

ANNOTATIONS FROM THE LITERATURE

GENETICS AND EVOLUTION: ANTI-MUTATION MECHANISM

Gimble FS, Thorner J. 1992. Homing of a DNA endonuclease gene by meiotic gene conversion in *Saccharomyces cerevisiae*. *Nature* 357:301-306.

Summary. The yeast *Saccharomyces* contains a gene that produces a subunit of a vacuolar membrane enzyme. The enzyme (VMA1) is produced from a larger protein by removal of a smaller protein. This paper reports that the smaller protein is actually an endonuclease. This endonuclease has the ability to attack any copy of the VMA1 gene that does not include the sequence for the endonuclease. If only one copy of the VMA1 gene lacks the sequence for the endonuclease, the endonuclease produced by the other copy of the gene will attack the defective gene. The gene will be cut at the exact spot where the endonuclease sequence should be, and the missing sequence will be copied into the defective gene. This type of mechanism for correcting genetic errors has previously been found only in introns.

GEOLOGY: "PSEUDO-PALEOSOLS"?

Rossinsky V, Wanless HR, Swart PK. 1992. Penetrative calcretes and their stratigraphic implications. *Geology* 20:331-334.

Summary. Calcrete (caliche) horizons have been commonly used to identify subaerial exposures. Recent work by Rossinsky et al. has identified a series of multiple calcrete horizons extending as deep as 5 m that they term "false penetrative calcretes." The entire system of penetrative calcretes is indicative of a single subaerial exposure. The penetrative calcrete horizons occur along subhorizontal surfaces (sequence or lithologic boundaries) and are connected by vertical rhizoliths (calcrete or chert having a root-like form). Use of the calcrete layers as indicators of distinct subaerial events from core borings may result in an incorrect calculation of the number of lowstand events in a marine deposit. Previous work indicated that the calcrete horizons may be joined by a single taproot. In addition, calcretes formed sub-surface are more likely to be preserved than those formed subaerially.

Both papers cited fluctuations in the water table as a significant factor in calcrete horizon formation.

GEOLOGY: RADIOMETRIC AGE CONTAMINATION?

Seaman SJ, Ramsey PC. 1992. Effects of magma mingling in the granites of Mount Desert Island, Maine. *Journal of Geology* 100:395-409.

Summary. Fine-grained inclusions (enclaves) in felsic plutons and volcanic rocks are usually interpreted as magmas that cooled and crystallized when they came into contact with their more siliceous host magmas. The minerals that crystallize from the enclave liquids and disaggregate into the host granite contaminate the granite with exotic components. Three mechanisms affecting composition and texture of the granite are described: 1) disaggregation and dispersion of crystals from pegmatite pods formed during the cooling of the enclave liquids, 2) ionic exchange between the enclave and granitic magmas, and 3) alkalic feldspar and hornblende rinds surrounding the enclaves. While the third process of rind development simplifies the process of identifying the extent of contamination in granites, the authors state "... textural and compositional data presented in this study suggest that the effects of ionic and mineralogic contamination by enclave liquids may be strong and pervasive, regardless of the appearance of a granite."

MOLECULAR PHYLOGENY

Hillis DM, Dixon MT. 1991. Ribosomal DNA: Molecular evolution and phylogenetic inference. *Quarterly Review of Biology* 66:411-453.

Summary. This article reviews the results of analysis of DNA sequences for ribosomal RNA (rRNA). A 7-page appendix references a large number of phylogenetic studies using ribosomal DNA sequences. Ribosomal RNA participates in the structure of the ribosomes, where proteins are made. Three or four main segments rRNA genes are present in the nuclei of most cells. The largest of these is a large subunit RNA (called 28S) of over 4000 nucleotides in length. This is associated with a smaller sequence (5.8S) of about 160 nucleotides. The rRNA (16S) making up the small subunit of the ribosome has about 1500 nucleotides. A fourth sequence (5S) of about 120 nucleotides is present in eukaryotic cells. Ribosomal DNA (rDNA) sequences are also present in mitochondria and chloroplasts. The DNA sequence of

the large subunit rDNA varies among species much more than do the two smaller sequences. The authors state that sequences should be at least 70% similar to be useful in phylogenetic studies, a condition that rDNA seems to fulfill better than many other molecules. One problem with rDNA studies is that multiple copies of the genes seem to maintain greater homogeneity among themselves than would be expected if each copy were evolving independently. This phenomenon, known as “concerted evolution,” is commonly seen in gene families having multiple copies, and confounds to some degree the process of phylogenetic interpretation.

Furhman JA, McCallum K, Davis AA. 1992. Novel major archaeobacterial group from marine plankton. *Nature* 356:148-149.

Summary. Marine bacteria are not well known because of difficulty in culturing them for identification. Molecular comparisons can be made without the need for culturing. No archaeobacteria, but only eubacteria, have been found in samples from the ocean surfaces. The authors analyzed 16S rRNA sequences from bacteria taken from below the ocean surface. These new sequences differ from those of any known bacteria as much as plants and animal sequences differ from each other. These bacteria may represent a new group not similar to any known group of organisms.

Cunningham CW, Blackstone NW, Buss LW. 1992. Evolution of king crabs from hermit crab ancestors. *Nature* 355:539-542.

Summary. King crabs are among the largest arthropods living. Like hermit crabs and several other groups, they have asymmetrical abdomens. Fossil hermit crabs are known at least from the Cretaceous, but no fossils of king crabs have been found. This paper reports on a molecular comparison of the gene for a mitochondrial ribosomal RNA molecule of hermit crabs and king crabs. Results showed that the king crab molecular sequence was more similar to that of some species of hermit crabs than were some sequence comparisons among hermit crab species from the same genus (*Pagurus*). The authors suggest that king crabs might be derived from hermit crabs that outgrew their ability to fit into discarded molluscan shells.

Joss JM, Cramp N, Baverstock PR, Johnson AM. 1991. A phylogenetic comparison of 18S ribosomal RNA sequences of lungfish with those of other chordates. *Australian Journal of Zoology* 39:509-518.

Summary. The origin of the tetrapods is generally traced to one or two groups of fishes. Most morphologists have favored the extinct rhipidistians as closest to the ancestry of tetrapods, while others have favored the lungfish. Because it is generally believed to be descended from the extinct rhipidistians, the coelacanth should therefore be more similar to tetrapods than is the lungfish. In this study, ribosomal RNA gene sequences were compared for five groups of fish and two groups of amphibians. A partial sequence of coelacanth rRNA was also compared. Lungfish did not group well with any of the other groups included in the study. This leaves the relationships of tetrapods, coelacanths and lungfish unresolved, despite many years of intense study and debate.

Westerman M. 1991. Phylogenetic relationships of the marsupial mole, *Notoryctes typhlops* (Marsupialia: Notoryctidae). *Australian Journal of Zoology* 39:529-537.

Summary. The marsupial mole is found only in Australia, where it burrows in sandy soils in the interior of the continent. Its relationships to other marsupials have been enigmatic, and it has generally been placed in a group by itself, sometimes in a separate Order. Fossil moles have been nearly unknown, but some fossils have recently been discovered at Riversleigh, Queensland. These fossils are similar in structure to the living moles, giving no hint of relationship to any other marsupial group. This paper reports the results of DNA-DNA hybridization studies comparing the marsupial mole to various other groups of marsupials. The DNA results are similar to other kinds of data in indicating that the marsupial mole is not similar to any other group of marsupials, but should be maintained in a group by itself.

PALEOECOLOGY: ECOLOGICAL ZONATION?

DiMichele WA, Aronson RB. 1992. The Pennsylvanian-Permian vegetational transition: A terrestrial analogue to the onshore-offshore hypothesis. *Evolution* 46:807-824.

Summary. The authors note that floras from Lower and Middle Pennsylvanian deposits are typically wetland types. Upper Pennsylvanian floras include both wetland and drier types. Drier habitats

predominate in Permian deposits. Several prominent Upper Permian and Mesozoic taxonomic groups have first appearances in drier type floras. The authors compare this ecological trend with the onshore-offshore hypothesis of ecological trend in terrestrial deposits.

Comment. Such examples indicate ecological trends in depositional sequences that might profitably be examined in the context of ecological zonation theory.

PALEONTOLOGY

Han T-M, Runnegar B. 1992. Megascopic eukaryotic algae from the 2.1-billion-year-old Negaunee Iron-Formation, Michigan. *Science* 257:232-235.

Summary. Fossils believed to be those of a macroscopic alga have been discovered in Precambrian deposits in Michigan. The fossils are about 1 mm in diameter and up to 90 mm in length. If correctly identified as eukaryotes, these are the stratigraphically lowest eukaryote fossils yet found. The inferred photosynthetic ability of these fossil algae requires a very early date for the widely accepted hypothesis of an endosymbiotic origin of chloroplasts.

Briggs DEG, Fortey RA, Wills MA. 1992. Morphological disparity in the Cambrian. *Science* 256:1670-1673.

Summary. In his book *Wonderful Life*, Stephen Jay Gould states that the fossils of the Burgess Shale show an extraordinarily great diversity of body plans. Gould uses the term “disparity” to distinguish the idea from large numbers of species. Briggs et al. take exception to Gould’s characterization of great disparity within the Burgess Shale arthropods. Briggs et al. used principal components analysis to compare the disparity among living and Burgess Shale arthropods. They concluded that living arthropods exhibit essentially the same degree of disparity as Burgess Shale arthropods.

Comment. It is, nevertheless, remarkable that the diversity of body plans found in a single fossil locality, and a Cambrian locality at that, would be as great as found among all living arthropods worldwide.

Sansom IJ, Smith MP, Armstrong HA, Smith MM. 1992. Presence of the earliest vertebrate hard tissues in conodonts. *Science* 256:1308-1311.

Summary. Conodont fossils are widely distributed both geographically and stratigraphically, mostly in Paleozoic deposits, including

the Cambrian. For many years no one knew what kind of animal produced the tooth-like conodont fossils. Recent discoveries have shown that the tooth-like fossils functioned as teeth in the mouths of the small, soft-bodied swimming conodont animals. This paper reports on the presence of cellular bone in conodont elements, leading to the conclusion that conodonts must be considered to be vertebrates.

Comment. Enamel-like tissues are found, but no dentine, contrary to the evolutionary hypothesis that dentine is primitive with respect to enamel.

Sereno PC, Chenggang R. 1992. Early evolution of avian flight and perching: New evidence from the Lower Cretaceous of China. *Science* 255:845-848.

Summary. A newly described fossil bird from China is said to be an important link between *Archaeopteryx* and modern birds. The sparrow-sized bird was discovered in Lower Cretaceous lake deposits in northeastern China.

The new bird, named *Sinornis santensis*, shares several reptilian traits with *Archaeopteryx*. The snout is short and toothed. The carpus and manus are separate. The metacarpals are separate and with digits. The pelvic girdle elements are free rather than co-ossified. The iliac blades are erect; the ischiurn is blade-shaped; and the pubis seems directed ventrally, terminating in a hook-shaped foot as in *Archaeopteryx*. The metatarsals are fused only at the proximal ends. Gastral ribs are present, as are several advanced avian traits. The tail is short, and a pygostyle is present. The shoulder joint permits raising of the wing above the level of the vertebral column. The second digit of the manus and the ulna support flight feathers. The wing seems to have been capable of folding. The manus is shorter than the forearm or the humerus. The hallux (thumb) is opposable, and the fifth digit of the pes is absent. The authors reject the proposed avian character of the upper Triassic *Protoavis*. *Sinornis* shows supposed advances over *Archaeopteryx* for flight, but retains several ancestral traits.

Lockley MG, Yang SY, Matsukawa M, Fleming F, Lim SK. 1992. The track record of Mesozoic birds: evidence and implications. *Philosophical Transactions of the Royal Society of London, Series B* 336:113-134.

Summary. Bird footprints are more common in Mesozoic sediments than is generally recognized. Several factors may have contributed to a general failure to recognize bird tracks. The paucity of fossil birds in

pre-Cretaceous deposits may have hindered the recognition of pre-Cretaceous bird tracks. Dinosaur footprints are more common than bird footprints, which may have led to misidentification of some bird tracks as dinosaur tracks. Also, many Mesozoic bird tracks are found associated with larger and more spectacular dinosaur tracks, possibly resulting in the bird tracks being largely ignored.

Several criteria are presented for distinguishing bird tracks from other types such as dinosaur tracks. Several examples of tracks that meet the criteria for bird tracks are described. Most of the bird tracks appear to be those of shorebirds, and are especially similar to those of plovers. A few tracks are as large as those of large herons. Bird tracks have been discovered from the Lower Cretaceous of East Asia and North America, and from the Jurassic of Africa and North America.

Comment. The presence of numerous examples of shorebird tracks in deposits stratigraphically lower than *Archaeopteryx* is further evidence that *Archaeopteryx* is not the ancestor of birds.

Godthelp H, Archer M, Cifelli R, Hand SJ, Gilkeson CF. 1992. Earliest known Australian Tertiary fauna. *Nature* 356:514-516.

Summary. Several new fossil mammals and other vertebrates have been discovered in an Eocene clay deposit in Queensland, Australia. The fossils include turtles, crocodiles, snakes, frogs, birds and mammals. Most of the fossil mammals appear to be marsupials, none of which seem clearly related to any other known marsupials. A fossil bat is present, which is stratigraphically the oldest bat known. The most significant mammal fossil found in this deposit is a single tooth that is believed to be from a condylarth, an extinct group of placental mammals. Except for bats and rodents, this is the first fossil of a terrestrial fossil placental mammal to be discovered in Australia. Rodents have not been found in layers below the Pliocene. This adds a new twist to the question as to why Australia has so many marsupials, but no members of such widespread placental groups as hoofed mammals, elephants, carnivores, or shrews.

Pascual R, Archer M, Jaureguizar EO, Prado JL, Godthelp H, Hand SJ. 1992. First discovery of monotremes in South America. *Nature* 356:704-706.

Summary. A fossil tooth discovered in southern Argentina has been identified as the tooth of an extinct platypus-like mammal. The platypus and the echidna are the only members of a group of egg-laying mammals

known as monotremes. This is the first record of any monotreme occurring outside of the Australian region. It was found in Paleocene deposits, along with fossils of crocodiles, turtles, mangrove pollen, and at least three other types of extinct mammals. This discovery adds to the evidence for faunal similarity between Australia and South America.

TAPHONOMY

Allison PA, Briggs DEG, editors. 1991. *Taphonomy: releasing the data locked in the fossil record*. Topics in Geobiology, Vol. 9. NY and London: Plenum Press.

Summary. This book consists of 11 chapters by various authors, covering many interesting aspects of taphonomy. Topics include taphonomy of organic biomolecules, nonmineralized tissues, plants, shells and vertebrates. The effects of minerals on fossil preservation are discussed with respect to pyrite, phosphates, carbonates and silica. A final chapter deals with taphonomic comparisons between deposits and taphonomic trends in the fossil record.

Comment. The book contains much useful and stimulating material, and is recommended for anyone interested in the fossil record.