial exposure of sedimentary surfaces during the Flood.’

‘Much more study is obviously warranted before we have solid criteria for distinguishing genuine dinosaur trackways from traces

formed by fish.’

‘As for the fossil record, all vertebrate tracks, which have up to now been accepted as such without question, should be re-examined for their actual origins ...’

The logic of these statements is essentially as follows:

1. The ‘dinosaur’ tracks at Isona may have been made by rays.
2. The geological record contains countless numbers of tracks attributed to dinosaurs.
3. Therefore all dinosaur tracks may have been made by rays.

This differs little from a form of reasoning recognised to be fallacious as long ago as Aristotle:

1. All men are animals
2. Horses are animals.
3. Therefore all men are horses.

In reality, no palaeontologist approaches vertebrate tracks ‘without question’. There is a continual questioning and re-evaluation of evidences, as the *Palaios* report itself attests. It is just not true that ‘ovate depressions found in bedding planes’ are ‘automatically ... assumed to be vertebrate tracks’. Paleontologists consider a wide range of morphological criteria, supplemented by broader sedimentological analysis. Field examples will always be found where there is some ambiguity, the Isona ‘tracks’ (Fig. 1) being a case in point: the prints interpreted by some as dinosaur footprints are subcircular depressions without the distinct foot morphology of a bipedal or quadrupedal animal. However, such cases should not be presented as typical of all, nor should they be used to suggest that every alleged trackway is suspect. Woodmorappe’s assertion to the contrary notwithstanding, solid criteria for distinguishing genuine dinosaur trackways from traces formed by rays already exist.

As it happens, two of us visited the Isona site two years before the *Palaios* article. Understandably, the Spanish tourist authorities were exploiting the idea that they had large numbers of dinosaur tracks, despite the lack of a proper description or scientific investigation of the surface.

Tourists were informed that a sauropod herd had been milling around. But we were puzzled: manus and pes combinations (made by the front and hind legs of a sauropod) could not be discerned. Neither were we able to make out a single specific trackway. The prints were described as undertracks, i.e. they underlay the sediment in immediate contact with the animal, and as such they were more difficult to interpret than the majority of dinosaur tracks, where the impressed surface is revealed.

Woodmorappe says: ‘the occurrence of footprints is, at times, needlessly supposed to be a hindrance to our understanding of the Flood origins of most Phanerozoic sedimentary strata’ (see diagram of geologic record). Mechanisms can be found, he says, that ‘would have easily allowed the temporarily surviving animals to make numerous footprints, and to do so repeatedly at successive horizons within sediment’.

Such alleged mechanisms have yet to be presented. The problems which they must address have been set out in this journal in previous papers of ours. Among them:

As Woodmorappe acknowledges, land-vertebrate footprints occur in the upper two thirds of the Phanerozoic geological record. In other words, the lowest part of the Phanerozoic is barren of traces of air-breathing animals, and the remainder has them. On the other hand, the Scriptural record indicates that, if footprint-makers survived the onslaught of the first day of the Flood at

Eon	Era	Period		
Phanerozoic	Cenozoic	Quaternary		
		Neogene		
		Paleogene		
	Mesozoic	Cretaceous		
		Jurassic		
		Triassic		
	Paleozoic	Carboniferous	Permian	
			Pennsylvanian	
			Mississippian	
		Devonian		
		Silurian		
		Ordovician		
Cambrian				
Pre-Cambrian	Proterozoic			
	Archean			

The geologic record as conventionally presented: Land vertebrate footprints occur in the upper two thirds of the Phanerozoic. Dinosaur tracks are associated with the Mesozoic.

all, ‘they were alive towards the earlier stages of the Flood, but not the latter’. Thus any Flood model allocating the bulk of the Phanerozoic to the Flood would predict no footprints within these two-thirds.

It is impossible to point to any high ground below the Phanerozoic, to which the vertebrates might have escaped for a while. The footprints invariably occur where the alleged pre-Flood land surface is already covered, and they invariably occur in lowland settings.

The sediment pile above which tracks occur is commonly many kilometres thick. We are unable to conceive of a Flood so catastrophic as to lay down kilometres of sediment while at the same time allowing terrestrial animals 'temporarily to survive' that catastrophe.

If one such track seems problematic enough within such a scenario, the worldwide occurrence of thousands of documented, unambiguously terrestrial tracks is still more problematic.

This difficulty is further compounded by the frequent occurrence of dinosaur tracks at successive horizons at the same locality. In Korea, there is one locality where as many as 300 successive horizons have been counted, through a vertical thickness exceeding 110 m.³ In the course of a few hours or, at most, days the deposition of 110 m would be catastrophic. Somehow we are to imagine the beasts surviving wave after wave of deluge and returning to the same spot, notwithstanding that it was under shallow water and thus not even visible to them. It also needs to be pointed out that sediment is deposited in topographic lows, not highs, i.e. we are not to imagine a repeatedly emerging and submerging island, repeatedly covered with trackways, but precisely the reverse. In such situations the origin of the track-makers is invariably a topographic high, i.e. surrounding land, not water, and the tracks are made in a topographic low, e.g. a lake or shore.

The majority of dinosaur tracks are associated with rippled surfaces indicative of quieter, low-energy movement of water. The sheer number of such tracks known from Mesozoic rocks on all continents must place some constraint on the sedimentary processes operating.

After the first third of the Phanero-

zoic vertebrate tracks form a continuous record. Any Flood model which attempted to interpret the bulk of the Phanerozoic as Flood deposits would need to be able to point to a substantial period where the continents supported absolutely no animal life other than in the vicinity of the Ark. As indicated above, that hiatus ought to be immediately after wherever the beginning of the Flood is placed. Thus the fact that the vertebrate track record is essentially unbroken from the Devonian (one third up the Phanerozoic) right up to the present day is surely clear evidence that the latter two thirds of the Phanerozoic (at least) is post-Flood. Throughout that time we cannot point to any period when the land was cleared of walking, breeding and feeding animals.

Animal tracks are not an isolated phenomenon. The tracks left by living animals are often complemented by other signs of normal life such as burrows, nests, eggs, feces. Whilst local catastrophes may readily account for their preservation, their existence points to animals feeding and breeding and generally not operating under stress.

We do not feel that the extent to which the above points are problematic for current Flood models has been appreciated. Woodmorappe's reference to 'small changes in floodwater levels', indistinguishable in isolation from orthodox explanations referring to small changes in lake or sea level, does not amount to the required mechanism. It is merely an *ad hoc* postulation of possible circumstances at one particular moment, not an explanation of phenomena in both their local and global context, taking into account the vast thicknesses of sediment beneath them. Woodmorappe also refers to Oard's attempt to show how trackways might have been laid down during the early Flood.⁴ Again, this article did not seem to us at all convincing, and we responded in a letter⁵ to that journal. In other articles Garner,⁶ Garton⁷ and Robinson⁸ explored the issues in more detail. Nonetheless, Woodmorappe still repeats Oard's elementary

fallacy that the sediments in which tracks are found can be construed as topographic highs ('significant strips of land') surrounded by topographic lows ('water'); as explained above, the situation is the reverse. As subsequent exchanges have only served to confirm, Oard's approach is a lost cause.

Some readers may be interested in our excursion to the Rioja region of Spain to examine some of Europe's best dinosaur trackways. There are well-preserved tracks of many different dinosaurs (Fig. 2) and the sedimentary horizons bear the marks of desiccation events. In his article⁹ Garton illustrates and discusses the field evidences and points out the implications for diluvialist thinking. In our view, the framework developed therein provides a far more reasonable understanding of the data than that underlying Woodmorappe's Forum article.

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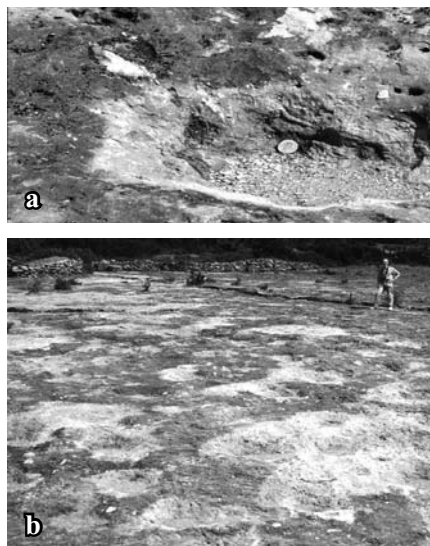


Figure 1. (b) These randomly distributed impressions were attributed to dinosaurs. Closeup (a) shows that they are shallow pits, often elongate and lacking any distinct impressions of toes etc. Isona, Southern Pyrénées.

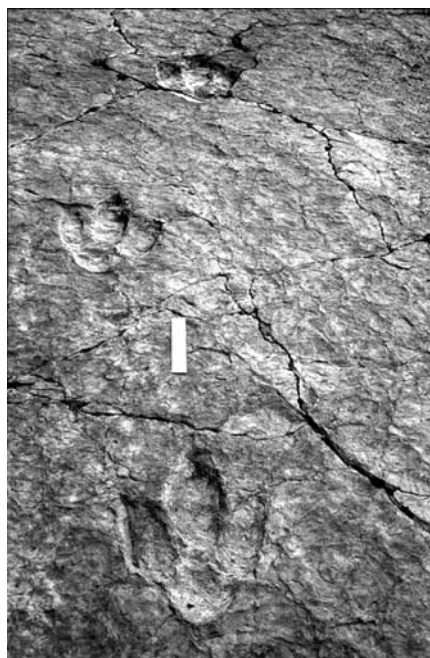


Figure 2. In total contrast to the shallow pits at Isona, real dinosaur tracks almost always preserve sufficient detail such that there is no doubt they are animal tracks. Munilla, Rioja, Spain.

John Woodmorappe and Michael Oard reply:

Since Mr Oard's article has come up in this discussion, his input is included in this response. To begin with, it does not look as if Garton *et al.* have read Woodmorappe's paper too carefully. We are amazed at their misuse of formal logic, and overall misrepresentation of Woodmorappe's paper. It is obvious from Woodmorappe's article that he is in no way saying that all dinosaur tracks were actually caused by ray traces. As to his statement about checking all dinosaur traces, this refers to *establishing the boundary* between clearly dinosaur tracks, clearly ray traces, and markings of ambiguous origin—certainly not implying that all dinosaur tracks may actually be ray traces.

Garton *et al.* call attention to such features as the pes and manus in dinosaur footprints, as if Woodmorappe was unaware of them. He most certainly does discuss these (and other) anatomical features, albeit with the qualification that such otherwise-certain identifiers of dinosaur footprints are often eroded away (actually or supposedly), complicating the identification of ovate depressions. And, even when the dinosaur-footprint identification seems clear-cut, Woodmorappe is emphasizing the fact that we need to be certain that these criteria cannot be explained by alternative causes. In view of the fact that non-traditional explanations for vertebrate footprints have only been sparsely investigated, further research is clearly warranted. That was, and is, Woodmorappe's point.

We have divergent opinions about the paleontological literature. While indeed there are instances where dinosaur tracks are questioned, this is usually not the case, in our experience. Relatively few papers on vertebrate tracks ever suggest alternative origins. If nothing else, the fact that the fish-ray explanation has appeared only in the last few years alone attests to the overall rarity of 'out of the box' thinking about vertebrate tracks. We are surprised to hear that there had been no proper prior sci-

entific description of the Isona 'tracks'. Proper according to whose opinion? Martinell *et al.* cite some studies that had suggested dinosaurian origins for the Isona markings.

We remain totally unconvinced that the challenges to Flood geology, as presented by Garton *et al.*, either in the present critique or in their earlier papers, add up to insurmountable problems for Flood geology. They try to squeeze the Flood into a smaller and smaller part of the geologic record just as Baron Cuvier did two centuries ago, albeit in different ways. We refer to this as the neo-Cuvierist position, which, taken to its logical conclusion does away with the evidence for the Biblical Flood completely.

They labour under the illusion that the textbook geologic column is a reality, notably when they say we would predict no tracks in the top 2/3 of the Phanerozoic, where the tracks are found. When they say this they are assuming the geological column is an absolute time sequence for the Flood and that it is LINEAR. We have addressed the geological column a number of times; but the neo-Cuvierists simply buy into speeded-up uniformitarian thinking. A case can be made for the 'Cenozoic' being deposited: a) before the first 150 days, b) from Day 150 to Day 371, and c) post-Flood.¹ With the tremendous onslaught of the Flood, it is obvious sedimentation would NOT be linear, but most of it would occur during the first 150 days, including the continental 'Cenozoic' deposits. The Recessive Stage of the Flood is mainly an erosional event of what has already been deposited on the continents. Of course there is new sedimentation along the continental shelves and a few other places. Oard has presented a perfectly viable hypothesis for forming dinosaur tracks on freshly laid Flood sediments.

Second, neo-Cuvierists fail to appreciate the complexity of the Flood. They seem to think the Flood catastrophe struck every square inch of the Earth at the same time and at the same intensity, in which case there would not be anything alive after Day 1. Worse yet, neo-Cuvierists freely make totally unsubstantiated claims about the 'im-

possibly catastrophic' deposition of the sediment that underlies dinosaur footprints. Note that an 'inability to conceive' of something (by them) does not constitute evidence against its occurrence. The repeated emergence and submergence of vast land areas is not at all *ad hoc*. It is common sense. When repeated many times in the same area, and throughout the flooded world, it became a common, global process. Note that ripple marks can occur in various environments.

We reject the recurrent neo-Cuvierist notion that sediments cannot be deposited on topographic highs. In fact, we would of course expect much more sedimentation in lows, but with very muddy water, sedimentation can also occur on highs, especially broad highs. There would also be slow water areas around shoals during the Flood, so that a sea level rise would not erode the tracks, but simply cover them up. Furthermore, owing to tectonic upheavals, 'highs' and 'lows' would no doubt change places repeatedly in relatively short periods of time. None of these events are difficult to envision during a complex Flood.

The neo-Cuvierists continue to insist that tracks indicate animals breeding and feeding. Oard has repeatedly pointed out that this is not the case, as we would expect, and hence is indirect evidence for catastrophic conditions all over the world. The particular data on the tracks indicates predominantly straight trackways. There are a number of parallel trackways, which the evolutionists take as 'gregarious' behavior. It would be hard to make a case for breeding and feeding in such parallel trackways. As for 'nonstressful' activities, who says that dinosaurs were under *continual* stress during the Flood, and who knows under what conditions dinosaurs could occasionally build nests or perform other 'normal' activities in the first place?

As for the alleged 300 dinosaur footprint horizons in South Korea, we are hampered both by space limitations as well as the fact that there are only two substantive English-language publications on this subject,² which

makes a detailed examination of these claims difficult. However, it is easy to see, from the stratigraphic sections presented, that lithological character, lithological thicknesses, and stratigraphic intervals between dinosaur footprint horizons vary greatly over relatively short distances (few kilometers). This makes it difficult for us to evaluate how these horizons can supposedly be unambiguously correlated and, from this, how the 300-footprint-horizon figure originated. In particular, does the field evidence *actually* require 300 successive events, or is it a composite of much fewer events occurring laterally in area and simultaneously in time?

The fact that there are relatively few footprints in total suggests a small amount of time for each set of footprints. Moreover, the fact that there are usually only a few to few tens of centimeters of sediment between empirically-determined footprint horizons means that only small ebbings of Floodwaters would have been sufficient to bring in the sediment. The latter's thinness would have enabled the dinosaurs to simply keep stepping upward as the water kept flowing while progressively more sediment accumulated around their toes (visualize, by analogy, a large snowstorm where people don't move great lateral distances but keep stepping upon successively thicker snow, eventually leaving many 'footprint horizons' within the overall thick layer of snow).

As it turns out, there are a number of observations relative to the Korean site which is inconsistent with the standard interpretation but consonant with a Flood one. The sauropod tracks are all of similar size, and from a young juvenile, which is certainly strange for the supposed extended period of time during which allegedly pedogenic calcareous nodules, lenses, etc. formed. (Recall also that claims of paleosols are based on subjective criteria.) Second, there is a preferred orientation of the dinosaur tracks, with some variability, that is perpendicular to the strongly preferred orientation of wave ripples. We should find lots of tracks parallel to the supposed lake if it were a natural

setting for dinosaurs along a lake. We are also asked to believe that, over so much supposed time, the subsidence of 110 m was taking place in exact balance to deposition. Somehow, the postulated repeated flash floods, occurring over long periods of time, did not cut gullies. The evidence better supports a sheet deposit laid down quickly by pulses of rising Floodwater with no time for extensive channelization. More information is needed to evaluate the '300 footprint horizon' claim than is readily available.

Conclusions

Pointedly, the neo-Cuvierist position being defended by Garton *et al.* encounters far more problems than any attributable to standard Flood geology. For instance, all forms of neo-Cuvierism, regardless of whether they place much of the fossiliferous sedimentary record before *or* after the Flood, suffer from the fatal defect of attributing impossibly large volumes of sediment to quasi-normal sedimentary processes.³ Second, the biostratigraphic differentiation of fossils is left without plausible explanation. If, as they insist, the upper 2/3 of the textbook geological column was deposited after the Flood, the dinosaurs would have had to be very clever not to be fossilized with the mammals after the Flood.

Anti-creationists have exploited neo-Cuvierist thinking. Most definitely they are not concerned about the pre-Flood/Flood/post-Flood boundaries! They correctly see neo-Cuvierism for what it is: a concession to uniformitarianism which, when taken to its logical conclusion, does away with the Flood altogether. To suddenly throw out the main Flood model when putative challenges are encountered (dinosaur tracks and eggs) is a very unstable position, since there are literally hundreds of 'problems'. This is partly caused by our limited understanding of the Flood. Moreover, one can find real or imagined problems *wherever* in the sedimentary record that one would try to pigeonhole even a geologically scaled-down Flood. No wonder that ex-creationists com-

monly used neo-Cuvierism as a way station between Flood geology and total abandonment of the Flood. We contend that neo-Cuvierist thinking is seriously wrongheaded, and recommend that it be considered dead and buried once and for all.

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Filling the details in Humphreys' cosmology

Regarding Humphreys' reply to my letter in which I raised some concerns about his cosmology, I would like to thank Humphreys for the clarifications he offered in response to my point 3, and the calculations he presented in response to point 4. However, there were some other issues which I raised that Humphreys has not addressed.

1. *Expansion of the universe.* The Hebrew of Genesis 1 suggests 'and it was so' relates to both the creation of the expanse *and* the separation since the latter is a direct result of the former. This is evident when we look at the use of this same clause in

the descriptions of the other days. On day three, this phrase refers to *both* the gathering together of the waters *and* the appearance of dry land, not just the appearance of dry land. Again, on day four, the 'And it was so' does not refer just to their illumination of the Earth, but also to their functioning as markers for seasons, days and years. Therefore, it seems to me that the interpretation Humphreys suggests is a case of 'special pleading' in the light of what Scripture explicitly states.

Furthermore, all the 'other possibilities' Humphreys provides for the way the stretching occurs deny that the creation of the expanse was a completed event as indicated by 'And it was so' (Heb. *Wayyehi-kēn*).¹

2. *Euclidean Zone.* In the light of point 1 above, Humphreys' favoured option of a Euclidean zone appearing and disappearing on Day 4 is a non-starter. A Euclidean zone appears when matter and space contract causing a black-hole to white-hole bounce. However, the language of Scripture indicates that the universe had already stopped stretching/expanding during Day 2, so this model is not a valid option because it does not square with what Scripture states.

5. *Friedmann-Lemaître space-time expansion.* I particularly feel that Humphreys' has not addressed my concerns over the employment of Friedmann-Lemaître (F-L) space-time expansion. Humphreys writes:

'The concept of spacetime expansion goes deeper than work by Friedmann and Lemaître. It is enmeshed in general relativity theory itself, which pictures space-time as a material that can be bent and stretched.' Humphreys seems to have missed the point I was making.

Although general relativity theory pictures space-time as a material that can be bent and stretched, and although F-L space-time expansion is a perfectly valid solution to the field equations, this does not mean that space-time expansion is an actual, physical reality. Mathematical models are just that—models. Furthermore,

there are other solutions such as Einstein's static space-time, which do not involve space-time expansion.

Humphreys may be correct in saying that the claims of falsification of F-L space-time expansion by the operation of the Global Positioning System (GPS) did not originate with Gentry, but he does not address the claims, dismissing them as simply 'non-peer-reviewed allegations on the Internet'. Gentry has written a technical paper which Humphreys is aware of and which discusses this issue in great detail.² In it, he cites C. Møller's theoretical analysis which contradicts the F-L prediction of in-flight wavelength lengthening,³ and the principal GPS investigator, C.O. Alley's actual experience in setting up the GPS.⁴ Humphreys says he 'tried to chase them down to their roots' but found that 'they seem to be without documentation'. However, all the documentation needed is in Gentry's paper.

I also note that Humphreys did not address the fact that F-L space-time expansion involves massive energy losses and therefore violates the law of conservation of energy.

The strangest thing of all about Humphreys' response is that, regarding my requests for clarification and more details, he feels 'no particular obligation to produce them', because (a) he has staked no claim on creationist cosmology as his exclusive domain, and (b) he has many other research areas to explore besides cosmology. He adds:

'So I encourage Kulikovsky and others to fill in the details for themselves, or to depart from my sketchy map entirely and discover for themselves new hills and valleys in spacetime.'

This is a particularly odd thing to say given that on numerous occasions in the past Humphreys has promised to respond to any published criticisms of his model. If Humphreys wishes his cosmological model to be taken seriously then the responsibility to defend it lies with him alone.

Humphreys encourages myself and any others to fill in the missing details