



Problems with a Global Flood

Second Edition

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This essay covers some logistical problems with the Genesis Ark story, including space on the Ark, collection of the animals, food for the animals, and animal migration after the flood.

[The Miracle of Noah's Ark](#)

"Arkeologist" Ron Wyatt claims to have discovered the remains of Noah's Ark on Mt. Ararat. This web site contains photographs of what is purported to be the Ark.

Creationist models are often criticized for being too vague to have any predictive value. A literal interpretation of the Flood story in Genesis, however, does imply certain physical consequences which can be tested against what we actually observe, and the implications of such an interpretation are investigated below. Some creationists provided even more detailed models, and these are also addressed (see especially sections 5 and 7).

References are listed at the end of each section.

Two kinds of flood model are **not** addressed here. First is the local flood. Genesis 6-8 can be interpreted as a homiletic story such that the "world" that was flooded was just the area that Noah knew. Creationists argue against the local flood model because it doesn't fit their own literalist preconceptions, but I know of no physical evidence contrary to such a model.

Second, the whole story can be dismissed as a series of supernatural miracles. There is no way to contradict such an argument. However, one must wonder about a God who reportedly does one thing and then arranges every bit of evidence to make it look like something else happened. It's entirely possible that a global flood occurred 4000 years ago or even last Thursday, and that God subsequently erased all the evidence, including our memories of it. But even if such stories are true, what's the point?

1. Building the Ark

Wood is not the best material for shipbuilding. It is not enough that a ship be built to hold together; it must also be sturdy enough that the changing stresses don't open gaps in its hull. Wood is simply not strong enough to prevent separation between the joints, especially in the heavy seas that the Ark would have encountered. The longest wooden ships in modern seas are about 300 feet, and these require reinforcing with iron straps and leak so badly they must be constantly pumped. The ark was 450 feet long [Gen. 6:15]. Could an ark that size be made seaworthy?

2. Gathering the Animals

Bringing all kinds of animals together in the vicinity of the ark presents significant problems.

Could animals have traveled from elsewhere? If the animals traveled from other parts of the world, many of them would have faced extreme difficulties.

- Some, like sloths and penguins, can't travel overland very well at all.
- Some, like koalas and many insects, require a special diet. How did they bring it along?
- Some cave-dwelling arthropods can't survive in less than 100% relative humidity.
- Some, like dodos, must have lived on islands. If they didn't, they would have been easy prey for other animals. When mainland species like rats or pigs are introduced to islands, they drive many indigenous species to extinction. Those species would not have been able to survive such competition if they lived where mainland species could get at them before the Flood.

Could animals have all lived near Noah? Some creationists suggest that the animals need not have traveled far to reach the Ark; a moderate climate could have made it possible for all of them to live nearby all along. However, this proposal makes matters even worse. The last point above would have applied not only to island species, but to almost all species. Competition between species would have driven most of them to extinction.

There is a reason why Gila monsters, yaks, and quetzals don't all live together in a temperate climate. They can't survive there, at least not for long without special care. Organisms have preferred environments outside of which they are at a deadly disadvantage. Most extinctions are caused by destroying the organisms' preferred environments. The creationists who propose all the species living together in a uniform climate are effectively proposing the destruction of all environments but one. Not many species could have survived that.

How was the Ark loaded? Getting all the animals aboard the Ark presents logistical problems which, while not impossible, are highly impractical. Noah had only seven days to load the Ark (Gen. 7:4-10). If only 15764 animals were aboard the Ark (see section 3), one animal must have been loaded every 38 seconds, without letup. Since there were likely more animals to load, the time pressures would have been even worse.

3. Fitting the Animals Aboard

To determine how much space is required for animals, we must first determine what is a kind, how many kinds were aboard the ark, and how big they were.

What is a kind? Creationists themselves can't decide on an answer to this question; they propose criteria ranging from species to order, and I have even seen an entire kingdom (bacteria) suggested as a single kind. Woodmorappe (p. 5-7) compromises by using genus as a kind. However, on the ark "kind" must have meant something closer to species for three reasons:

- For purposes of naming animals, the people who live among them distinguish between them (that is, give them different names) at roughly the species level. [Gould, 1980]
- The Biblical "kind," according to most interpretations, implies reproductive separateness. On the ark, the purpose of gathering different kinds was to preserve them by later reproduction. Species, by definition, is the level at which animals are reproductively distinct.
- The Flood, according to models, was fairly recent. There simply wouldn't have been time enough to accumulate the number of mutations necessary for the diversity of species we see within many genera today.

What kinds were aboard the ark? Woodmorappe and Whitcomb & Morris arbitrarily exclude all animals except mammals, birds, and reptiles. However, many other animals, particularly land arthropods, must also have been on the ark for two reasons:

- The Bible says so. Gen. 7:8 puts on the ark all creatures that move along the ground, with no further qualifications. Lev. 11:42 includes arthropods (creatures that "walk on many feet") in such a category.
- They couldn't survive outside. Gen. 7:21-23 says every land creature not aboard the ark perished. And indeed, not one insect species in a thousand could survive for half a year on the vegetation mats proposed by some creationists. Most other land arthropods, snails, slugs, earthworms, etc. would also have to be on the ark to survive.

Were dinosaurs and other extinct animals on the ark? According to the Bible, Noah took samples of all animals alive at the time of the Flood. If, as creationists claim, all fossil-bearing strata were deposited by the Flood, then all the animals which became fossils were alive then. Therefore all extinct land animals had representatives aboard the

ark.

It is also worth pointing out that the number of extinct species is undoubtedly greater than the number of known extinct species. New genera of dinosaurs have been discovered at a nearly constant rate for more than a century, and there's no indication that the rate of discovery will fall off in the near future.

Were the animals aboard the ark mature? Woodmorappe gets his animals to fit only by taking juvenile pairs of everything weighing more than 22 lbs. as an adult. However, it is more likely that Noah would have brought adults aboard:

- The Bible (Gen. 7:2) speaks of "the male and his mate," indicating that the animals were at sexual maturity.
- Many animals require the care of adults to teach them behaviors they need for survival. If brought aboard as juveniles, these animals wouldn't have survived.

The last point does not apply to all animals. However, the animals don't need parental care tend to be animals that mature quickly, and thus would be close to adult size after a year of growth anyway.

How many clean animals were on the ark? The Bible says either seven or fourteen (it's ambiguous) of each kind of clean animal was aboard. It defines clean animals essentially as ruminants, a suborder which includes about 69 recent genera, 192 recent species [Wilson & Reeder, 1993], and probably a comparable number of extinct genera and species. That is a small percentage of the total number of species, but ruminants are among the largest mammals, so their bulk is significant.

Woodmorappe (p. 8-9) gets around the problem by citing Jewish tradition which gives only 13 domestic genera as clean. He then calculates that this would increase the total animal mass by 2-3% and decides that this amount is small enough that he can ignore it completely. However, even Jewish sources admit that this contradicts the unambiguous word of the Bible. [Steinsaltz, 1976, p. 187]

The number and size of clean birds is small enough to disregard entirely, but the Bible at one point (Gen. 7:3) says seven of *all kinds* of birds were aboard.

So, could they all fit? It is important to take the size of animals into account when considering how much space they would occupy because the greatest number of species occurs in the smallest animals. Woodmorappe performed such an analysis and came to the conclusion that the animals would take up 47% of the ark. In addition, he determines that about 10% of the ark was needed for food (compacted to take as little space as possible) and 9.4% for water (assuming no evaporation or wastage). At least 25% of the space would have been needed for corridors and bracing. Thus, increasing the quantity of animals by more than about 5% would overload the ark.

However, Woodmorappe makes several questionable and invalid assumptions. Here's how the points discussed above affect his analysis. Table 1 shows Woodmorappe's analysis and some additional calculations.

Table 1: Size analysis of animals aboard the Ark. Page numbers refer to Woodmorappe, 1996, from which the figures in the row are taken. (Minor arithmetic errors in totals are corrected.) Woodmorappe treats many animals as juveniles; "yearling" masses are masses of those animals after one year of growth. "Total mass after one year" is the maximum load which Woodmorappe allows for. Additional clean animal figures assume they are taken aboard by sevens, not seven pairs, and also assume juvenile animals.

Log mass range (g)	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	
Ave. mass (kg) (p. 13)	.005	.05	.5	5	50	316	3160	31600	
# of mammals (p. 10)	466	1570	1378	1410	1462	892	246		7424
# of birds (p. 10)	630	2272	1172	450	70	4			4598
# of reptiles (p. 10)	642	844	688	492	396	286	270	106	3724
total # of animals	1738	4686	3238	2352	1928	1182	516	106	15746

Ave. yearling mass (kg) (p. 66)	.005	.05	.5	5	10	100	300	1000	
Total mass after one year	8.7	234.3	1619	11760	19280	118200	154800	106000	411902
Total mass assuming adults	8.7	234.3	1619	11760	96400	373512	1630560	3349600	5463694
Additional clean birds	1575	5680	2930	1125	175	10			11495
Additional ruminants (138 genera)					260	420	10		690
Additional clean animal mass (yearling weight, kg)	8	284	1465	5625	4350	43000	3000		47600

- Collecting each species instead of each genus would increase the number of individuals three- to fourfold. The most speciose groups tend to be the smaller animals, though, so the total mass would be approximately doubled or tripled.
- Collecting all land animals instead of just mammals, birds, and reptiles would have insignificant impact on the space required, since those animals, though plentiful, are so small. (The problems come when you try to care for them all.)
- Leaving off the long-extinct animals would free considerable space. Woodmorappe doesn't say how many of the animals in his calculations are known only from fossils, but it is apparently 50-70% of them, including most of the large ones. However, since he took only juveniles of the large animals, leaving off all the dinosaurs etc. would probably not free more than 80% of the space. On the other hand, collecting all extinct animals in addition to just the known ones would increase the load by an unknown but probably substantial amount.
- Loading adults instead of juveniles as small as Woodmorappe uses would increase the load 13- to 50-fold.
- Including extra clean animals would increase the load by 1.5-3% if only the 13 traditional domestic ruminants are considered, but by 14-28% if all ruminants are considered clean.

In conclusion, an ark of the size specified in the Bible would not be large enough to carry a cargo of animals and food sufficient to repopulate the earth, especially if animals that are now extinct were required to be aboard.

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4. Caring for the Animals

Special diets. Many animals, especially insects, require special diets. Koalas, for example, require eucalyptus leaves, and silkworms eat nothing but mulberry leaves. For thousands of plant species (perhaps even most plants), there is at least one animal that eats only that one kind of plant. How did Noah gather all those plants aboard, and where did he put them?

Other animals are strict carnivores, and some of those specialize on certain kinds of foods, such as small mammals, insects, fish, or aquatic invertebrates. How did Noah determine and provide for all those special diets?

Fresh foods. Many animals require their food to be fresh. Many snakes, for example, will eat only live foods (or at least warm and moving). Parasitoid wasps only attack living prey. Most spiders locate their prey by the vibrations it produces. [Foelix, 1996] Most herbivorous insects require fresh food. Aphids, in fact, are physically incapable of sucking from wilted leaves. How did Noah keep all these food supplies fresh?

Food preservation/Pest control. Food spoilage is a major concern on long voyages; it was especially thus before the inventions of canning and refrigeration. The large quantities of food aboard would have invited infestations of any of hundreds of stored product pests (especially since all of those pests would have been aboard), and the humidity one would expect aboard the Ark would have provided an ideal environment for molds. How did Noah keep pests from consuming most of the food?

Ventilation. The ark would need to be well ventilated to disperse the heat, humidity, and waste products (including methane, carbon dioxide, and ammonia) from the many thousands of animals which were crowded aboard. Woodmorappe (pp. 37-42) interprets Genesis 6:16 to mean there was an 18-inch opening all around the top, and says that this, with slight breezes, would have been enough to provide adequate ventilation. However, the ark was divided into separate rooms and decks (Gen. 6:14,16). How was fresh air circulated throughout the structure?

Sanitation. The ungulates alone would have produced tons of manure a day. The waste on the lowest deck at least (and possibly the middle deck) could not simply be pushed overboard, since the deck was below the water line; the waste would have to be carried up a deck or two. Vermicomposting could reduce the rate of waste accumulation, but it requires maintenance of its own. How did such a small crew dispose of so much waste?

Exercise/Animal handling. The animals aboard the ark would have been in very poor shape unless they got regular exercise. (Imagine if you had to stay in an area the size of a closet for a year.) How were several thousand diverse kinds of animals exercised regularly?

Manpower for feeding, watering, etc. How did a crew of eight manage a menagerie larger and more diverse than that found in zoos requiring many times that many employees? Woodmorappe claims that eight people could care for 16000 animals, but he makes many unrealistic and invalid assumptions. Here are a few things he didn't take into account:

- Feeding the animals would take much longer if the food was in containers to protect it from pests.
- Many animals would have to be hand-fed.
- Watering several animals at once via troughs would not work aboard a ship. The water would be sloshed out by the ship's roll.
- Many animals, in such an artificial environment, would have required additional special care. For example, all of the hooved animals would need to have their hooves trimmed several times during the year. [Batten, 1976, pp. 39-42]
- Not all manure could be simply pushed overboard; a third of it at least would have to be carried up at least one deck.
- Corpses of the dead animals would have to be removed regularly.
- Animals can't be expected to run laps and return to their cages without a lot of human supervision.

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5. The Flood Itself

Where did the Flood water come from, and where did it go? Several people have proposed answers to these questions, but none which consider all the implications of their models. A few of the commonly cited models are addressed below.

Vapor canopy. This model, proposed by Whitcomb & Morris and others, proposes that much of the Flood water was suspended overhead until the 40 days of rain which caused the Flood. The following objections are covered in more detail by Brown.

- How was the water suspended, and what caused it to fall all at once when it did?
- If a canopy holding the equivalent to more than 40 feet of water were part of the atmosphere, it would raise the atmospheric pressure accordingly, raising oxygen and nitrogen levels to toxic levels.
- If the canopy began as vapor, any water from it would be superheated. This scenario essentially starts with most of the Flood waters boiled off. Noah and company would be poached. If the water began as ice in orbit, the gravitational potential energy would likewise raise the temperature past boiling.
- A canopy of any significant thickness would have blocked a great deal of light, lowering the temperature of the earth greatly before the Flood.
- Any water above the ozone layer would not be shielded from ultraviolet light, and the light would break apart the water molecules.

Hydroplate. Walt Brown's model proposes that the Flood waters came from a layer of water about ten miles underground, which was released by a catastrophic rupture of the earth's crust, shot above the atmosphere, and fell as rain.

- How was the water contained? Rock, at least the rock which makes up the earth's crust, doesn't float. The water would have been forced to the surface long before Noah's time, or Adam's time for that matter.
- Even a mile deep, the earth is boiling hot, and thus the reservoir of water would be superheated. Further heat would be added by the energy of the water falling from above the atmosphere. As with the vapor canopy model, Noah would have been poached.
- Where is the evidence? The escaping waters would have eroded the sides of the fissures, producing poorly sorted basaltic erosional deposits. These would be concentrated mainly near the fissures, but some would be shot thousands of miles along with the water. (Noah would have had to worry about falling rocks along with the rain.) Such deposits would be quite noticeable but have never been seen.

Comet. Kent Hovind proposed that the Flood water came from a comet which broke up and fell on the earth. Again, this has the problem of the heat from the gravitational potential energy. The water would be steam by the time it reached the surface of the earth.

Runaway subduction. John Baumgardner created the runaway subduction model, which proposes that the pre-Flood lithosphere (ocean floor), being denser than the underlying mantle, began sinking. The heat released in the process decreased the viscosity of the mantle, so the process accelerated catastrophically. All the original lithosphere became subducted; the rising magma which replaced it raised the ocean floor, causing sea levels to rise and boiling off enough of the ocean to cause 150 days of rain. When it cooled, the ocean floor lowered again, and the Flood waters receded. Sedimentary mountains such as the Sierras and Andes rose after the Flood by isostatic rebound. [Baumgardner, 1990a; Austin et al., 1994]

- The main difficulty of this theory is that it admittedly doesn't work without miracles. [Baumgardner, 1990a, 1990b] The thermal diffusivity of the earth, for example, would have to increase 10,000 fold to get the subduction rates proposed [Matsumura, 1997], and miracles are also necessary to cool the new ocean floor and to raise sedimentary mountains in months rather than in the millions of years it would ordinarily take.
- Baumgardner estimates a release of 10^{28} joules from the subduction process. This is more than enough to boil off all the oceans. In addition, Baumgardner postulates that the mantle was much hotter before the Flood (giving it greater viscosity); that heat would have to go somewhere, too.
- Cenozoic sediments are post-Flood according to this model. Yet fossils from Cenozoic sediments alone show a 65-million-year record of evolution, including a great deal of the diversification of mammals and angiosperms. [Carroll, 1997, chpts. 5, 6, & 13]
- Subduction on the scale Baumgardner proposes would have produced very much more vulcanism around plate boundaries than we see. [Matsumura, 1997]

New ocean basins. Most flood models (including those above, possibly excepting Hovind's) deal with the water after the flood by proposing that it became our present oceans. The earth's terrain, according to this model, was

much, much flatter during the Flood, and through cataclysms, the mountains were pushed up and the ocean basins lowered. (Brown proposes that the cataclysms were caused by the crust sliding around on a cushion of water; Whitcomb & Morris don't give a cause.)

- How could such a change be effected? To change the density and/or temperature of at least a quarter of the earth's crust fast enough to raise and lower the ocean floor in a matter of months would require mechanisms beyond any proposed in any of the flood models.
- Why are most sediments on high ground? Most sediments are carried until the water slows down or stops. If the water stopped in the oceans, we should expect more sediments there. Baumgardner's own modeling shows that, during the Flood, currents would be faster over continents than over ocean basins [Baumgardner, 1994], so sediments should, on the whole, be removed from continents and deposited in ocean basins. Yet sediments on the ocean basin average 0.6 km thick, while on continents (including continental shelves), they average 2.6 km thick. [Poldervaart, 1955]
- Where's the evidence? The water draining from the continents would have produced tremendous torrents. There is evidence of similar flooding in the Scablands of Washington state (from the draining of a lake after the breaking of an ice dam) and on the far western floor of the Mediterranean Sea (from the ocean breaking through the Straits of Gibraltar). Why is such evidence not found worldwide?
- How did the ark survive the process? Such a wholesale restructuring of the earth's topography, compressed into just a few months, would have produced tsunamis large enough to circle the earth. The aftershocks alone would have been devastating for years afterwards.

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6. Implications of a Flood

A global flood would have produce evidence contrary to the evidence we see.

How do you explain the relative ages of mountains? For example, why weren't the Sierra Nevadas eroded as much as the Appalachians during the Flood?

Why is there no evidence of a flood in ice core series? Ice cores from Greenland have been dated back more than 40,000 years by counting annual layers. [Johnsen et al, 1992; Alley et al, 1993] A worldwide flood would be expected to leave a layer of sediments, noticeable changes in salinity and oxygen isotope ratios, fractures from buoyancy and thermal stresses, a hiatus in trapped air bubbles, and probably other evidence. Why doesn't such evidence show up?

How are the polar ice caps even possible? Such a mass of water as the Flood would have provided sufficient buoyancy to float the polar caps off their beds and break them up. They wouldn't regrow quickly. In fact, the Greenland ice cap would *not* regrow under modern (last 10 ky) climatic conditions.

Why did the Flood not leave traces on the sea floors? A year long flood should be recognizable in sea bottom

cores by (1) an uncharacteristic amount of terrestrial detritus, (2) different grain size distributions in the sediment, (3) a shift in oxygen isotope ratios (rain has a different isotopic composition from seawater), (4) a massive extinction, and (n) other characters. Why do none of these show up?

Why is there no evidence of a flood in tree ring dating? Tree ring records go back more than 10,000 years, with no evidence of a catastrophe during that time. [Becker & Kromer, 1993; Becker et al, 1991; Stuvier et al, 1986]

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7. Producing the Geological Record

Most people who believe in a global flood also believe that the flood was responsible for creating all fossil-bearing strata. (The alternative, that the strata were laid down slowly and thus represent a time sequence of several generations at least, would prove that some kind of evolutionary process occurred.) However, there is a great deal of contrary evidence.

Before you argue that fossil evidence was dated and interpreted to meet evolutionary assumptions, remember that the geological column and the relative dates therein were laid out by people who believed divine creation, before Darwin even formulated his theory. (See, for example, Moore [1973], or the closing pages of Dawson [1868].)

Why are geological eras consistent worldwide? How do you explain worldwide agreement between "apparent" geological eras and several different (independent) radiometric and nonradiometric dating methods? [e.g., Short et al, 1991]

How was the fossil record sorted in an order convenient for evolution? Ecological zonation, hydrodynamic sorting, and differential escape fail to explain:

- the extremely good sorting observed. Why didn't at least one dinosaur make it to the high ground with the elephants?
- the relative positions of plants and other non-motile life. (Yun, 1989, describes beautifully preserved algae from Late Precambrian sediments. Why don't any modern-looking plants appear that low in the geological column?)
- why some groups of organisms, such as mollusks, are found in many geologic strata.
- why organisms (such as brachiopods) which are very similar hydrodynamically (all nearly the same size, shape, and weight) are still perfectly sorted.
- why extinct animals which lived in the same niches as present animals didn't survive as well. Why did no pterodons make it to high ground?
- how coral reefs hundreds of feet thick and miles long were preserved intact with other fossils below them.
- why small organisms dominate the lower strata, whereas fluid mechanics says they would sink slower and thus end up in upper strata.
- why artifacts such as footprints and burrows are also sorted. [Crimes & Droser, 1992]
- why no human artifacts are found except in the very uppermost strata. If, at the time of the Flood, the earth was overpopulated by people with technology for shipbuilding, why were none of their tools or buildings mixed with trilobite or dinosaur fossils?
- why different parts of the same organisms are sorted together. Pollen and spores are found in association with the trunks, leaves, branches, and roots produced by the same plants [Stewart, 1983].

- why ecological information is consistent within but not between layers. Fossil pollen is one of the more important indicators of different levels of strata. Each plant has different and distinct pollen, and, by telling which plants produced the fossil pollen, it is easy to see what the climate was like in different strata. Was the pollen hydraulically sorted by the flood water so that the climatic evidence is different for each layer?

How do surface features appear far from the surface? Deep in the geologic column there are formations which could have originated only on the surface, such as:

- Rain drops. [Robb, 1992]
- River channels. [Miall, 1996, especially chpt. 6]
- Wind-blown dunes. [Kocurek & Dott, 1981; Clemmenson & Abrahamsen, 1983; Hubert & Mertz, 1984]
- Beaches.
- Glacial deposits. [Eyles & Miall, 1984]
- Burrows. [Crimes & Droser, 1992; Thackray, 1994]
- In-place trees. [Cristie & McMillan, 1991]
- Soil. [Reinhardt & Sigleo, 1989; Wright, 1986, 1994]
- Desiccation cracks. [Andrews, 1988; Robb, 1992]
- Footprints. [Gore, 1993, has a photograph (p. 16-17) showing dinosaur footprints in one layer with water ripples in layers above and below it. Gillette & Lockley, 1989, have several more examples, including dinosaur footprints on top of a coal seam (p. 361-366).]
- Meteorites and meteor craters. [Grieve, 1997; Schmitz et al, 1997]
- Coral reefs. [Wilson, 1975]
- Cave systems. [James & Choquette, 1988]

How could these have appeared in the midst of a catastrophic flood?

How does a global flood explain angular unconformities? These are where one set of layers of sediments have been extensively modified (e.g., tilted) and eroded before a second set of layers were deposited on top. They thus seem to require at least two periods of deposition (more, where there is more than one unconformity) with long periods of time in between to account for the deformation, erosion, and weathering observed.

How were mountains and valleys formed? Many very tall mountains are composed of sedimentary rocks. (The summit of Everest is composed of deep-marine limestone, with fossils of ocean-bottom dwelling crinoids [Gansser, 1964].) If these were formed during the Flood, how did they reach their present height, and when were the valleys between them eroded away? Keep in mind that many valleys were clearly carved by glacial erosion, which is a slow process.

When did granite batholiths form? Some of these are intruded into older sediments and have younger sediments on their eroded top surfaces. It takes a long time for magma to cool into granite, nor does granite erode very quickly. [For example, see Donohoe & Grantham, 1989, for locations of contact between the South Mountain Batholith and the Meugma Group of sediments, as well as some angular unconformities.]

How can a single flood be responsible for such extensively detailed layering? One formation in New Jersey is six kilometers thick. If we grant 400 days for this to settle, and ignore possible compaction since the Flood, we still have 15 meters of sediment settling *per day*. And yet despite this, the chemical properties of the rock are neatly layered, with great changes (e.g.) in percent carbonate occurring within a few centimeters in the vertical direction. How does such a neat sorting process occur in the violent context of a universal flood dropping 15 meters of sediment per day? How can you explain a thin layer of high carbonate sediment being deposited over an area of ten thousand square kilometers for some thirty minutes, followed by thirty minutes of low carbonate deposition, etc.? [Zimmer, 1992]

How do you explain the formation of varves? The Green River formation in Wyoming contains 20,000,000 annual layers, or varves, identical to those being laid down today in certain lakes. The sediments are so fine that each layer would have required over a month to settle.

How could a flood deposit layered fossil forests? Stratigraphic sections showing a dozen or more mature forests layered atop each other--all with upright trunks, in-place roots, and well-developed soil--appear in many locations. One example, the Joggins section along the Bay of Fundy, shows a continuous section 2750 meters thick (along a 48-km sea cliff) with multiple in-place forests, some separated by hundreds of feet of strata, some even showing evidence of forest fires. [Ferguson, 1988. For other examples, see Dawson, 1868; Cristie & McMillan, 1991; Gastaldo, 1990; Yuretich, 1994.] Creationists point to logs sinking in a lake below Mt. St. Helens as an example of how a flood can deposit vertical trunks, but deposition by flood fails to explain the roots, the soil, the layering, and

other features found in such places.

Where did all the heat go? If the geologic record was deposited in a year, then the events it records must also have occurred within a year. Some of these events release significant amounts of heat.

- **Magma.** The geologic record includes roughly 8×10^{24} grams of lava flows and igneous intrusions. Assuming (conservatively) a specific heat of 0.15, this magma would release 5.4×10^{27} joules while cooling 1100 degrees C. In addition, the heat of crystallization as the magma solidifies would release a great deal more heat.
- **Limestone formation.** There are roughly 5×10^{23} grams of limestone in the earth's sediments [Poldervaart, 1955], and the formation of calcite releases about 11,290 joules/gram [Weast, 1974, p. D63]. If only 10% of the limestone were formed during the Flood, the 5.6×10^{26} joules of heat released would be enough to boil the flood waters.
- **Meteorite impacts.** Erosion and crustal movements have erased an unknown number of impact craters on earth, but Creationists Whitcomb and DeYoung suggest that cratering to the extent seen on the Moon and Mercury occurred on earth during the year of Noah's Flood. The heat from just one of the largest lunar impacts released an estimated 3×10^{26} joules; the same sized object falling to earth would release even more energy. [Fezer, pp. 45-46]
- **Other.** Other possibly significant heat sources are radioactive decay (some Creationists claim that radioactive decay rates were much higher during the Flood to account for consistently old radiometric dates); biological decay (think of the heat released in compost piles); and compression of sediments.

5.6×10^{26} joules is enough to heat the oceans to boiling. 3.7×10^{27} joules will vaporize them completely. Since steam and air have a lower heat capacity than water, the steam released will quickly raise the temperature of the atmosphere over 1000 C. At these temperatures, much of the atmosphere would boil off the Earth.

Aside from losing its atmosphere, Earth can only get rid of heat by radiating it to space, and it can't radiate significantly more heat than it gets from the sun unless it is a great deal hotter than it is now. (It is very nearly at thermal equilibrium now.) If there weren't many millions of years to radiate the heat from the above processes, the earth would still be unlivably hot.

As shown in section 5, all the mechanisms proposed for causing the Flood already provide more than enough energy to vaporize it as well. These additional factors only make the heat problem worse.

How were limestone deposits formed? Much limestone is made of the skeletons of zillions of microscopic sea animals. Some deposits are thousands of meters thick. Were all those animals alive when the Flood started? If not, how do you explain the well-ordered sequence of fossils in the deposits? Roughly 1.5×10^{15} grams of calcium carbonate are deposited on the ocean floor each year. [Poldervaart, 1955] A deposition rate ten times as high for 5000 years before the Flood would still only account for less than 0.02% of limestone deposits.

How could a flood have deposited chalk? Chalk is largely made up of the bodies of plankton 700 to 1000 angstroms in diameter [Bignot, 1985]. Objects this small settle at a rate of .0000154 mm/sec. [Twenhofel, 1961] In a year of the Flood, they could have settled about half a meter.

How could the Flood deposit layers of solid salt? Such layers are sometimes meters in width, interbedded with sediments containing marine fossils. This apparently occurs when a body of salt water has its fresh-water intake cut off, and then evaporates. These layers can occur more or less at random times in the geological history, and have characteristic fossils on either side. Therefore, if the fossils were themselves laid down during a catastrophic flood, there are, it seems, only two choices:

- (1) the salt layers were themselves laid down at the same time, during the heavy rains that began the flooding, or
- (2) the salt is a later intrusion. I suspect that both will prove insuperable difficulties for a theory of flood deposition of the geologic column and its fossils. [Jackson et al, 1990]

How were sedimentary deposits recrystallized and plastically deformed in the short time since the Flood? The stretched pebble conglomerate in Death Valley National Monument (Wildrose Canyon Rd., 15 mi. south of Hwy. 190), for example, contains streambed pebbles metamorphosed to quartzite and stretched to 3 or more times their original length. Plastically deformed stone is also common around salt diapirs [Jackson et al, 1990].

How were hematite layers laid down? Standard theory is that they were laid down before Earth's atmosphere contained much oxygen. In an oxygen-rich regime, they would almost certainly be impossible.

How do you explain fossil mineralization? Mineralization is the replacement of the original material with a different mineral.

- Buried skeletal remains of modern fauna are negligibly mineralized, including some that biblical

archaeology says are quite old - a substantial fraction of the age of the earth in this diluvian geology. For example, remains of Egyptian commoners buried near the time of Moses aren't extensively mineralized.

- Buried skeletal remains of extinct mammalian fauna show quite variable mineralization.
- Dinosaur remains are often extensively mineralized.
- Trilobite remains are usually mineralized - and in different sites, fossils of the same species are composed of different materials.

How are these observations explained by a sorted deposition of remains in a single episode of global flooding?

How does a flood explain the accuracy of "coral clocks"? The moon is slowly sapping the earth's rotational energy. The earth should have rotated more quickly in the distant past, meaning that a day would have been less than 24 hours, and there would have been more days per year. Corals can be dated by the number of "daily" growth layers per "annual" growth layer. Devonian corals, for example, show nearly 400 days per year. There is an exceedingly strong correlation between the "supposed age" of a wide range of fossils (corals, stromatolites, and a few others -- collected from geologic formations throughout the column and from locations all over the world) and the number of days per year that their growth pattern shows. The agreement between these clocks, and radiometric dating, and the theory of superposition is a little hard to explain away as the result of a number of unlucky coincidences in a 300-day-long flood. [Rosenberg & Runcorn, 1975; Scrutton, 1965; Wells, 1963]

Where were all the fossilized animals when they were alive? Schadewald [1982] writes:

"Scientific creationists interpret the fossils found in the earth's rocks as the remains of animals that perished in the Noachian Deluge. Ironically, they often cite the sheer number of fossils in 'fossil graveyards' as evidence for the Flood. In particular, creationists seem enamored by the Karoo Formation in Africa, which is estimated to contain the remains of 800 billion vertebrate animals (see Whitcomb and Morris, p. 160; Gish, p. 61). As pseudoscientists, creationists dare not test this major hypothesis that all of the fossilized animals died in the Flood.

"Robert E. Sloan, a paleontologist at the University of Minnesota, has studied the Karoo Formation. He asserts that the animals fossilized there range from the size of a small lizard to the size of a cow, with the average animal perhaps the size of a fox. A minute's work with a calculator shows that, if the 800 billion animals in the Karoo formation could be resurrected, there would be twenty-one of them for every acre of land on earth. Suppose we assume (conservatively, I think) that the Karoo Formation contains 1 percent of the vertebrate [land] fossils on earth. Then when the Flood began, there must have been at least 2100 living animals per acre, ranging from tiny shrews to immense dinosaurs. To a noncreationist mind, that seems a bit crowded."

A thousand kilometers' length of arctic coastal plain, according to experts in Leningrad, contains about 500,000 *tons* of tusks. Even assuming that the entire population was preserved, you seem to be saying that Russia had wall-to-wall mammoths before this "event."

Even if there was room physically for all the large animals which now exist only as fossils, how could they have all coexisted in a stable ecology before the Flood? Montana alone would have had to support a diversity of herbivores orders of magnitude larger than anything now observed.

Where did all the organic material in the fossil record come from? There are 1.16×10^{13} metric tons of coal reserves, and at least 100 times that much unrecoverable organic matter in sediments. A typical forest, even if it covered the entire earth, would supply only 1.9×10^{13} metric tons. [Ricklefs, 1993, p. 149]

How do you explain the relative commonness of aquatic fossils? A flood would have washed over everything equally, so terrestrial organisms should be roughly as abundant as aquatic ones (or more abundant, since Creationists hypothesize greater land area before the Flood) in the fossil record. Yet shallow marine environments account for by far the most fossils.

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8. Species Survival and Post-Flood Ecology

"He blotted out every living thing that was upon the face of the ground," the Bible says (Gen 7:23). If the Flood was as described, that must have been an understatement.

How did all the modern plant species survive?

- Many plants (seeds and all) would be killed by being submerged for a few months. This is especially true if they were soaked in salt water. Some mangroves, coconuts, and other coastal species have seed which could be expected to survive the Flood itself, but what of the rest?
- Most seeds would have been buried under many feet (even miles) of sediment. This is deep enough to prevent spouting.
- Most plants require established soils to grow--soils which would have been stripped by the Flood.
- Some plants germinate only after being exposed to fire or after being ingested by animals; these conditions would be rare (to put it mildly) after the Flood.
- Noah could not have gathered seeds for all plants because not all plants produce seeds, and a variety of plant seeds can't survive a year before germinating. [Garwood, 1989; Benzing, 1990; Densmore & Zasada, 1983] Also, how did he distribute them all over the world?

How did all the fish survive? Some require cool clear water, some need brackish water, some need ocean water, some need water even saltier. A flood would have destroyed at least some of these habitats.

How did sensitive marine life such as coral survive? Since most coral are found in shallow water, the turbidity created by the runoff from the land would effectively cut them off from the sun. The silt covering the reef after the rains were over would kill all the coral. By the way, the rates at which coral deposits calcium are well known, and some highly mature reefs (such as the great barrier) have been around for millions of years to be deposited to their observed thickness.

How did diseases survive? Many diseases can't survive in hosts other than humans. Many others can only survive in humans and in short-lived arthropod vectors. The list includes typhus, measles, smallpox, polio, gonorrhea, syphilis. For these diseases to have survived the Flood, they must all have infected one or more of the eight people aboard the Ark.

Other animals aboard the ark must have suffered from multiple diseases, too, since there are other diseases specific to other animals, and the nonspecific diseases must have been somewhere.

Host-specific diseases which don't kill their host generally can't survive long, since the host's immune system eliminates them. (This doesn't apply to diseases such as HIV and malaria which can hide from the immune system.) For example, measles can't last for more than a few weeks in a community of less than 250,000 [Keeling & Grenfell, 1997] because it needs nonresistant hosts to infect. Since the human population aboard the ark was somewhat less than 250,000, measles and many other infectious diseases would have gone extinct during the Flood.

Some diseases that can affect a wide range of species would have found conditions on the Ark ideal for a plague. Avian viruses, for example, would have spread through the many birds on the ark. Other plagues would have affected the mammals and reptiles. Even these plague pathogens, though, would have died out after all their prospective hosts were either dead or resistant.

How did short-lived species survive? Adult mayflies on the ark would have died in a few days, and the larvae of many mayflies require shallow fresh running water. Many other insects would face similar problems.

How could more than a handful of species survive in a devastated habitat? The Flood would have destroyed the food and shelter which most species need to survive.

How did predators survive? How could more than a handful of the predator species on the ark have survived, with only two individuals of their prey to eat? All of the predators at the top of the food pyramid require larger numbers of food animals beneath them on the pyramid, which in turn require large numbers of the animals they prey on, and so on, down to the primary producers (plants etc.) at the bottom. And if the predators survived, how did the other animals survive being preyed on?

How could more than a handful of species survive random influences that affect populations? Isolated populations with fewer than 20 members are usually doomed even when extraordinary measures are taken to protect them. [Simberloff, 1988]

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9. Species Distribution and Diversity

How did animals get to their present ranges? How did koalas get from Ararat to Australia, polar bears to the Arctic, etc., when the kinds of environment they require to live doesn't exist between the two points. How did so many unique species get to remote islands?

How were ecological interdependencies preserved as animals migrated from Ararat? Did the yucca and the yucca moth migrate together across the Atlantic? Were there, a few thousand years ago, unbroken giant sequoia forests between Ararat and California to allow indigenous bark and cone beetles to migrate?

Why are so many animals found only in limited ranges? Why are so many marsupials limited to Australia; why are there no wallabies in western Indonesia? Why are lemurs limited to Madagascar? The same argument applies to any number of groups of plants and animals.

Why is inbreeding depression not a problem in most species? Harmful recessive alleles occur in significant numbers in most species. (Humans have, on average, 3 to 4 lethal recessive alleles each.) When close relatives breed, the offspring are more likely to be homozygous for these harmful alleles, to the detriment of the offspring. Such inbreeding depression still shows up in cheetahs; they have about 1/6th the number of motile spermatozoa as domestic cats, and of those, almost 80% show morphological abnormalities. [O'Brien et al, 1987] How could more than a handful of species survive the inbreeding depression that comes with establishing a population from a single mating pair?

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10. Historical Aspects

Why is there no mention of the Flood in the records of Egyptian or Mesopotamian civilizations which existed at the time? Biblical dates (1 Kings 6:1, Gal 3:17, various generation lengths given in Genesis) place the Flood 1300 years before Solomon began the first temple. We can construct reliable chronologies for near Eastern history, particularly for Egypt, from many kinds of records from the literate cultures in the near East. These records are independent of, but supported by, dating methods such as dendrochronology and carbon-14. The building of the first temple can be dated to 950 B.C. +/- some small delta, placing the Flood around 2250 B.C. Unfortunately, the

Egyptians (among others) have written records dating well back before 2250 B.C. (the Great Pyramid, for example dates to the 26th century B.C., 300 years before the Biblical date for the Flood). No sign in Egyptian inscriptions of this global flood around 2250 B.C.

How did the human population rebound so fast? Genealogies in Genesis put the Tower of Babel about 110 to 150 years after the Flood [Gen 10:25, 11:10-19]. How did the world population regrow so fast to make its construction (and the city around it) possible? Similarly, there would have been very few people around to build Stonehenge and the Pyramids, rebuild the Sumerian and Indus Valley civilizations, populate the Americas, etc.

Why do other flood myths vary so greatly from the Genesis account? Flood myths are fairly common worldwide, and if they came from a common source, we should expect similarities in most of them. Instead, the myths show great diversity. [Bailey, 1989, pp. 5-10; Isaak, 1997] For example, people survive on high land or trees in the myths about as often as on boats or rafts, and no other flood myth includes a covenant not to destroy all life again.

Why should we expect Genesis to be accurate? We know that other people's sacred stories change over time [Baaren, 1972] and that changes to the Genesis Flood story have occurred in later traditions [Ginzberg, 1909; Utley, 1961]. Is it not reasonable to assume that changes occurred between the story's origin and its being written down in its present form?

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11. Logical, Philosophical, and Theological Points

Are flood models consistent with the Bible? Creationists who write about the Flood often contradict the very story they're trying to support. For example, Whitcomb & Morris [1961, p. 69n] suggest that large numbers of kinds of land animals became extinct because of the Flood, while Genesis repeatedly says that Noah was ordered to take a representative sample of all kinds of land animals on the Ark to save them from extinction, and that Noah did as ordered. Woodmorappe [1996, p. 3] wants to leave invertebrates (i.e., just about "every creeping thing on the ground") off the ark. Why should we give credence to a story whose most ardent supporters abandon when it's inconvenient?

Genesis 6-8 speaks only of rain, fountains, and a flood; it makes no mention of other catastrophies which many Creationists associate with the Flood. Their proposed Flood models not only contradict geology, they have no Biblical support, either.

How can a literal interpretation be appropriate if the text is self-contradictory? Genesis 6:20 and 7:14-15 say there were two of each kind of fowl and clean beasts, yet Genesis 7:2-3,5 says they came in sevens.

How can a literal interpretation be consistent with reality? How could Noah have gathered male and female of each kind [Gen. 7:15-16] when some species are asexual, others are parthenogenic and have only females, and others (such as earthworms) are hermaphrodites? And what about social animals like ants and termites which need the whole nest to survive?

Why stop with the Flood story? If your style of Biblical interpretation makes you take the Flood literally, then shouldn't you also believe in a flat and stationary earth? [Dan. 4:10-11, Matt. 4:8, 1 Chron. 16:30, Psalms 93:1, ...]

In fact, is there any reason at all why the Flood story should be taken literally? Jesus used parables; why wouldn't God do so, too?

Does a global flood make the whole Bible less credible? Davis Young, an Evangelical and geologist, wrote [p. 163]:

"The maintenance of modern creationism and Flood geology not only is useless apologetically with unbelieving scientists, it is harmful. Although many who have no scientific training have been swayed by creationist arguments, the unbelieving scientist will reason that a Christianity that believes in such nonsense must be a religion not worthy of his interest. . . . Modern creationism in this sense is apologetically and evangelistically ineffective. It could even be a hindrance to the gospel.

"Another possible danger is that in presenting the gospel to the lost and in defending God's truth we ourselves will seem to be false. It is time for Christian people to recognize that the defense of this modern, young-Earth, Flood-geology creationism is simply not truthful. It is simply not in accord with the facts that God has given. Creationism must be abandoned by Christians before harm is done. . . ."

Another Christian scientist said, "Creationism is an incredible pain in the neck, neither honest nor useful, and the people who advocate it have no idea how much damage they are doing to the credibility of belief." [quoted in Easterbrook, 1997, p. 891]

Does the Flood story indicate an omnipotent God?

- If God is omnipotent, why not kill what He wanted killed directly? Why resort to a roundabout method that requires innumerable additional miracles?
- The whole idea was to rid the wicked people from the world. Did it work?

Finally, even if the flood model weren't riddled by all these problems, why should we accept it? What it does attempt to explain is already explained far more accurately, consistently, and thoroughly by conventional geology and biology, and the flood model leaves many other things unexplained, even unexplainable. How is flood geology useful?

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