NEWS AND COMMENTS

GEOLOGICAL SOCIETY OF AMERICA MEETING

Kurt P. Wise*
Bryan College
Dayton, Tennessee
and
Arthur V. Chadwick**
Southwestern Adventist University
Keene, Texas

WHAT THIS NEWS NOTE IS ABOUT

This is a brief summary of some highlights of the Geological Society of America's Annual Meeting, held November 9-18, 2000 in Reno, Nevada. The authors attended the meeting and a cumulative total of approximately 100 talks out of over 3 000 papers presented. Abstracts for these talks are published in the GSA Abstracts With Programs *32(7).*

SEDIMENTARY GEOLOGY

One of the geologic "fads" at the Geological Society of America annual meeting for 2000 was the "snowball earth" hypothesis proposed by Hoffman et al. (1998). Upper Proterozoic diamictites (conventionally interpreted as glacial tills) are widely distributed over continents and latitudes, both present and ancient. Equatorial paramagnetic indicators on multiple continents suggest the entire earth's surface was frozen at this time (thus the "snowball earth" concept). The excitement and debate over the new theory resulted in many papers, including computer modeling studies, identification of new outcrops (e.g., the Red Pine Shale by Crossey et al. [2000]), reevaluation of old sites, and debates about "cap carbonates" (carbonates found atop the diamictites in many localities).

*Kurt P. Wise, P.O. Box 7585, Dayton, TN 37321-7000 USA; (423) 775-7252; wise@bryancore.org
**Arthur V. Chadwick, Southwestern Adventist University, Keene, TX 76059 USA: (817) 556-4700-3921 x277; chadwick@swau.edu

Stanley Awramik et al. (2000), for example, argued once again for a glacial interpretation of Kingston Range's Kingston Peak Formation. Steven A. Austin et al. (1994), R. Sigler (1998), and Steven A. Austin and Kurt P. Wise (1999) had previously interpreted these deposits as submarine landslide deposits based upon strong current indicators, huge megaclasts, slumping features, and the absence of autochthonous shallow-water carbonates and glacial indicators. Awramik et al., however, claimed the presence of such glacial indicators as "abundant" "dropstones" and striated boulders as well as autochthonous carbonate. It seems that these claims need to be reexamined by Austin and Wise.

Another recurrent subject in the 2000 abstracts was the strong negative carbon-isotope excursion often found in the cap carbonates. Since sea water usually has C-isotope values only slightly negative (-4) and organic carbon is strongly fractionated (-20), the negative excursion is thought to involve a huge dump of organic carbon into the oceans (e.g., a methane "burp" as suggested by Martin J. Kennedy et al. 2000). According to Kennedy et al., the molar quantity of organic carbon necessary to produce the isotope excursion is on the order of magnitude of the amount of carbon necessary to cap the entire world with a thin carbonate. Cool (methane) seep sedimentary features are also similar to those seen in cap carbonates.

Yet another possibility might be that the initiation of the Flood (which Austin and Wise 1994; and Austin et al. 1994 tentatively place immediately below these upper Proterozoic diamictites) released huge volumes of pre-Flood organic carbon into the world's oceans. This might not only create the C-isotope excursion but possibly also force the precipitation of the so-called "cap carbonates." Perhaps the same mechanism is then also responsible for the simultaneous excursions in sulfur isotopes (Hurtgen et al. 2000) and oxygen isotopes.

Chris Baldwin and colleagues (2000) presented a novel interpretation of the Bright Angel Shales in the Grand Canyon region. McKee and Resser (1945) considered the shales a deepening offshore facies of the Tapeats Sandstone. Baldwin et al. now report evidences of shallow water, and even eolean deposition, and reports strontium isotope signatures of fresh water in these beds. In spite of the radical reworking of an iconic model (shallow rather than deep, dry in place of wet, and fresh for marine), there were not challenges from the audience.

Several GSA abstracts discussed newly excavated bone beds. Each of them described the bone as lying in a coarse conglomerate with long bone orientation indicating deposition in a current. In each case, logs were present among the bones. One log acted as a current baffle during the deposition of the bed (and possibly facilitating the concentration of bones). This is true of a bone bed in the Upper Triassic Chinle Formation (Ziegler et al. 2000) and one in the Upper Cretaceous Judith River Formation (Larock et al. 2000).

Kevin Burke and Jeffrey Kraus (2000) reported on the remarkable extent of the mature Cambro-Ordovician sandstones. They estimate 15 x 10^6 km^3 of sand deposited over North Africa, Arabia, and associated sedimentary basins in South America and eastern North America. This is equivalent to covering all 50 states of the USA with one kilometer of sand! These sandstones have been carved in one place to produce the famous city of Petra, and eroded in others to produce the massive sand dunes of the Sahara Desert. This sandstone unit has the uniformity, thickness, areal extent and distant source area which Austin (1994) suggests should characterize Flood deposits. Another example of sediments with broad areal extent uncharacteristic of the present (but expected in a global Flood) was reported by Andrew Webber et al. (2000) for Cincinnnatian sediments of mid-continental North America.

PALEONTOLOGY

Among the paleontology papers at a GSA meeting are usually some which introduce new revelations of biological design ("adaptation" in conventional evolutionary terminology). At the 2000 annual meeting, Tomasz Baumiller and David Meyer reported a design which allows stalked crinoids to align themselves to maximize food intake. The crinoids studied are found above wave base in the Great Barrier Reef. They need to continually and rapidly (in seconds) realign to respond to oscillating currents. Baumiller and Meyer found that the pinnules passively swivel due to loose, flexible ligaments aligned perpendicular to the axis and yet remain vertical in the current due to the shape of inter-element articulation and rigid spines aligned parallel to the pinnule axis.

It is usual among GSA's paleontology papers to report on remarkable examples of fossil preservation. As an example, two papers by Arthur Chadwick and Leonard Brand and students (Carvajal et al. 2000; Esperante-Caamano et al. 2000), following up on last year's initial report (Esperante-Caamano et al. 1999), described hundreds of whales preserved in a Peruvian diatomite. The lack of bioturbation and scavenging, and the remarkable preservation suggests a taphonomy quite unlike that experienced by modern whales. This suggests these Miocene/Pliocene sediments were deposited under conditions of rapid deposition not found in the present. Stefan Bengston (2000) reports on some remarkably well-preserved, phosphatized Upper Neoproterozoic and Lower Cambrian embryos which even seem to show cleavage patterns (see also Xiao and Knoll 2000)! Such embryos argue for the reality of the Cambrian explosion (preservation is sufficient to pick up soft-bodied forms that may have been there) and provide exciting specimens to paleontologists working out the origin of the animal phyla.

The current hot topic in evolutionary theory is "Evo-Devo" (pronounced EE-voh DEE-voh). The failure of megaevolutionary theory to explain the apparently rapid origin and subsequent stasis of animal phyla (the "Cambrian Explosion") has forced theorists to seek new mechanisms of organismal change. Developmental biology has been appealed to for evidence and theory (thus the new journal Evolution & Development and the same-named field, abbreviated "Evo-Devo"). There was an entire Evo-Devo session at the GSA with 14 papers, including one by Stephen Jay Gould, the abstract of which did not appear in the published Program. This special session, including four invited papers, was an attempt to synthesize developmental biology and paleobiology.

One of the invited papers was a review by Rudy Raff (2000). He reminded the audience that Ernst Haeckel's claim (e.g., see Pennisi 1997) that all animals develop through similar first stages is contradicted by the observation that extremely divergent steps occur *prior to* similar steps. He calls this a "developmental hourglass." He also reminded us of the extreme robustness of development (e.g., genome elements from a fly placed in a developing echinoid results in the animal initially developing as if it were heading for a fly/echinoid chimera, but ultimately adjusting and becoming a perfectly good echinoid). This suggests that development is designed to survive substantial perturbations in early growth. It also suggests that mutation is going to have a very hard time modifying organisms according to the "needs" of evolutionary theory.

Raff also reviewed a couple examples of echinoderm species (e.g., two similar species of the starfish genus *Patriella*) which have adult similarity, and yet have radically different early developments. This is rather difficult to explain in conventional evolutionary theory. Raff also claimed that multiple times among the echinoderms, identical larval forms have convergently evolved. The rapid origin of alternative developmental pathways indicated by these latter two examples may be better explained by Todd Wood's AGEing (altruistic genetic elements) hypothesis (Wood, in review a).

Eric Davidson's (2000) invited Evo-Devo paper briefly reviewed regulatory genes and their theoretical impact upon evolution. Davidson argues that the differences among animal phyla are largely found in the regulatory gene network — both during development and in the adults. Davidson describes these regulatory networks as "hard-wired" into the organism's genome. He claimed to deliberately use an analogy from humanly designed electronics systems because of the mindboggling complexity and "if-then-else" statement-type logic of the system. Davidson focused on outlining the incredible complexity of what he calls the "Type I Embryonic Process" which results in the production of larval forms in many bilateria.

A recently suggested and popular construct in evolutionary theory for the origin of the animal phyla is the development of "set aside cells" in larval forms as a place to evolve adult animal complexity while the larval form supports both itself and these new cells. It is difficult to explain how such complexity is generated by selection in such cells, and it is difficult to explain why natural selection would not select against the organism which possessed these energy-sapping (i.e., parasitic) cells.

Davidson alludes to yet another problem with this hypothesis in that the level of complexity in the regulatory system of these set-aside cells is literally orders of magnitude greater than that of the "Type I Embryonic Process" which produces the larvae. Note also that all this must occur before the Cambrian Explosion. Davidson repeatedly stressed the fact that "There is no simple bilaterian."

Early evolutionary development of complexity was a repeated theme in the Evo-Devo talks. Colin Sumrall (2000) argued that the 2-1-2 ambulacral (referring to rows of tube feet) symmetry (i.e., in some sense the most complex ambulacral symmetry) was the first echinoderm symmetry and all other "simpler" symmetries found in the fossil record and the present are developmental modifications (simplifications) of that more complex theme. Gould shared his conviction that the earliest bilateria must have had the full complex of *hox* genes, and any deviation from this has been more or less degeneration.

Abundant homoplasy (evolutionary parallelisms and reversals), with its attendant evolutionary consequences of convergent, parallel, and mosaic evolution was yet another theme which resurfaced repeatedly in the Evo-Devo talks at GSA. Although Sumrall's hypothesis seems to make some sense of the echinoderm disparity, it also requires the repeated, independent (convergent) evolution of the various reductions of that symmetry. Here then is an example of a hypothesis which suggests a phylogeny in a group which has been hitherto a phylogenetic nightmare, but which now requires a mindboggling amount of convergent evolution (i.e., the kind of ubiquitous homoplasy predicted by Wise's (1998) mosaic network hypothesis). Other examples of homoplasy included Raff's (2000) reminder that echinoderm larval forms evolved multiple times among the echinoderms.

Yet another repeated theme in the Evo-Devo talks was developmental bridging of fossil record gaps. Megaevolutionists believe that many transitions between major animal groups might have occurred in larval or early adult development. If so, then true morphological intermediates might have only been realized in larval forms. This, in turn, would explain the lack of (adult) stratomorphic intermediates (interpreted as "transitional forms" by evolutionists) in the fossil record. The divergence of developmental pathways from a common ancestor in echinoderms (Sumrall 2000) is an example. The absence of interclass and inter-order (adult) echinoderm stratomorphic intermediates could be argued to be due to transitions occurring in early developmental forms which are expressed in adults as abrupt and large changes. On the other hand the multiple origin of echinoderm larval forms in echinoderm genera (mentioned by Raff) and the multiple origin of developmental pathways in echinoderm higher groups (mentioned by Sumrall) seems to make this hypothesis highly unlikely.

Robert Carroll (2000) provided another more dramatic example by showing the strong similarities between several fossil larval forms of the extinct labyrinthodont amphibians (known as branchiosaurs) and modern salamanders and frogs. Thus, although there are no adult stratomorphic (stratigraphic and morphological) intermediates between labyrinthodonts and modern salamanders, larval labyrinthodonts (branchiosaurs) function in that capacity. However, mosaic combinations of salamander and frog morphologies among the branchiosaurs make the actual identification of stratomorphic intermediates difficult. If one assumes this scenario to be true, there are repeated convergences of the direction of developmental ossification. Such convergences seem to render the process improbable.

Yet another example was provided by Graham Budd and Joakim Eriksson (2000). Lower Paleozoic arthropods have anterior mouthparts rather than ventral mouthparts as in modern arthropods and onychophorans. Yet, onychophorans begin development with anterior facing tissue which develops into mouthparts. This suggests that the common ancestor had anterior mouthparts. This hypothesis is attractive because several worm groups have anterior mouthparts and so can function as an evolutionary ancestor. On the other hand, none of these groups have the segmentation of the Onychophora and Arthropoda, suggesting that segmentation and probably jointed appendages are convergent characters.

CLIMATOLOGY

Andrea Bair (2000) documented an increase in hypsodonty (high-crowned teeth) and diversity among fossil lagomorphs (e.g., rabbits) in the North American Miocene sediments. So, at about the same time and on the same continent that horses (see MacFadden 1992) and camels and other mammalian herbivores are (convergently) increasing in hypsodonty and diversity, rabbits and pikas are doing the same. In fact, Bair claims hypsodonty arose 5 different times in the pikas alone! Austin et al. (1994) suggested that the selection pressure for hypsodonty is a consequence of the post-Flood spread of grasses at the expense of broad-leafed plants during the cooling and drying period on the post-Flood earth.

As the climate of the post-Flood earth converged on a modern climatic regime, hot dry regions developed in the earth's low latitudes. The likely drop in partial pressure of carbon dioxide through the Flood (Austin et al. 1994) combined with the dry heat stress in low latitudes is likely to have favored the spread of grasses with photosynthetic pathways adapted for tropical (C_4) and desert (CAM) environments. This in turn is likely to have encouraged the proliferation of such grasses at the expense of broad-leafed plants. In the Paleontological Short Course held on the Sunday preceding the GSA meeting, Thure Cerling and J.R. Ehleringer (2000) reported that ungulate teeth and fossil soils first pick up carbon-isotopic evidence of C_4 photosynthesis in Miocene sediments. The oldest known fossil C_4 plant is also found in Miocene sediments. It is also in Miocene sediments that a substantial increase in hypsodonty is found in a variety of herbivores. It may be in the dry post-Flood times (during the brief period of deposition of Miocene sediments) that C_4 and CAM photosynthesis arose and spread among the plants. Such alternate photosynthetic pathways are now found in

15 different dicot families and 3 monocot families, including about 5000 grass species (Cerling and Ehleringer 2000; see also Wood [in review b] for more discussion). Such widespread and rapid origin of complexity is better explained by Wood's (in review a) theory of altruistic genetic elements (AGEing) than conventional evolutionary theory. AGEing is also likely to be the mechanism for the simultaneous explosion in diversity observed in lagomorphs (Bair 2000), horses (MacFadden 1992), and other herbivorous animals.

ARCHAEOLOGY

Robert Schoch and John West (2000) gave an update of their controversial research on the Egyptian Sphinx. Based on early Old Kingdom repairs on the Sphinx and early Old Kingdom quarrying that diverted surface water from eroding the Sphinx, the Sphinx is given a pre-dynastic age (Schoch and West 1991). The water erosion of the Sphinx and other pre-dynastic structures (including the core of the Dahshur Pyramid) suggests that pre-dynastic Egyptian climate included high precipitation rates, as expected in the post-Flood climate proposed by Michael Oard (1990) and modeled by Larry Vardiman (1994). At the same time, the pre-dynastic date for the Sphinx suggests a pre-dynastic date (and thus deeper time) for sophisticated culture in Egypt, as would be expected of culture-capable people dispersing from the Tower of Babel.

James Teller et al. (2000) proposed that Noah's Flood is to be identified with the inundation of the Persian Gulf. Dunes in United Arab Emirates are composed of carbonate grains derived from the floor of the Persian Gulf at a time when the Gulf was water-free. Following formation of these dunes, the Gulf was filled with water from the ocean — conventionally dated between 14,000 and 6,000 y.b.p. Teller et al. suggest that the sea level rise might have exceeded 1 km per year at times — so fast as to require boats to rescue people stranded on islands. Although geographically superior to recent proposed identification of Noah's Flood with the flooding of the Black Sea (Ryan and Pitman 1999), this explanation fails to explain a) the breaking up of the fountains for the great deep (Gen. 7:11); b) unusual rain (e.g., "windows of heaven" vs. rain in Gen. 8: 1); c) the great wind (Gen. 8: 1); d) the falling of the waters (e.g., Gen. 8:5); e) the covering of all the high hills under the whole heaven (Gen. 7:19); f) the death of all humans and animals on the face of the earth (e.g., Gen. 7:23); etc.

Stephen B. Mabee et al. (2000) reported early results on research into the famous Nasca Lines of Peru. They reported on two locations where ancient aquifers, habitations, and cemeteries are associated with fresh water springs, which are in turn located along earthquake faults. In each case, nearby Nasca Lines in the form of triangles actually point out the fault trace as it extends across the desert towards the next pass and associated water sources. The researchers are planning to test the hypothesis that the Nasca Lines were constructed so that these people could find water in the desert of Peru. This explanation is not only reasonable (vs., e.g., an alien origin a la von Däniken [1971]) but also suggests that the ancient Peruvians might have had some geologic acumen, capable of creating hydrology and fault maps. This is consistent with the biblical inference that humans have been intelligent and capable of high culture from their origin.

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