ANNOTATIONS FROM THE LITERATURE

AVIAN PHYLOGENY: THE PASSERINE PROBLEM

Johnson KP. 2001. Taxon sampling and the phylogenetic position of Passeriformes: evidence from 916 avian cytochrome b sequences. Systematic Biology 50:128-136.

Summary. Most avian phylogenies show ostriches and other ratites as basal, along with ducks and pheasants. Passeriformes (songbirds) are interpreted as highly derived. A phylogeny based on seven complete mitochondrial DNA sequences reversed this result, placing Passeriformes in a basal position, with ratites and fowl more derived. This paper tests that result by using cytochrome b sequences, increasing the number of species compared to 916. Results were that Passeriformes and ratites occupied a basal position, with ducks and pheasants clustering with other groups. In a different study, nuclear sequences grouped Passeriformes in a more traditional position.

Comment. Discovery of discontinuities in molecular sequence comparisons might aid in identification of groups with separate origins.

DESIGN: THE THEODICY PROBLEM

Miles SJ. 2001. Charles Darwin and Asa Gray discuss teleology and design. Perspectives on Science and Christian Faith 53:196-201.

Summary. Asa Gray is well known as a confidant of Charles Darwin, one of the few with whom Darwin openly discussed his views prior to publication of his famous book. However, the two men differed strongly in their theology of nature. Darwin could not make sense of the presence of evil, and concluded that God was not active in nature. Darwin did allow that God might have designed the cosmos, but there was too much suffering for Darwin to accept God's hand in guiding nature. Variation must be due to unguided "natural" selection. On the other hand, Gray insisted that God is active in nature, and variation is guided by Providence. Miles attributes the difference in the conclusions of Darwin and Gray to differences in their presuppositions. According to Miles, Darwin tried to reason from design in nature to belief in God,

but could not do it. Gray, in contrast, began with a belief in God, and saw design in nature as a result of that belief. The difference is significant. In the current debates over design in nature, it would be well to distinguish between arguing *from* design *to* God or *from* God *to* design.

Comment. The question of evil appears to be the basis for much disagreement in interpreting the relationship of God and nature. As with Darwin and Gray, the philosophical starting point has a huge influence on the deductions made concerning God and nature. The distinction between the argument from design and the argument to design has also been commented on by Wells [Wells J. 1990-91. Darwinism and the argument to design. Dialogue and Alliance 4(4): 69-85].

GENETICS: HIGH MUTATION RATE

Denver DR, Morris K, Lynch M, Vassilieva LL, Thomas WK. 2000. High direct estimate of the mutation rate in the mitochondrial genome of *Caenorhabditis elegans*. Science 289:2342-2344.

Summary. Mutation rate estimates have important implications for dealing with genetic diseases and application of the "molecular clock" hypothesis. Direct estimates of mutation rates have not been possible until recently. In this study, 74 lineages of the nematode, *C. elegans* were studied, and mitochondrial DNA sequences compared after an average of 214 generations. The calculated mutation rate was two orders of magnitude greater than previous phylogenetic estimates. Although the *C. elegans* genome has a high ratio of thymine (T) to cytosine (C), this is not due to mutational bias, since the observed number of T to C mutations greatly exceeded the number of C to T mutations. Mutations appeared to be biased; for example, five of ten observed indel mutations occurred within a single stretch of 11 adenine bases, and five of nine observed amino acid changes were also found in the species *C. briggsae*.

Comment. If these results apply to other species, estimates of phylogenetic divergence times based on the molecular clock hypothesis might need to be reduced by two orders of magnitude. If accepted, this could have significant implications for understanding earth history.

GENETICS: WHY NO MUTATIONAL MELTDOWN?

Nachman MW, Crowell SL. 2000. Estimate of the mutation rate per nucleotide in humans. Genetics 156:297-304.

Summary. The rate of mutation in humans is difficult to measure accurately. Estimates have been made based on screening for visible mutants, but this provides only a minimum estimate. Here, an estimate of mutation rate is based on comparison of pseudogenes in humans and chimpanzees. Results suggest a genomic mutation rate of 175 mutations per genome per generation. The rate of deleterious mutations is estimated as 3 per genome per generation. If these deleterious mutations have multiplicative effects, the average human female would need to produce 40 offspring in order to prevent the species from going extinct. The solution to this paradox may be that deleterious mutations are more harmful in combination than when evaluated separately.

Comment. Some of the assumptions used in this report are questionable. For example, the calculations were based on an estimate of 70,000 genes in the human genome, while recent studies have suggested the number may be closer to half as many genes. Nevertheless, others have noted an apparent paradox in the survival of the species despite a high rate of harmful mutations (see, for example, chapter 9 in: Remine WJ. 1993. The biotic message. St Paul, MN: St Paul Science).

GEOCHEMISTRY: SILICA-REPLACED FOSSILS

Grimes ST, Brock F, Rickard D, Davies KL, Edwards D, Briggs DEG, Parkes RJ. 2001. Understanding fossilization: experimental pyritization of plants. Geology 29:123-126.

Summary. Pyritized fossils preserve excellent tissue detail, and understanding the process of pyritization would aid in interpreting the fossils. Fourteen different experimental conditions were employed, but mineralization occurred in only one of them, indicating the need for highly specific conditions. Both *Platanus* and *Psilotum* material was successfully pyritized. Pyritization is driven by anaerobic bacteria, and can be observed in less than 80 days. Direct replacement of organic

materials was not observed, and lignin molecules remained in the pyritized material.

Comment. Reconstructing the conditions under which fossils form may shed valuable light on the processes acting during the biblical flood.

Kidder DL, Erwin DH. 2001. Secular distribution of biogenic silica through the Phanerozoic: comparison of silica-replaced fossils and bedded chert at the series level. Journal of Geology 109:509-522.

Summary. Fossils are sometimes found in which the original material has been replaced with silica. The silica is thought to be derived from living organisms that concentrate silica from sea water and deposit it in their skeletons. The principal organisms involved in secreting silica are certain types of sponges, radiolarians, and diatoms. The abundance of silica-replaced fossils varies in the Phanerozoic. Silica replacement is seen in slightly more than 20% of described Paleozoic faunas, but in only 4% of Mesozoic and Cenozoic faunas. Peaks of silica replacement occur in Upper Ordovician and Middle Devonian faunas, and are correlated with peaks in fossils of siliceous sponges. Silica replacement is typically high just before a mass extinction, and drops precipitously after the mass extinction. This pattern is seen in the end-Ordovician, middle Devonian, end Permian and end Cretaceous mass extinctions, but not in the end Triassic mass extinction.

Comment. Trends in depositional patterns through Phanerozoic sediments may provide useful constraints on models of earth history. More analysis of these data might be fruitful.

MASS EXTINCTIONS: END-PERMIAN

Becker L, Poreda RJ, Hunt AG, Bunch TE, M. Rampino M. 2001. Impact event at the Permian-Triassic boundary: evidence from extraterrestrial noble gases in fullerenes. Science 291:1530-1533.

Summary. Fullerenes are molecules formed of carbon atoms arranged to form a cage-like structure. Their cage-like structure enables them to trap other materials, such as atoms of noble gases. Fullerenes have been linked to extraterrestrial impacts, such as the Precambrian Sudbury Crater in Canada and in the end-Cretaceous impact layer. Now they are reported from two Permian-Triassic boundary sections,

in China and in Japan. Molecules of noble gases found within the fullerenes have isotopic compositions similar to extraterrestrial material, suggesting that an extraterrestrial impact occurred at the Permian-Triassic boundary.

Jin YG, Wang Y, Want W, Shang QH, Cao CQ, Erwin DH. 2001.Pattern of marine mass extinction near the Permian-Triassic boundary in South China. Science 289:432-436.

Summary. The best-known Permo-Triassic boundary section in the world is in South China. Analysis of the boundary sediments shows a major mass extinction is associated with a 100- to 1000-fold increase in microspherules. This suggests the possibility of an extraterrestrial impact, although no impact crater has been satisfactorily identified.

Kaiho K, Kajiwara Y, Nakano H, Miura Y, Kawahata H, Tazaki K, Ueshima M, Chen Z, Shi GR. 2001. End-Permian catastrophe by a bolide impact: evidence of a gigantic release of sulfur from the mantle. Geology 29:815-818.

Summary. Southern China contains an excellent depositional sequence spanning the Permian-Triassic boundary. The boundary itself is identified within a marl. The boundary lies just above the last appearances of many genera of marine organisms. Associated with this mass extinction is an abrupt increase in nickel and an increase in the proportion of isotopically light sulfur. Impact-metamorphosed grains are also found. Based on the quantity of impact-associated material, the impactor is estimated to have been either a comet 15-30 km in diameter or an asteroid 30-60 km in diameter.

Twitchett RJ, Looy CV, Morante R, Visscher H, Wignall PB. 2001. Rapid and synchronous collapse of marine and terrestrial ecosystems during the end-Permian biotic crisis. Geology 29:351-354.

Summary. A Permian-Triassic boundary sequence in East Greenland contains both marine and terrestrial organisms. A major mass extinction occurs in both groups within a short depositional interval, indicating an ecological collapse that involved both environments.

Smith RMH, Ward PD. 2001. Pattern of vertebrate extinctions across an event bed at the Permian-Triassic boundary in the Karoo Basin of South Africa. Geology 29:1147-1150.

Summary. The Karoo Basin contains a continuous depositional sequence across the Permian-Triassic boundary. New field study has resulted in identification of an "event bed" marking the boundary. This bed coincides with a mass extinction of terrestrial organisms, and indicates that the mass extinction was geologically sudden rather than extended over a long period of time.

Ward PD, Montgomery DR, Smith R. 2000. Altered river morphology in South Africa related to the Permian-Triassic extinction. Science 289:1740-1743.

Summary. The Karoo Basin of South Africa shows a basin-wide change in sedimentary facies at the Permian Triassic boundary. The change is interpreted as reflecting a basin-wide increase in sedimentation rates, due to change from meandering to braided river systems. A global catastrophic die-off of vegetation is inferred at the Permo-Triassic boundary.

Comment. The causes of "mass extinctions" are poorly understood. It is difficult to understand the selectivity of "mass extinctions." An impact large enough to destroy every individual of numerous species worldwide might easily be expected to destroy virtually all living macroscopic organisms. Despite the lack of "smoking gun" evidence for an end-Permian impact, sentiment seems swinging toward favorably regarding such a possibility.

PALEOBIOGEOGRAPHY: MADAGASCAR MAMMALS

Krause DW. 2001. Fossil molar from a Madagascan marsupial. Nature 412:497-498.

Summary. A fossil marsupial tooth is reported from the uppermost Cretaceous Maevarano Formation in Madagascar. This is the first report of a marsupial from Madagascar, and is one of the oldest marsupial fossils known. The modern mammal fauna of Madagascar seems unrelated to the Cretaceous fossils so far discovered. Since Madagascar is believed to have been an island throughout the Cenozoic, the modern mammal fauna must have dispersed over water.

Marivaux L, Welcomme J-L, Antoine P-O, Metais G, Baloch IM, Benammi M, Chaimanee Y, Ducrocq S, Jaeger J-J. 2001. A fossil lemur from the Oligocene of Pakistan. Science 294:587-591.

Summary. Living lemurs are confined to Madagascar, but they have almost no fossil record in Madagascar, and have been unknown elsewhere. Here, a fossil lemur is reported from the lower Oligocene Chitarwata Formation in the Bugti Hills of Pakistan. Surprisingly, the fossil appears to belong to the living family Cheirogaleidae, rather than to the "stem lineage" of lemurs.

Comment. The source of the Madagascan mammal fauna remains a mystery. The apparent lack of any connection between Cretaceous and living mammals is problematic, since Madagascar is believed to have been isolated since the Cretaceous.

PALEONTOLOGY: CAMBRIAN EXPLOSION

Siveter DJ, Williams M, Waloszek D. 2001. A phosphatocopid crustacean with appendages from the Lower Cambrian. Science 293:479-481.

Summary. Lower Cambrian rocks in England have produced an undoubted fossil crustacean, usually considered an extinct type of ostracod, but now believed to be the sister group of all living Crustacea. This adds to the diversity in the Lower Cambrian.

Shu D-G, Conway Morris S, Han J, Chen L, Zhang X-L, Zhang Z-F, Liu H-Q, Li Y, Liu J-N. 2001. Primitive deuterostomes from the Chengjiang Lagerstatte (Lower Cambrian, China). Nature 414:419-424.

Summary. Several fossils, representing at least four different taxa, have been classified as a new phylum. The fossils were found in the Lower Cambrian Qiongzhusi (Chiungchussu) Formation in the famous Chengjiang region of China. The new phylum is named Vetulicolia, and is thought to share characteristics with the echinoderms, chordates and hemichordates.

Shu D-G, Chen L, Han J, Zhang X-L. 2001. An Early Cambrian tunicate from China. Nature 411:472-473.

Summary. An inch-long fossil from China has been identified as a tunicate, similar in morphology to the living *Styela*, although classified in a different genus. Fossil tunicates are rare, although this is not the first report of a Cambrian tunicate.

Comment. The discoveries emphasize the magnitude of the "Cambrian Explosion" and the utility of explaining the pattern of sudden appearances as indicating separate ancestries.

PALEONTOLOGY: EDIACARAN ORGANIC REMAINS

Steiner M, Reitner J. 2001. Evidence of organic structures in Ediacara-type fossils and associated microbial mats. Geology 29:1119-1122.

Summary. Ediacaran fossils are known mostly from imprints in fine-grained sandstones. Ediacaran fossils with preserved organic material have been reported from mudstones of the Neoproterozoic Doushantuo and Liulaobei Formations of China. Some of the fossils are pyritized. The fine detail in these fossils suggests the original organisms were not related to metazoans, but were similar to myxobacteria, a poorly known group of colonial bacteria. The wrinkled surfaces associated with some Ediacaran fossils are identified as microbial mats. Although some Ediacaran fossils might truly be metazoans, at least some of them are not. The Ediacaran fauna is probably polyphyletic.

Comment. The Ediacaran fossils have been variously interpreted as ancestors of living phyla, an extinct group unrelated to living forms, or simply unidentified. This report adds to the variety of interpretations.

PALEONTOLOGY: QUALITY OF THE FOSSIL RECORD

Alba DM, Agusti J, Moya-Sola S. 2001. Completeness of the mammalian fossil record in the Iberian Neogene. Paleobiology 27:79-83.

Summary. The taxonomic completeness of the Neogene fossil record of mammals from the Iberian peninsula was studied. The conclusions were that the fossil record reflects more than 75% of all Neogene mammal species and more than 90% of all genera. This is similar to estimates of the completeness of the record for marine invertebrates. This raises doubts about the significance of episodic deposition in this area.

Comment. The quality of the fossil record has been discussed at length, because many deductions about earth history depend on assumptions about the completeness or incompleteness of the record. As our knowledge of the fossil record becomes increasingly complete, the probability of finding transitional fossils becomes more unlikely.

Kidwell SM. 2001. Preservation of species abundance in marine death assemblages. Science 294:1091-1094.

Summary. The question explored here is whether the fossil record of marine molluscs preserves enough information to infer which fossil species were more common. Natural accumulations of mollusc shells were sampled and compared with assemblages of living species in the same localities. Results indicate that abundance-rank order is preserved in natural death assemblages if shells less than 1 mm long are excluded and if at least 100 specimens are counted. Accumulations of shells of dead molluscs typically include all the species living in the area, plus an additional 20% or so.

Comment. This result does not seem surprising, since mollusc shells are quite durable. These results confirm that the fossil record is expected to be excellent for groups such as shelled molluscs.

PHILOSOPHY OF SCIENCE

Murray BG. 2001. Are ecological and evolutionary theories scientific? Biological Reviews 76:255-289.

Summary. Scientific generalizations may be of two types. One type refers to observables, and is inductive. Boyle's Law is an example. The second type refers to unobservables and is deductive. An example is Newton's Laws of Motion. Biology has many examples of the first type, such as Bergmann's Rule, but very little of the second, deductive type. Most studies of scientific method have focused on the deductive method favored by physics rather than the inductive method used by biologists. Thus, more study needs to be given to biological studies to evaluate their scientific status. The serious question is whether hypotheses concerning unobservables can be considered scientific if empirical facts cannot be deduced from them. Theoretical biology (as opposed to experimental biology), such as fitness, natural selection, and ecological theory, lacks universal laws and predictive theory. Thus, it is not scientific. However, it could be made scientific by developing predictive theories. An example is proposed in which three "laws" are constructed to predict differences in life-history traits in different species. These laws have predictive power, making them both testable and scientific. Theoretical (explanatory) biology is not scientific.

Comment. The contrast between deductive prediction and inductive description is one that needs wider recognition when discussing issues in earth history. As this article points out, the logical structure of conclusions in earth history may be fundamentally different from the logical structure used in the experimental laboratories in which the reputation of science has been established. Most studies of earth history lack both knowledge of the initial conditions and controls — features that give experimental science its great power.

RADIOHALOS AND GRANITE

Armitage M. 2001. New record of polonium radiohalos, Stone Mountain granite, Georgia (USA). Creation Ex Nihilo Technical Journal 15(1):86-88.

Walker T. 2001. New radiohalo find challenges primordial granite claim. Creation Ex Nihilo Technical Journal 15:14-16.

Summary. Stone Mountain is an intruded granitic dome located near Atlanta, Georgia. Based on field relationships, creationists have interpreted the uplift of Stone Mountain as occurring during the Flood, perhaps during the later stages of the Flood. It does not appear to have been created as it is now found. Evidence of contact metamorphism is present, suggesting the granitic material might have been molten when emplaced. Radiohalos have been found in the granite of Stone Mountain. Based on their size, they were probably produced by polonium-210. If radiohalos were created in the original rock, they would be completely destroyed by melting. Thus, the existing radiohalos must have been produced during or after the Flood. This refutes the claim by some creationists that granites are primordial rocks, remaining from the creation.

Comment. This report adds to other evidence that contradicts the claim that some granites are part of the originally created rocks of the earth (e.g., see *Origins* 15:32-38).

SPECIATION

Ryan MJ. 2001. Food, song and speciation. Nature 409:139-140. Commenting on Podos J. 2001. Correlated evolution of morphology and vocal signal structure in Darwin's finches. Nature 409:185-188.

Summary. Research on the finches of the Galapagos Islands suggests that beak size may affect certain aspects of a bird's song.

Birds with larger beaks tend to have a slower rate of "trill." Since bird song is important in courtship, it is plausible that changes in beak size might contribute to speciation, due to changes in characteristics of the song. This may be reinforced by changes in feeding habits. Sound is an important element in frog courtship as well, and variation in sound reception seems to correlate with the number of species of frogs. It remains to be seen whether rates of speciation in songbirds can be definitively linked to beak structure, song, and feeding habits, but it seems a possibility.

Comment. Bird song is partially inherited and partially learned. Variability in either component could enhance the process of speciation and help explain the large number of species of songbirds.

Sato A, Tichy H, O'hUigin C, Grant PR, Grant BR, Klein J. 2001. On the origin of Darwin's finches. Molecular Biology and Evolution 18:299-311.

Summary. The Galapagos finches seem clearly to be related to the finches of South America, but the closest relative has not been identified conclusively. Nuclear and mitochondrial DNA sequences were compared from 28 species, representing the main groups within the family Fringillidae (including the Emberizidae and Icteridae). The Galapagos finches clustered with the dull-colored grassquit (*Tiaris obscura*), which is found from northwest Venezuela to northwest Argentina. Other closely related species are found in South America and the West Indies. The origin of the Galapagos finches may be related to the establishment of the Panamanian isthmus connecting North and South America.

Comment. Grassquits show good powers of dispersal, being found in the Caribbean as well as in Central and South America. Perhaps it should not be surprising that some may have found their way to the Galapagos Islands as well.