ANNOTATIONS FROM THE LITERATURE*

BIOGEOGRAPHY: HIGH DIVERSITY IN DEEP ANTARCTIC WATERS

Brandt A, Gooday AJ, Brandão SN, Brix S, Brökeland W, Cedhagen T, Choudhury M, Cornelius N, Danis B, De Mesel I, Diaz RJ, Gillan DC, Ebbe B, Howe JA, Janussen D, Kaiser S, Linse K, Malyutina M, Pawlowski J, Raupach M, Vanreusel A. 2007. First insights into the biodiversity and biogeography of the Southern Ocean deep sea. *Nature* 447:307-311.

Summary. The fauna of the deep sea around Antarctica is more diverse than previously expected. Three sampling expeditions were conducted in the area from 2002 to 2005. A high proportion of the species collected were new to science and apparently endemic to the deep Southern Ocean. Several groups have diversity equal to or greater than that known for tropical deep sea faunas. The continental shelf is much deeper than average, and contains a mixture of species from the deep sea and the continental slope. The polar front is a barrier for pelagic species, but benthic species can disperse freely beneath the front. The extent of endemism seems related to larval ecology.

Comment. The deep sea has traditionally been thought to be depleted in biodiversity, due to the extreme environmental conditions. Recent exploration and discovery is modifying that view.

DEVELOPMENT: DIFFERENT PATHWAYS FOR DIFFERENT BODY PLANS

Dunn EF, Moy VN, Angerer LM, Angerer RC, Morris RL, Peterson KJ. 2007. Molecular paleoecology: using gene regulatory analysis to address the origins of complex life cycles in the late Precambrian. *Evolution & Development* 9:10–24.

Summary. Both protostome and deuterostome bilaterians produce free-living planktonic larvae with a specific arrangement of cilia on their surface which allow them to swim and feed as plankton. Protostome trochophore larvae and deuterostome dipleurula larvae from the red abalone *Haliotis*

*Other annotations are available on our website: www.grisda.org

rufescens and purple sea urchin *Strongylocentrotus purpuratus* respectively, both have an apical tuft which Dunn *et al*. show to be the product of different developmental pathways. Based on this, they suggest that, despite morphological similarity in their larvae, protostomes and deuterostomes independently evolved planktotrophic (plankton-feeding) larvae from dipleurula (yolk-feeding) larvae.

Comment. The results of molecular studies seem regularly to require more complex evolutionary pathways to accommodate the data. This study illustrates this phenomenon as it eliminates the simpler possibility of a planktotrophic stage evolving in an ancestor that then evolved into both protostomes and deuterostomes. Instead convergent evolution has to be invoked to account for both the similar morphology and survival strategy of the larvae in these two profoundly different groups. But if the larvae really are constructed using different gene regulatory pathways, it is not clear why common ancestry and not polyphyly would be inferred in the first place.

GEOLOGY: A BRITISH MEGAFLOOD

Gupta S, Collier JS, Palmer-Felgate A, Potter G. 2007. Catastrophic flooding origin of shelf valley systems in the English Channel. Nature 448:342-345.

Summary. Detailed mapping of the floor of the English Channel reveals landforms that indicate formation by a very large flood. Scouring of the seafloor formed islands that are elongated in the direction of flow of the flood current. Additional longitudinal scours are parallel to the direction of flow. These features resemble similar features seen in the Channeled Scablands and attributed to the great Missoula Flood. Further evidence of flood erosion is seen in crescent-like scours that meet upstream in V-shaped headcuts. Evidence for a second megaflood is seen in a bedrock bench at the valley margin. There, the seafloor has been rapidly eroded, forming a "hanging tributary" where a paleo-river flowed into the valley. The source of the water is believed to have been a large glacial lake formed when advancing ice sheets created a dam in the North Sea between Scandinavia and Britain. This dam trapped water between the ice sheet, the European continent, and the Weald-Artois Anticline connecting Britain and Europe at Dover. As the resulting lake filled with water, it eventually breached the rock dam at Dover, and eroded the dam. The result was permanent separation of Britain from the rest of Europe. The Channel megafloods were among the largest of several known glacial megafloods.

Comment. The role of catastrophe is increasingly recognized in earth history. Large-scale flooding can rapidly accomplish geological changes that would otherwise take long periods of time, or more likely, not occur at all. The size and scope of such floods serve as illustrations of the possible effects of a global flood.

GEOLOGY: SNOWBALL EARTH IN DOUBT

Eyles N, Januszczak N. 2007. Syntectonic subaqueous mass flows of the Neoproterozoic Otavi Group, Namibia: where is the evidence of global glaciation? Basin Research 19:179-198.

Summary. Sediments of the Otavi Group are located along the southern margin of the Congo Craton in Namibia. The Otavi Platform is a shallow-water carbonate shelf that transitions southward into the deepwater Outjo Basin. The basin contains poorly sorted sediments that include breccias, conglomerates and turbidites. These sediments were deposited in deep water at the foot of steep scarps formed by faulting along the margin of the Congo Craton. These sediments have been interpreted variously as glacial deposits or as mass flows. This paper concludes the evidence does not support a glacial origin, but interprets the sediments as the result of mass flows in deep water along the margin of the craton. Interpretation of glacial origin was based on the lack of sorting of the clasts, but the lack of striation or glacial clasts does not fit with this interpretation. Poorly sorted sediments may also be produced by mass flows, and this interpretation is favored. The presence of turbidites indicates subaqueous deposition, while the similar lithologies of the clasts, largely carbonate, indicate a common source. The angular nature of the breccias indicates a nearby source for the sediments, which are mixed with more rounded clasts from higher on the slope. The depositional setting includes steep slopes leading to deep water along a cratonic margin, where mass flows would be expected. This combination of features points to a mass flow regime, not a glacial origin. The non-glacial origin of these sediments removes the basis for proposals of a "Snowball Earth" in the Proterozoic.

Comment. Some authors have proposed a "Snowball Earth" scenario during Neoproterozoic (Upper Precambrian) sedimentation, in which most or all of the earth was covered by glaciers. This idea has grown in acceptance and has been widely publicized in the media. However, many geologists have remained skeptical because it is not well supported and because it fails to explain some of the data. The "Snowball Earth" hypothesis was largely based on the presence of unsorted sediments in areas that paleogeographic reconstructions place at tropical latitudes, and grew out

of earlier interpretations of the Otavi Group in Nambia. This interpretation is no longer viable, since the Otavi Group sediments are not glacial, but mass flows, similar to those found commonly throughout Phanerozoic rocks.

MOLECULAR PALEONTOLOGY: COLLAGEN FROM FOSSILS

Asara JM, Schweitzer MH, Freimark LM, Phillips M, Cantley LC. 2007. Protein sequences from *Mastodon* and *Tyrannosaurus rex* revealed by mass spectrometry. Science 316:280-285.

Summary. Fragments of the protein collagen have been recovered from bones of a fossil mastodon and a fossil dinosaur and sequenced by mass spectrometry. Collagen was abundant in the mastodon bone, putatively 160,000 to 600,000 years old. About one-third of the alpha-1-t-1 collagen strand was sequenced in the mastodon, and at least four short sequences were found to be unique to that species. Collagen was much more difficult to recover from the dinosaur bone, but seven sequences could be aligned with amino acid sequences of collagen from other vertebrates. This study shows that mass spectrometry can be used to determine amino acid sequences from very tiny amounts of protein.

Comment. Collagen is an important and very common protein that has been reported from numerous other fossils. Preservation of soft tissue was reported for the same dinosaur specimen, so the identification and sequencing of collagen seems well established. It is less clear how such material could survive intact for millions of years. This report seems less surprising to those who favor a short chronology for the presence of life on Earth.

PALEONTOLOGY: EVIDENCE OF PROBABLE ASPHYXIATION IN FOSSILS

Faux CM, Padian K. 2007. The opisthotonic posture of vertebrate skeletons: postmortem contraction or death throes? Paleobiology 33:201-226.

Summary. The condition of a fossil may provide information about the environment in which the organism lived and died. Vertebrate fossils in which the bones are still articulated indicate rapid burial and preservation. Many articulated dinosaurs and certain other vertebrates are preserved with the head drawn back over the spine and the legs extended – a condition known as opisthotonus. Several explanations have been offered for the opisthotonic condition, the most commonly accepted one being that it

reflects changes that occurred to the skeleton after death. However, this explanation has not been substantiated experimentally, and seems at odds with the necessity for rapid burial to preserve skeletal articulation. Several experiments were done to test various hypotheses proposed to explain opisthotonus. The experiments showed that opisthotonus is not induced post-mortem, but is the result of death throes involving injury to the central nervous system. Probable causes include asphyxiation, poisoning, trauma, disease or nutritional deficiencies. Opisthotonus appears to be restricted to birds, dinosaurs, pterosaurs and placental mammals. Death from asphyxiation caused by volcanic ash or drowning, followed by rapid burial, seems particularly likely to explain many of these fossil specimens. This change in understanding will impact the interpretation of many paleo-environments in which opisthotonic specimens have been found.

Comment. The proffered explanation has been available for many years in the clinical literature, as noted in the article. Nevertheless, poorly supported explanations of opisthotonus have been uncritically accepted for decades. This should give us all cause to think critically, even about the "scientific consensus." The new understanding is congenial to a flood scenario, as drowning is a major cause of asphyxiation. However, it should not be taken as proving a flood; asphyxiation from volcanic ash is thought to be responsible for at least some of the opisthotonic specimens. Of course, volcanic ash is not unexpected in a global flood catastrophe, and widespread death by asphyxiation would be expected in such a catastrophe.

PALEONTOLOGY: SWIMMING DINOSAURS?

Ezquerra R, Doublet S, Costeur L, Galton PM, Perez-Lorente F. 2007. Were non-avian theropod dinosaurs able to swim? Supportive evidence from an Early Cretaceous trackway, Cameros Basin (La Rioja, Spain). Geology 35:507-510.

Summary. A dinosaur trackway with twelve consecutive scratch-like footprints has been discovered in Lower Cretaceous lacustrine sediments in northern Spain. The footprints have characteristics of theropod dinosaurs. Tracks left by the left foot are oriented in parallel with the direction of the trackway, while tracks produced by the right foot are oriented at a 40 degree angle with the trackway. This is interpreted as indicating that the animal was swimming across a current flowing from left to right. Although other possible evidence of dinosaur swimming have been proposed, this is the first definitive evidence that dinosaurs could, in fact, swim.

Comment. The evidence offered here indicates that a dinosaur left marks in the bottom of a lake while trying to cross a current in a body of water. However, it may not indicate anything about the normal habitat of the dinosaur. Theropods seem unlikely inhabitants of aquatic habitats, and this individual may have accidentally slipped into the water, or perhaps was caught in a storm. Interestingly, there are numerous examples of dinosaurs, mostly hadrosaurs, buried in marine sediments.[1] Whether this represents the natural habitat of these dinosaurs is somewhat doubtful, although perhaps some species inhabited coastal regions. Fossil preservation is often an exceptional event and does not necessarily reflect the normal habitat of these animals.

ENDNOTES

1. (a) Coombs WP, Deméré TA. 1996. A Late Cretaceous nodosaurid ankylosaur (Dinosauria: Ornithischia) from marine sediments of coastal California. Journal of Paleontology 70:311-326; (b) Fiorillo AR. 1990. The first occurrence of hadrosaur (Dinosauria) remains from the marine Claggett Formation, Late Cretaceous of South-central Montana. Journal of Vertebrate Paleontology 10:515-517; (c) Horner JR. 1979. Upper Cretaceous dinosaurs from the Bearpaw Shale (marine) of South-central Montana with a checklist of Upper Cretaceous dinosaur remains from marine sediments in North America. Journal of Paleontology 53:566-577.

SPECIATION: PARALLEL SPECIATION IN SONGBIRDS

Ryan PG, Bloomer P, Moloney CL, Grant TJ, Delport W. 2007. Ecological speciation in South Atlantic island finches. *Science* 315:1420-1423.

Summary. Small songbirds on two islands in the South Atlantic Ocean appear to provide an example of ecological speciation in parallel. Two species of buntings in the genus *Nesospiza* are found on both Nightingale and Inaccessible Islands in the Tristan da Cunha group. Each island has an abundant species with a small beak and an uncommon species with a large beak. The two forms are reproductively isolated on Nightingale, and partially so on Inaccessible. However, molecular evidence reported in this study suggests that the forms on each of the islands are more closely related to each other than to the similar form on the other island. Assuming the ancestral form had a small beak, forms with large beaks must have evolved independently. This appears to be an example of ecological selection, where speciation was driven by differences in size of seeds used as food.

Comment. It is conceivable that speciation in response to habitat and food differences could also occur on a continental scale. This would promote rapid diversification of a lineage. Molecular phylogenies with

closely bunched branches and inconsistent tree structure might be explained as the result of rapid radiation following an immigration event. Beak size is easily changeable; see annotation in newsletter 7 (2006) at http://grisda.org/newsletter/07.pdf.

SPECIATION: SIZE DIFFERENCES IN DOGS

Sutter NB, Bustamante CD, Chase K, Gray MM, Zhao K, Zhu L, Padhukasahasram B, Karlins E, Davis S, Jones PG, Quignon P, Johnson GS, Parker HG, Fretwell N, Mosher DS, Lawler DF, Satyaraj E, Nordborg M, Lark KG, Wayne RK, Ostrander EA. 2007. A single IGF1 allele is a major determinant of small size in dogs. Science 316:112-115.

Summary. Dogs are noted for diversity in size. Variation in the gene for insulin-like growth factor 1 (IGF1), gene is located on chromosome 15, shows a strong correlation with size differences. Nearly all of 463 Portuguese water dogs studied had only two sequence types for this gene. Dogs homozygous for sequence type "B" are smaller than those with sequence type "I," and have lower serum levels of IGF1 protein. Comparison with other breeds confirmed that all 14 sampled small dog breeds have the "B" sequence. Rottweilers, a large breed, also has the "B" sequence, showing that other genetic factors are involved. Nonetheless, it appears that the "B" sequence type is a major determinant of size among dogs.

Comment. This study is a reminder that small genetic differences can sometimes account for large morphological differences. Species with genetic systems such as this may be able to diversify into many morphological forms in a relatively short time period, as appears to be the case with domestic dogs and their wild relatives.