ANNOTATIONS FROM THE LITERATURE*

ANTHROPOLOGY: SMALL HUMANS WITH ARCHAIC FEATURES

Berger LR, Churchill SE, De Klerk B, Quinn RL. 2008. Small-bodied humans from Palau, Micronesia. *PLoS ONE* 3/3:e1780. doi:10.1371/journal.pone.0001780.

Summary: The Palau Archipelago is situated in the Pacific Ocean, approximately 600 km east of the Philippines, the nearest large land masses. Abundant human skeletal remains were uncovered during exploration of two caves on smaller islands of the archipelago. These cave deposits yielded skeletal material both from the surface and a small test excavation. Associated skeletal elements were very rare and the recovered human remains appeared to be disturbed and redeposited, possibly by reworking of the cave deposits during storms and by bioturbation. The large number of collected remains implies that bones from several tens of individuals are preserved in the two sites.

Radiocarbon dating of skeletal material from the test excavation indicates that, despite disturbance of sediment, stratigraphic order is maintained in the deposits and that the skeletal assemblage can be roughly dated as 940-2890 years old. Older specimens have size distribution compatible with an extremely small-bodied population of *Homo sapiens*, whose average body mass at an adult developmental stage was estimated at approximately 30-50 kg. It appears that individuals of this population possessed a number of morphological traits (such as small brain size, enlarged supraorbital tori, and absence of chins) which are usually considered primitive for the genus *Homo*. The small body size of the Palau human fossils is interpreted as a result of insular dwarfism and the occurrence of archaic skeletal features as developmental correlates of small body size in pygmoid populations.

Comment: The small-bodied human fossils from Palau represent a dramatic example of human morphological plasticity. The peculiar traits of this population suggest that phenotypic modifications of skeletal elements may be triggered by specific ecological and environmental conditions in short time spans and without necessarily implying the generation of new

*Other annotations are available on our website: www.grisda.org species. The occurrence of archaic skeletal traits in the Palau fossils evidences how some morphological attributes often considered sufficient to discriminate between lineages may instead reflect adaptations to ecological conditions well within the variability of the same genetic pool. Finally, the study of the Palau fossils is also likely to have an impact on the interpretation of the recently discovered *Homo floresiensis* remains, which are currently the subject of an acrimonious debate within the paleoanthropologist community. (RN)

DESIGN: EVOLUTIONARY CHALLENGE TO THE FLAGELLUM

Wong T, Amidi A, Dodds A, Siddiqi S, Wang J, Yep T, Tamang DG, Saier MH (Jr). 2007. Evolution of the bacterial flagellum. *Microbe* 2(7):335-340.

Renyi L, Ochman H. 2007. Stepwise formation of the bacterial flagellar system. *Proceedings of the National Academy of Sciences (USA)* 104:7116-7121.

Summary: The bacterial organelle of locomotion, the flagellar system (FS), consists of more than fifty proteins. They include a filamentous propeller, a basal body, an interconnecting hook complex, a rotary motor that is driven by the flow of either hydrogen or sodium ions, a secretion/assembly system, a secretion-energizing ATP-ase and regulatory proteins. Michael Behe cited the FS as an example of an irreducible complex system, the origin of which was not addressed by evolutionary theorists.[1] More recent publications, however, began suggesting possible evolutionary histories of the FS.[2] The two articles considered here propose further elaborations on this theme.

Based on sequence homologies, Wong *et al* suggest that the components of FS originated from several different sources via gene duplication, domain recruiting and mutation. The filament may be formed from adhesins, the motor from the proton conducting channel complex, the flagellar subunit secretor from virulence related type III secretion system and the ATP-ase from rotary F type ATP-ases.

Renyi and Ochman examined sequence homologies among 41 flagellated species of microorganisms from eleven bacterial phyla. They identified a core set of twenty-four structural genes that were found in every species. Moreover, based on similarities among these genes, the authors propose that they were derived from one another and suggest their sequence of origins. Accordingly, the earliest flagellar proteins were those closest to the inner (cytoplasmic) membrane, followed by proteins spanning the gram negative organism's outer membrane, followed by the outermost structures. These are the hook, junction, filament and capping proteins. Thus the order of flagellar assembly recapitulates its evolutionary history. Using arguments of sequence homologies, the authors conclude that the FS started out as a primitive secretion system and gradually became the organelle of locomotion.

Comment: The evolutionary paradigm forces its adherents to interpret sequence homologies as proofs of common ancestry. In the pursuit of this logic, the authors leave a gaping hole in their explanation. In suggesting that newer genes arose by duplication and modification, an explanation is required how and why the organism would select for and retain many dozens of temporarily functionless genes, for a future irreducibly complex system.[3] (GTJ)

ENDNOTES

1. Behe M. 1966. *Darwin's Black Box*. NY: The Free Press, p 73-75.
2. Pallen MJ, Matzke NJ. 2006. From *The Origin of Species* to the origin of bacterial flagella. *Nature Reviews* 4:784-790.
3. Javor GT. 2007. Letters to Editor regarding the article "Evolution of the bacterial flagellum." *Microbe* 2 (10):473.

GENETICS: ANTIBIOTIC RESISTANCE

Maurice F, Broutin I, Podglajen I, Benas P, Collatz E, Dardel F. 2008. Enzyme structural plasticity and the emergence of broad-spectrum antibiotic resistance. *EMBO Reports AOP*. DOI:10.1038/embor.2008.9

Summary: Bacteria utilize a number of antibiotic resistance enzymes passed around on plasmids and other natural vectors such as integrons. One class of enzyme that confers resistance to aminoglycoside antibiotics are the aminoglycoside 6'-N-acetyltransferases (AAC(6')). These generally have relatively narrow specificity and thus, while they may inactivate gentamicin or other naturally occurring aminoglycoside antibiotics, other modified versions, like Amikacin, may remain effective against gram negative bacteria because addition of a side chain prevents binding to the enzymes active site. Comparison of the crystal structures of ACC(6') versions that maintain a narrow aminoglycoside specificity and a version that has a broad specificity, reveals that the broad-spectrum version has a much more flexible and open binding site.

Comment: The antibiotic ACC(6') exists in different forms. One form, ACC(6')Ib_{11}, is a broad-spectrum form, while ACC(6')Ib is a narrow-spectrum version. These two forms differ by only two amino acids, thus it falls within the "edge of evolution" defined by Michael Behe.[1] Further, ACC(6')Ib_{11} demonstrates the recurring principle of loss of specificity, a common theme of antibiotic resistance evolution. The difficult question is where these antibiotic resistance enzymes came from in the first place. Some may well be degenerated forms of enzymes or other proteins that have other functions within bacteria, but degenerate forms of proteins that still do something do not explain either the ultimate origin of these proteins or why they naturally occur in more narrowly specified forms. (TGS)

ENDNOTES

1. Behe MJ. 2007. The Edge of Evolution: The search for the limits of Darwinism. New York: Free Press.

PALEONTOLOGY: BAT EXPLOSION

Smith T, Rana RS, Missiaen P, Rose KD, Sahni A, Singh H, Sing L. 2007. High bat (Chiroptera) diversity in the Early Eocene of India. Naturwissenschaften DOI 10.1007/s00114-007-0280-9.

Summary: Bats are absent below the Lower Eocene, where they have been found in Western Europe (the Paris Basin), North America (Green River Formation) and Australia (Queensland). Smith *et al*. report fossil bats from the Lower Eocene Cambay Formation of India that are remarkable for their diversity and affinity with the Lower Eocene bat fauna of Western Europe. Only one Asian species from the Lower Middle Eocene of China, *Lapichiropteryx*, appears to be a genus close to these bats reported from India.

Comment: Sudden appearance of diverse and widely geographically distributed fossils of organisms lacking obvious evolutionary ancestors is an increasingly common pattern evident in the fossil record. The most spectacular example is the appearance of various animal phyla in Cambrian rocks, but smaller "explosions" are seen in birds, other organisms and now bats. This runs counter to Darwinian predictions which requires that information about fossils coninues to increase as the fossil record be progressively viewed as less informative about evolutionary history. (TGS)

PALEONTOLOGY: CRETACEOUS FEATHERS

Perrichot V, Marion L, Neraudeau D, Vollo R, Tafforeau P. 2008. The early evolution of feathers: fossil evidence from Cretaceous amber of France. *Proceedings of the Royal Society (London) B*. DOI:10.1098/rsb.2008.0003

Summary: Feathers are specialized complex structures well adapted for their role in bird flight and insulation. Because these structures are unique to birds, how they could have evolved from integumentary structures found in other creatures, such as dinosaurs, is not obvious. Putative step-by-step morphological stages of feather evolutionary development have been proposed,[1] although they lack a specific detailed mechanism and supporting fossil evidence is "desperately missing."

Perrichot *et al*. report on several 2.3 mm and smaller feather fragments found in Upper Albian (top of the Lower Cretaceous) amber from France. These minute feather fragments have a rachis with barbs, but lack the barbules that knit together the barbs of feathers on many modern bird feathers. These feathers are presented as an intermediate stage of feather evolution providing at least some of the "desperately missing" intermediate fossil evidence. The authors speculate that these feathers may well be from a feathered theropod dinosaur rather than a bird.

Comment: The remarkable technique used in this research to obtain digital reconstructions of fine details of the feather fragments offers great promise for the study of other small inclusions in amber; however, the actual results reported do not provide evidence of a gradual evolutionary development of feathers. Feathers with a rachis but lacking barbules on the barbs are found on modern birds such as kiwis. These feathers are interpreted as derived rather than primitive. Further, even though it may be possible to argue that the Upper Albian feathers reported here lack an exact modern analog, they are found in strata well above the numerous bird fossils of the Upper Jurassic and Lower Cretaceous. These birds, including neornithean (modern) birds contemporary with or below the Albian feathers,[2] had modern-appearing feathers with well preserved barbules.[3] (TGS)

ENDNOTES

1. Prum RO. 1999 Development and evolutionary origin of feathers. *Journal of Experimental Zoology B* (Molecular and Developmental Evolution) 285:291–306. (DOI:10.1002/(SICI)1097-010X(19991215)285:4!291::AID-JEZ1O3.0.CO;2-9); Prum RO, Brush AH. 2002 The evolutionary origin and diversification of feathers. *Quarterly Review of Biology* 77:261–295 (DOI:10.1086/341993) Xu, X. 2006

Feathered dinosaurs from China and the evolution of major avian characters. *Integrative Zoology* 1:4–11 (DOI: 10.1111/j.1749-4877.2006.00004.x).

2. For example: You H, Lamanna MC, Harris JD, Chiappe LM, O'Connor J, Ji S, Lu J, Yuan C, Li D, Zhang X, Lacovara KJ, Dodson P, Ji Q. 2006. A Nearly Modern Amphibious Bird from the Early Cretaceous of Northwestern China. *Science* 312:1640-1643.
3. For example: Waldman M. 1970. A Third Specimen of a Lower Cretaceous Feather from Victoria, Australia. *The Condor* 72(3):377.

PALEONTOLOGY: DINOSAUR RESPIRATION

Codd JR, Manning PL, Norell MA, Perry SF. 2007. Avian-like breathing mechanics in maniraptoran dinosaurs. *Proceedings of the Royal Society (London) B.* DOI: 10:1098/rspb.2007.1233.

Summary: Some maniraptoran dinosaurs appear to have uncinate processes on their ribs. These processes extend dorsally from approximately the midpoint of ribs and resemble uncinate processes on bird ribs, particularly those found on diving birds. In birds uncinate processes were thought to function in stiffening the ribcage to withstand forces exerted by the pectoral and other muscles during contraction to move wings during flight. More recently it has been shown that they also play a role in the unique way in which birds breath. From this Codd *et al.* argue that maniraptoran dinosaurs exhibited a respiratory system homologous to that found in birds.

Comment: Explaining the evolution of birds' respiratory system via a Darwinian mechanism is challenging. If it was also present in some dinosaurs, how it evolved is still not explained. The problem is simply broadened and, within evolutionary thinking, the time to achieve this remarkable system is reduced. Furthermore; the morphology of dinosaur uncinate processes along with the rest of the bones in their chests is different enough from birds that the argument of Codd *et al*. seems strained. In birds the uncinate process is physically joined bone-to-bone to the ribs, while what are being called uncinate processes in maniraptorans are thought to have been attached via cartilage. As cartilage is rarely preserved, uncinate processes are generally disarticulated and may be lost or misidentified as gastralia (abdominal ribs).

Structures resembling uncinate processes have been found in some ornithischian dinosaurs, some "early" tetrapods, *Sphenodon punctatus* (tuataras) and crocodiles. While it is only possible to speculate on how systems worked in extinct creatures, living creatures — like tuataras and crocodiles — can be studied and these do not exhibit respiratory systems that resemble birds. Ultimately, the argument that because maniraptoran uncinate processes most resemble those found in diving birds and thus these dinosaurs breathed in the same way seems remarkable given that ratites are considered to be closest to the non-avian maniraptorans and they essentially lack, or have massively reduced, uncinate processes. Why birds that most resemble maniraptorans in morphology and habits would least resemble them in terms of their uncinate processes and how this logically leads to the opinion that they used a fundamentally similar respiratory system is not obvious. Further, the absence of uncinate processes in some Upper Jurassic and Lower Cretaceous birds, which was considered to be a primitive trait, must be called into question. If these birds had uncinate processes that were similar to those found in maniraptorans then they may have been overlooked. If they do actually lack them, then this must be reevaluated as a derived rather than a primitive trait. (TGS)