ANNOTATIONS FROM THE LITERATURE*

GEOLOGY: DEBRIS FLOWS MOVE MUD RAPIDLY

Rogers RR. 2005. Fine-grained debris flows and extraordinary vertebrate burials in the Late Cretaceous of Madagascar. Geology 33:297-300.

Summary. Numerous vertebrate fossils are found in the Upper Cretaceous Maevarano Formation of northwestern Madagascar. Fossils are concentrated in the upper 14 meters of the formation, and include fish, frogs, lizards, snakes, turtles, crocodiles, dinosaurs, birds and mammals, sometimes with spectacular preservation. Most of these well-preserved fossils are covered with fine-grained sediments interpreted as debris flows. The widespread and repeated debris flows are attributed to heavy, seasonal rains flooding semiarid floodplains. The suggestion is made that large numbers of vertebrates died near the end of the dry season, and were quickly covered by muds from heavy, seasonal floods. The Maevarano Formation is the uppermost terrestrial Mesozoic deposit, and is overlain by the Cretaceous marine Berivotra Formation.

Comment. Well-preserved fossils indicate rapid burial, while fine-grained sediments are typically interpreted as accumulating slowly. In this instance, the excellent condition of the bones and the inferred nonmarine nature of the depositional environment strongly indicate massive rapid mudflows covering scores of square kilometers.

ORIGIN OF LIFE: COMPOSITION OF PREBIOTIC ATMOSPHERE

Tian F, Toon OB, Pavlov AA, De Sterck H. 2005. A hydrogen rich early Earth atmosphere. Science 308:1014-1017. Chyba CF. 2005. Rethinking Earth's early atmosphere. Science 308:962-963.

Summary. Tian and co-workers propose a model in which the escape rate of hydrogen from Earth's early atmosphere might have been two orders of magnitude slower than previously thought. Balancing slow hydrogen escape and volcanic outgassing would have maintained a substantially reducing atmosphere containing hydrogen and carbon dioxide. Tian *et al*.'s

*Other annotations are available on our website: www.grisda.org model posits an anoxic atmosphere in which UV radiation would not be absorbed by atomic oxygen thus lowering the exobase[1] temperature significantly below current levels. This lower exobase temperature — perhaps similar to that of the CO_2-rich Venusian and Martian exobases — would leave only the slower hydrodynamic process, driven by solar EUV flux, for hydrogen escape. In a hydrogen rich atmosphere, prebiotic organic compound formation, mediated by electric discharges, could have created an organic soup ocean with amino acids concentrations of ~ 10^{-6} M.

In an accompanying article, Chyba reviews evidence that led to the abandonment by most scientists of the Miller-Urey atmosphere, rich in methane and ammonia. He mentions that although the H_2-CO_2 rich atmosphere of Tian *et al*. is less favorable for organic production than a Miller-Urey one, it is far better than previous model atmospheres with low H_2 concentrations. However, Chyba also points out that the ocean may still not have been a hospitable place for prebiotic chemistry. The condensation of amino acids into proteins requires the removal of water and is therefore strongly thermodynamically disfavored in aqueous environments. Furthermore, in an early ocean as saline as that of today, salt inhibits key prebiotic reactions.

Comment. The key assumption, from which Tian *et al*. deduced a slower H_2 escape rate, was that the early Earth's atmosphere contained no oxygen. However, oxygen is the most abundant element in Earth's crust. Furthermore it is also overwhelmingly present, combined with hydrogen, in the hydrosphere. Tian *et al*.'s scenario for the early Earth comprises therefore a solid crust replete in oxygen, a large liquid ocean in which oxygen is overpoweringly present, but improbably surrounded by a gaseous atmosphere devoid of oxygen. Chyba states that older models of Earth's evolution, which postulated abundant metallic iron in the mantle, acting as an oxygen sink, are not tenable because it now seems unavoidable that the iron was largely sequestered in the core from the start. The presence of the large ocean also effectively guarantees significant oxygen in the atmosphere because UV photolysis of H_2O in the upper atmosphere releases oxygen. Direct observations from the moon during the Apollo 16 mission revealed that substantial amounts of hydrogen were leaving Earth's atmosphere due to photochemical water dissociation.[2] Jupiter's moons Europa and Ganymede have surface water in the form of ice and both are known to have atmospheres containing oxygen.[3] Recently, it was found that the rings of Saturn, which are largely composed of ice, also have their own oxygen atmosphere.[4] It seems far more likely that Earth's atmosphere has always contained a substantial amount of oxygen. At best, Tian *et al.*'s atmosphere could lead to only a very dilute prebiotic soup, but even this would be abolished by atmospheric oxygen.

(Written by John C. Walton, D. Sc. and Timothy G. Standish Ph.D.)

ENDNOTES

1. Below the exobase, a particle with kinetic energy greater than its gravitational potential energy, will, due to atmospheric density, lose that energy in collisions with other particles before it can escape.
2. Carruthers GR, Page T. 1972. Apollo 16 far-ultraviolet camera-spectrograph: Earth observations. Science 177:788.
3. Showman AP, Malhotra R. 1999. The Galilean satellites. Science 286:77-84.
4. Waite JH, Jr., Cravens TE, Ip W-H, Kasprzak WT, Luhmann JG, McNutt RL, Niemann HB, Yelle RV, Mueller-Wodarg I, Ledvina SA, Scherer S. 2005. Oxygen ions observed near Saturn's A ring. Science 307:1260-1262. See also: Coates A. 2005. Report on the Cassini-Huygens mission to Saturn, British Festival of Space. http://news.bbc.co.uk/1/hi/sci/tech/4640641.stm

PALEONTOLOGY: MESOZOIC BIRD FOSSIL RECORD

Fountaine TMR, Benton MJ, Dyke GJ, Nudds RL. 2005. The quality of the fossil record of Mesozoic birds. Proceedings of the Royal Society of London, Series B 272:289-294.

Summary. The fossil record of birds begins with *Archaeopteryx* in Upper Jurassic Tithonian Solnhofen limestone. Understanding of the Mesozoic record of birds has not changed greatly since the announcement of *Archaeopteryx* in 1861. The rapid discovery of Mesozoic bird fossils, including many new genera, since 1985 has produced no widely accepted birds below the Tithonian.

Fountaine *et al*. argue that because the general pattern of bird fossils has not changed despite these new fossils, examples of which have been found on every continent, the still small sample size gives an accurate picture of the real fossil pattern. This pattern is the sudden Upper Jurassic/Lower Cretaceous appearance of diverse "basal" bird groups while Neornithes (modern bird) fossils appear in relatively small numbers and low quality in the Cretaceous. The paucity of good modern bird fossils in the Mesozoic is attributed to real biological factors; these birds were not as abundant as the kinds of basal birds that were fossilized.

Comment. In 1859 Charles Darwin excused the fact that the geological record lacks numerous intermediates by appealing to its "extreme imperfection."[1] When *Archaeopteryx* first appeared, it was thought to be one of the "missing links" Darwin's theory both predicted and needed for support. Since then it has become evident that Archaeopteryx is one member of a diverse group of birds which appear in the fossil record suddenly in the Upper Jurassic/Lower Cretaceous.[2] Instead of being evidence for evolution, *Archaeopteryx* along with other birds found near the Jurassic/Cretaceous boundary represent another instance of sudden appearance in the fossil record. These sudden appearances of profoundly diverse members of living groups run counter to the gradual evolution Darwin proposed.

Order evident in the fossil record also presents a problem for creationism should the majority of the fossil record be attributed to the Flood. Both Darwinists and creationists can come up with tentative explanations for the order and pattern of the record, but, if Fountaine *et al*. are correct, neither side can appeal to the imperfection of the Mesozoic bird record.

ENDNOTES

1. Darwin CR. 1859 (1958 ed.). On the Origin of Species by Means of Natural Selection or the Preservation of the Favored Races in the Struggle for Life. Ch X "On the imperfection of the fossil record," p 288. Markam, Ontario: Penguin Books Canada.
2. Standish TG. 2004. Fossil birds. Geoscience Reports 37:1-5.

PALEONTOLOGY: RECOVERY OF PROTEIN FROM FOSSILS

Nielsen-Marsh CM, Richards MP, Hauschka PV, Thomas-Oates JE, Trinkaus E, Pettitt PB, Karavanic I, Poinar H, Collins MJ. 2005. Osteocalcin protein sequences of Neanderthals and modern primates. Proceedings of the National Academy of Sciences (USA) 102:4409-4413.

Summary. Osteocalcin is the second most abundant protein in bone and appears to interface with both hydroxyapatite ($Ca(PO_4)_3OH$) crystals and the most abundant bone-protein, collagen. Nielsen-Marsh *et al*. tested bone samples from 4 Neanderthal specimens: 3 from Iraq and one from Croatia. Two of the Iraqi specimens, Shanidar 2 and 6, contained detectable amounts of osteocalcin, one of them in sufficient quantities for direct protein sequencing of the C-terminus. In addition, osteocalcin from modern chimpanzees, gorillas and orangutans was sequenced. All sequences were compared with each other and previously published sequences from humans, a monkey (*Macaca fasticularis*) and cows.

Comment. That osteocalcin or any other protein could survive for significant periods of time, especially given the environment in Iraq, seems remarkable. Both specimens in which ostocalcin was found have been putatively dated at 60,000[1] and even 75,000[2] years old. Clearly some proteins are more stable than others, as collagen was not detected. The N-terminus of osteocalcin, which is thought to interact with collagen, was also absent. Unfortunately the C-terminus sequence provides no information about Neanderthals as it is identical in all the species examined.

The more variable N-terminus of osteocalcin was compared in all species other than Neanderthal. Interestingly, the human and gorilla sequences are identical except for a posttranslational modification of proline-9 to hydroxyproline. Chimpanzee and Orangutan osteocalcin each differed from the human sequence by different single amino acid substitutions. The chimpanzee substitution of Pro-15 with Thr most parsimoniously requires a C $\rightarrow$ A transversion at the first position in the Pro DNA codon. While the data provided is extremely limited, it is not consistent with the hypothesis that chimpanzees shared a more recent common ancestor with humans than gorillas.

ENDNOTES

1. http://www.mnh.si.edu/anthro/humanorigins/ha/shanidar.html
2. Trinkaus E. 1983. The Shanidar Neandertals. NY: Academic Press.

PALEONTOLOGY: SOUTH AMERICAN DINOSAUR

Makovicky PJ, Apesteguia S, Agnolin FL. 2005. The earliest dromaeosaurid theropod from South America. Nature 437:1007-1011.

Summary. Dromaeosaurs — a group of theropod dinosaurs thought to be related to birds — have until recently been found unambiguously only in continents thought to be derived from the post-Pangaean supercontinent Laurasia. Now a quite complete South American specimen named *Buitreraptor gonzalezorum* has been described. This dromaeosaur is important because it is the first good specimen found on a continent thought to have been part of the other supercontinent resulting from the breakup of Pangaea: Gondwanaland. Thus, if common ancestry of all dromaeosaurs is true, even though this fossil was found in Cenomanian (Upper Cretaceous) deposits, it logically requires a Pangaean ancestor confirming that dromaeosaurs did have enough time to evolve into birds.

Comment: The fact that putative ancestors of birds show up in strata above the Upper Jurassic limestone in which *Archaeopteryx* specimens have been found has long been a problem for the theory that birds evolved from this particular dinosaur group. The temptation has been to appeal to, as Charles Darwin put it, the “extreme imperfection of the fossil record.” In terms of hard evidence, *B. gonxalexorum* does nothing to address this problem and in fact makes it worse.

The fossil evidence does not show that a common ancestor of dromaeosaurs from both Laurasia and Gondwanaland ever existed. In fact, finding dromaeosaurs on the remnants of both super continents confirms yet another super-gap in the fossil record as it is conventionally understood. Pangaea is thought to have broken up during the Lower Jurassic while dromaeosaurs do not show up until well into the Cretaceous. According to conventional dating this leaves a gap of something more than 50 million years with no fossil record of dromaeosaurs evolving from their common ancestor. In addition, it still fails to show them evolving into birds. In defense of the theory that all dromaeosaurs came from a common ancestor, one could hardly argue that fossil dinosaurs are uncommon in Jurassic strata.