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OTHER MEDIA REVIEW

# Paleontology and Evolution in the News

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Three months have elapsed since my previous contribution and, as usual, the number of publications related to paleontology and evolution exceeds the space allowed for this column. How to choose which contribution to include here? Often, press releases are issued in connection with the publication of articles, and those that have some compelling aspect enjoy attention from various media outlets. In general, it turns out that those chosen would also be of interest for discussions in classrooms. I realize that there are many outstanding contributions not accompanied by press releases, but there are many more covered than can be described here. News releases of general interest in media outlets often may interest students too. In choosing which of the news-making articles claim my attention, I'm apt to choose those that are well illustrated and can be downloaded for use during class presentations and provide additional information such as interviews with the author(s).

Occasionally, fossils are found that seem to possess preserved color patterns on their shells: notably brachiopods, snails, and clams raise considerable interest. In the online edition of *Nature* on January 27, 2010 (http://www.nature.com) Matt Kaplan reports on "Fossil feather reveals dinosaurs true colors. Pigment-storage sacs found in fossils give hints about hue." He reports that a team of paleontologists led by Michael Benton of the University of Bristol, UK, and Zhongle Zhou of the Institute of Paleoanthropology in Beijing, have discovered ancient color-producing sacs in fossilized feathers from the Jehol site in northeastern China that are more than 100 million years old. The article indicates that up to now these pigment-packed organelles, called melanosomes, have only been found in fossilized bird feathers. In the new discovery, melanosomes were found in small theropod dinosaurs that "ran around low to the ground with tiny feathers or bristles distributed across their bodies." The team found two types of melanosomes buried within the structures of the fossil feathers: sausage-shaped organelles called eumelanosomes that are seen today in the black stripes of zebras and the black masks of cardinal birds, and spherical organelles called phaeomelanosomes which make up and store the pigment that creates the rusty reds of red-tailed hawks and red human hair. Other colors such as yellows and purples were not found because the authors suggest that those pigments degrade and do not leave a trace in the fossils. One of the theropod dinosaurs, *Sinosauropteryx*, reveals that it had light- and dark-feathered stripes along the length of its tail that were phaeomelanosomes indicating that they were russet orange in color. One would expect that an article describing colors of dinosaurs would create considerable interest. In fact, within a day and a half of the press release, there were 238 news stories. One of them occurred in *U.S. News and World Report* (http://www.usnews.com). *The New York Times* story by Carl Zimmer on January 28, 2010 (http://www.nytimes.com) "Study offers an insight into dinosaur colors" begins with a slightly different description of the discovery: "What color were dinosaurs? Well at least one of them had a feathered mohawk tail in a subdued palette of chestnut and white stripes."

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And also in *The New York Times*, a recurring column, "Remarkable Creatures," occurs occasionally in the Tuesday *Science* section (http://www.nytimes.com) by Sean B. Carroll. The subject of the column on March 22, 2010 is "For extinct monsters of the deep, a little respect." The title doesn't really give a clue to what these monsters were, but the introductory paragraph of the article may, and reads as follows: "Here is a quick paleontology quiz. What group of animals included large, air-breathing predators up to 50 feet long that bore live young, dominated their world for more than 100 million years and were ultimately exterminated by an asteroid 65 million years ago. Easy, right? Did you say dinosaurs? Sorry, wrong answer." He reveals that the correct answer is marine reptiles, mosasaurs, plesiosaurs and pliosaurs, animals that became extinct with the dinosaurs at the end of the Cretaceous Period. The clue to the correct answer to his question is "bore live young." Dinosaurs were terrestrial and laid eggs. "Marine reptiles were fully aquatic and bore live young. Just like baby whales, dolphins and manatees the young of these marine reptiles emerged tail-first, a necessary adaptation to prevent air-breathing young from drowning. Knowledge of the live birth method of these animals comes from the numerous specimens which have been preserved in the act of giving birth. Sean B. Carroll is the author of two books, *Endless Forms Most Beautiful* (2005) and *The Making of the Fittest* (2007), both published by W.W. Norton, that were the basis for the December 29, 2009 two-hour Nova special on PBS, "What Darwin Never Knew," which is still available on DVD (http://www.pbs.org), exploring how evolution science reveals the workings of evolution at the most fundamental level. He is the winner of the 2010 Stephen Jay Gould Prize, awarded annually by the Society for the Study of Evolution. His latest book is *Remarkable Creatures* (2009), published by Houghton Mifflin Harcourt.

It seems as if the discoveries of and reporting about dinosaurs remain the number one paleontological news maker, so here are a few selections.

Jurassic Park, the first theme park with a Museum of Paleontology in Latin America, will open in the municipal park of La Victoria in the province of Chicalayo in Peru, reports *Andina* (http://www.andina.com/pe/Ingles/) on March 23, 2010. The 40,000 square meter project will receive support from foreign institutions in Germany (Praehistorica Institut de Hanau) and the United States (Wyoming Dinosaur Center) and training, as well as the donation of fossils. The park is designed to show visitors the evolution of the earth within an integrated environment that combines ecology, types of dinosaurs, and games for students.

Brian Maffly writes in *The Salt Lake Tribune* (http://www.sltrib.com) on March 24, 2010 that "Utah's Navaho sandstone yields rare dinosaur find." To set the scene of the discovery, Mr. Maffly describes the Jurassic Navajo sandstone as a "signature geological formation of the Colorado Plateau containing many natural features from dramatic stone arches to ancient cliff dwellings." He also indicates that the 500-foot thick sandstone, actually ancient fossil sand dunes, deposited during the early Jurassic Period, contributed little to the state's rich record of dinosaur paleontology. Up to 2005, that is. "A near-complete specimen recovered in 2005 from Comb Ridge near Bluff has proven to be a 200-hundred pound precursor to... sauropods, according to research published" in *PloS One*, vol. 5, issue 3, pp 1-17, (http://www.plosone.org/article/info:doi/10.1371/journal.pone.0009789) by (at the time) University of Utah Paleontologists Joseph J. W. Sertich and Mark A. Loewen. The specimen, a 185 million-year old plant-eating dinosaur that stood only four feet at the shoulders, was found protruding from the base of a 200-foot face near the Anasazi cliff ruins known as Eagle's Nest. After the discovery, scientists carefully removed the bones from their sandstone tomb only to discover that its head and tail were missing, probably eroded long ago. The skeleton was located at the base of the sandstone just above the darker Kayenta formation, sediments that were deposited in a much wetter environment. At the time, the base of the Navajo sandstone was still in the transition zone that would eventually become a Sahara-like desert, with towering sand dunes accounting for the rarity of fossils in the formation. The animal probably was buried by a migrating dune after it died. Excellent illustrations that can be used for class lessons accompany the article.

Another first has occurred in Australia: the discovery of the first tyrannosaur fossil in the southern hemisphere, an animal that was nine to ten feet long, weighing 175 pounds, was reported by Randolph E. Schmid of the *Associated Press* on March 25, 2010 (http://www.newsvine.com/_news/2010/03/25/4068844-first-tyrannosaur-fossil-from-southern-hemisphere). The specimen, one bone, was actually found in 1989 along with other fossils by Museum Victoria paleontologist Thomas Rich. It was discovered in Dinosaur Cove, Victoria. Only last year, they took it to Roger Benson, University of Cambridge, to see if he could identify it. Although only a foot long, the bone has distinctive characteristics that identify it as a hip of tyrannosaurs. A team of researchers led by Roger Benson of Cambridge University said in an email message "The new discovery tells us that 110 million years ago, in the middle of their history, tyrannosaurs were everywhere. So the question is, why did they achieve giant size as apex predators in the north, but dwindle away in the south?" Although one bone was found, "It shows that 110 million years ago small tyrannosaurs like ours might have been found worldwide." This story was reported in several dozen media outlets and is based on an article in *Science Magazine* (http://www.sciencemag.org) on March 29, 2010, page 1,613. One wonders about how many previously collected specimens lying in museum storage facilities are not what they seem to be and are waiting to be restudied.

Brown University's press release of March 22, 2010 (http://news.brown.edu/pressreleases/2010/03/dinosaurs) describes the work of a team of their scientists who claim to have learned how the dinosaurs became rulers of the earth. It all happened 200 million years ago when most of the land on earth congregated as a supercontinent called Pangaea. The team led by paleobiologist Jessica Whiteside explained what led to the dinosaurs' rise at the end of the Triassic Period. Widespread volcanism and a spike in atmospheric carbon dioxide wiped out half of the plant species and extinguished early crocodile relatives (crurotarsans) that competed with the earliest dinosaurs. The researchers "constructed a climate record marking the Triassic-Jurassic boundary by combining fossil evidence of plant and animal extinctions with the carbon signature found in the wax of ancient leaves and wood found in lake sediments intermixed with basalt," which formed as a result of the volcanic activity. "The team established through the fossil record that the abrupt rise in atmospheric gases decimated crurotarsans, which had competed vigorously with the earliest dinosaurs during the Triassic. Thanks to the climatic catastrophe, those early, small dinosaurs were freed from their main competitors to become the dominant force in the animal world." The triggering event was the breakup of Pangaea, which resulted in the creation of the Atlantic Ocean basin, accompanied by massive outflows of lava covering more than 3.5 million square miles, about the size of the land area of the continental United States. This massive outpouring of lava has been named the Central Magmatic Province (CAMP), which has been estimated to have lasted 600,000 years. Why the early dinosaurs survived and the early crocodile relatives perished has not been explained. "They had the blind luck of being unwittingly adapted to get through the climate catastrophe," Jessica Whiteside said. The authors admit that there are many scientific papers suggesting the connection between carbon dioxide and CAMP but they were the first scientists to document the link between volcanism and end-Triassic mass extinction. As expected, the press release was copied by numerous media outlets, some in its entirety and others mere snippets. The original Brown press release includes an image of cliffs at Five Islands Provincial Park, Nova Scotia, showing massive lava flows of CAMP sitting atop white end-Triassic sediments, below which are red beds of an earlier Triassic formation. On the other hand, this story in *The Guardian* (http://www.guardian.co.uk/science/2010/mar/22/volcanoes-helped-dinosaurs-rule-earth) was accompanied by an image of a model of *Tyrannosaurus rex* that is on display at the Natural History Museum in London. The actual article was published online first in *Proceedings of the Natural Academy of Sciences; PNAS*; http://www.pnas.org), March 22, 2010.

A press release from Centre National de la Rechereche Scientifique (CNRS; http://www2.cnrs.fr/en/1697.htm) February 9, 2010 describes the work of an international team of researchers concerning the apparent size reduction of marine animals in the aftermath of the Permian-Triassic mass extinction event, the so-called Lilliput Event. However, large-sized gastropods (up to 7 cm) dating from only one million years after the extinction have been discovered. These specimens call into question the existence of the Lilliput effect that has been postulated to span several millions of years after the extinction. The press report emphasizes the importance of this discovery by stating that the team's researches "have drastically changed paleontologists' current thinking regarding evolutionary dynamics and the way the biosphere functions in the aftermath of a mass extinction." All geology students as well as the public are aware of the fact that extinctions have taken place, notably the dinosaurs, but also today's rapidly declining diversity, especially of the larger charismatic animals. The history of life on earth has been punctuated by numerous mass extinctions, brief periods in which the diversity of life is considerably diminished, followed by episodes of re-conquest of the fauna and flora. Fossil faunal analyses of the paleontological record over the last 540 million years have revealed about twenty mass extinctions, of greater or lesser intensity; among these, (not counting the present episode), there have been five major events. The most profound of these is the Permian-Triassic mass extinction (252.6 million years ago) which is said to have decimated more than 90% of marine species existing at the time. As a result, it is suggested that food chains were disrupted, the oxygen content of oceanic water was reduced, and competition increased for what was left, drastically disrupting the environment and causing the reduction in size of animals. It took time for animals such as gastropods and bivalves to return to sizes comparable to those that existed prior to the crisis. "This is what scientists call the 'Lilliput effect,' in reference to the travels of Gulliver who was shipwrecked on the island of the same name, inhabited by very small Lilliputians." The team of researchers spent several years studying the re-conquest of the seas following the extinction. They have now discovered large gastropod shells dating from only one million years after the extinction. Examining layers of rock from that period, they focused on fossil-bearing outcrops in Utah which contain very large specimens of gastropods, up to 7 cm, which can be termed "giants" in comparison to those generally found that are normally no larger than 1 cm. The conclusions drawn from this discovery is that it either refutes the existence of a Lilliput effect on gastropods or at the very least suggests that its importance has been overestimated. Their work is published in the journal *Geology* (vol. 38, no. 2, pp, 147-150). The lead author is Arnaud Brayard of CNRS. Here they also suggest that if the Lilliput effect is a real biological phenomenon, then the rebound of gastropod size occurred earlier than previously assumed.

"Fossils net plankton-eating giant" is the headline of a University of Oxford press release on February 19, 2010 (http://www.ox.ac.uk/media/news_stories/2010/100219.html). Giant plankton-eating fishes roamed the prehistoric seas for over 100 million years before they were wiped out in the same event that killed off the dinosaurs, new fossil evidence has shown. Matt Friedman of Oxford University's Department of Earth Sciences authored the report in *Science* (http://www.sciencemag.org). He and his team "reveal a previously unknown dynasty of giant plankton-eating bony fish that filled the seas of the Jurassic and Cretaceous periods, between 66 - 172 million years ago." Today's giant plankton feeders—such as baleen whales, basking sharks, and manta rays—include the largest living vertebrate animals, so the fact that creatures of this kind were missing from the fossil record for hundreds of millions of years was always a mystery. We used to think that the seas were free of big filter feeders during the age of dinosaurs, but "our discoveries reveal that a dynasty of giant fishes filled this ecological role in the ancient oceans for more than 100 million years." The new fossils backing up this report came from Kansas in the USA, Dorset and Kent in the UK, and Japan. It is estimated that some of the members of this filter-feeding fish group grew up to nine meters long, a similar size to modern plankton-eating giants such as the basking shark. Friedman said that one of the reasons these big fishes were overlooked or misidentified lies in their anatomy. "Over their evolutionary history, these fishes reduced the amount of bone in their skeletons, probably to save weight, with the consequence that most of their hard parts were easily scattered after death. As it turns out, the only parts you routinely find in the fossil record are their well-developed forefins." Generally, paleontologists had argued that the owner of these isolated forefins looked something like modern-day swordfish. But when a specimen was being cleaned that also contained skull bones, instead of finding a head with a long sword-like snout and jaws lined with predatory fangs, researchers found long, toothless jaws supporting a gaping mouth and long, rod-like bones that contributed to the huge gill arches needed to filter out enormous quantities of tiny plankton.

*PhysOrg* (http://www.physorg.com/news189083097.html) on March 29, 2010 asks the following: "If scientists have identified some two million species, where can you find the latest information about the tree of life that unites them all? A vastly improved database gives scientists and educators access to state-of-the-art knowledge about the evolutionary relationships among living things." TreeBASE (www.treebase.org) is a database designed to help scientists and educators store, share, and study evolutionary trees. The database allows researchers to archive and retrieve published phylogenetic trees and data from different studies. Since the first prototype was developed, researchers have contributed more than 6,500 trees from over 2,400 articles, describing the relationships among well over 60,000 terminal taxa. In addition to getting a major makeover, the database in now being hosted by the National Evolutionary Synthesis Center (NESCent) in Durham, North Carolina.

Nancy Ross-Flanigan of *The University* [of Michigan] *Record Online*, March 21, 2010 (http://ur.umich.edu/0910/Mar22_10/927-urged-on-by) wrote the press release "Urged on by urchins: How sea lilies got their get-up-and-go" based on a paper published in the *PNAS* (*Proceedings of the National Academy of Sciences*), vol. 107 (13), pp. 5893-5896 (http://www.pnas.org/search?full text=Baumiller&go.x=9&go.y=7&go=GO&submit=yes). Nature abounds with examples of evolutionary arms races. Certain marine snails, for example, evolved thick shells and spines to avoid being eaten, but crabs and fish foiled the snails by developing shell-crushing claws and jaws. Common as such interactions may be, it's often difficult to trace their origins back in evolutionary time. Now, a study by University of Michigan paleontologist Tomasz Baumiller and colleagues finds that sea urchins have been preying on marine animals known as crinoids for more than 200 million years and suggests that such interactions drove one type of crinoid—the sea lily—to develop the ability to escape by creeping along the ocean floor. The work builds on previous research on present-day sea lilies and urchins. With their long stalks and feathery arms, sea lilies look a lot like their garden variety namesakes. Perhaps because of that resemblance, scientists long had thought that sea lilies stayed rooted instead of moving around like their stalkless relatives, the feather stars. But in the 1980s, Baumiller and collaborator Charles Messing of Nova Southeastern University's Oceanographic Center in Dania Beach, Florida, observed sea lilies shedding the ends of their stalks to release themselves from their anchor points and using their feathery arms to crawl away, dragging their stalks behind them. Then, while reviewing hundreds of hours of video shot during submersible dives, the two researchers came across footage that offered an explanation for why sea lilies might get up and go. The videos showed sea urchins lurking in gardens of sea lilies, some of which appeared to be creeping away from the predators. Further studies by Baumiller, Messing, and Rich Mooi of the California

Academy of Sciences suggested that sea urchins don't simply scavenge bits of dead sea lilies that they find on the ocean floor; they bite pieces right off their prey, giving sea lilies plenty of reason to shed their stalk ends like lizards' tails and scoot away. The supplemental material in the journal includes a movie showing *Eucidaris sp*. consuming an arm of a comatulid. When those findings were announced in 2005, the researchers said the next step was to scrutinize fossil crinoids for clues to how and when sea lilies developed the ability to shed their stalk ends and move around. In the new research, that's what they, along with Forest Gahn of Brigham Young University and Polish collaborators Mariusz Salamon and Przemyslaw Gorzelak, have done. The findings suggest that the development of motility in crinoids, as well as other escape strategies such as active swimming and floating, were stimulated by their interactions with predators. The time frame is significant, too, said Baumiller, professor of geological sciences and a curator at the Museum of Paleontology. Some of the best examples of the effects of escalating interactions between predators and prey come from something called the Mesozoic Marine Revolution, a dramatic increase in the diversity of predators and their prey that started during the late Mesozoic Era, about 150 million years ago. But the new study suggests that, at least for crinoids and their predators, the arms race began even earlier. In the abstract of their paper, they suggest that following their near demise during the end-Permian extinction, crinoids underwent a major evolutionary radiation during the Middle-Late Triassic that produced distinct morphological and behavioral novelties, particularly motile taxa that contrasted strongly with the predominantly sessile Paleozoic crinoid faunas. To see and download images of these creatures search *National Geographic*, March 2010, Archives (http://blogs.nationalgeographic.com/blogs/news/chiefeditor/science/2010/03/), which include a description of their work and which partly supported their research.

A paper by researchers at George Mason University and the University of Otago in New Zealand shows a strong link between the diversity of organisms at the bottom of the food chain and the diversity of mammals at the top, reported by Tara Laskowski in March 1, 2010 *University News of George Mason University* (http://news.gmu.edu/articles/1870). Mark Uhen, a Mason geologist, says that throughout the last 30 million years, changes in the diversity of whale species living at any given time period correlate with the evolution and diversification of diatoms, which are tiny, abundant algae that live in the ocean. In the paper "Climate, critters and cetaceans: cenozoic drivers of the evolution of modern whales," which was published in the Feb. 19, 2010 issue of *Science* (http://www.sciencemag.org), Uhen and co-author Felix G. Mark show that the more kinds of diatoms living in a given time period, the more kinds of whales there are in that same period. Looking at thousands of published accounts of whale fossil records, the researchers assembled the records in a database (http://www.pbdb.org/cgi-bin/bridge.pl) to analyze and pinpoint the various fossils. The fossil records show a direct link between the productivity of the ocean and the variety of whale fossils. Uhen says they also found a correlation between global changes and fossil variety. "This study shows that if we look at the bottom of the food chain, it might tell you something about the top," says Uhen. "Diatoms are key primary producers in the modern ocean and thus help to form the base of the marine food chain. The fossil record clearly shows that diatoms and whales rose and fell in diversity together during the last 30 million years." Uhen says this is the first time that such a correlation has been shown. Though scientists in the past have tried to answer the question of how the modern diversity of whale and dolphins arose, this question has been difficult to answer. The fossil record might not truly reflect evolutionary history, says Uhen. "Is it possible that the diversity of fossils we find through geological time might really just reflect the amount of preserved sedimentary rock paleontologists can search–the more rock there is, the more fossils we find? This comprehensive study has shown that the diversity of these fossils is in fact not driven by the sedimentary rock record." The researchers hope these findings will encourage other specialists to look at other animals with a similar narrow ecology to see if this link translates.

Readers of this column probably recognize that there have not been many articles cited that deal with plants. Below are a few that have appeared recently about the rise of flowering plants. Many previous articles indicate that angiosperms made their sudden appearance about 80-90 million years ago. Prior to that time there are no signs of them—no pollen, no leaves. So today, they are a mystery—as Darwin wrote, an "abominable mystery." As far as the poor earliest record shows, early angiosperms had a mix of features that are found in modern groups. But in modern groups, these characteristics arranged themselves into different lineages. The fossil record of angiosperms "exploded" in the Albian (mid-Cretaceous), giving us the great diversification we see today. It has been suggested that the reason for the lack of earlier angiosperms is that the earliest forms lived in dry, upland habitats and were therefore unlikely to be preserved as fossils. Another aspect to consider about early angiosperms is the nature of their growth form. Were these trees or shrubs, or were they herbs? Although the answer to these questions shifts back and forth, it is essentially undetermined today. For additional information see (http://www.ucap,berkeley.edu) and the results of the studies below, and note how they differ from textbooks used in high schools and colleges today. Keep in mind that the actual dates that are associated with the geologic time scale will vary depending upon when the article was published.

"Can the morphology of fossil leaves tell us how early flowering plants grew? New research confirms that early angiosperms were weedy, fast growing" is the headline of the press release from *EurekAlert!* (http://www.eurekalert.org/pub_releases/2010-03/ajob-ctm032210.php) and a few other news outlets from material provided by the *American Journal of Botany*. Even though I found this paper of great interest, the print media did not, and as a result it did not get much popular publicity, but I decided to include it anyway. "Fossils of angiosperms, or flowering plants (which are the most common plants today), first appear in the fossil record about 140 million years ago. Based on the material in which these fossils are deposited, it is thought that early angiosperms must have been weedy, fast-growing shrubs and herbs found in highly disturbed riparian stream channels and crevasses." Dana Royer from Wesleyan University, Connecticut, and colleagues wanted to see if aspects of a fossil plant's life history, such as its growth strategy, could be determined from its morphology rather than from the matrix in which it was deposited. Could this technique corroborate the idea that these ancient plants were fast-growing species? And, importantly, how common was this life history strategy for plants 100 million years ago? The results of their research are published in the March issue of the *American Journal of Botany* (http://www.amjbot.org/cgi/content/full/97/3/438). In previous research, Royer and colleagues had found that two simple measurements—petiole width and leaf area—could tell a lot about the ecophysiology of a plant. They found that the ratio of petiole width (squared) to leaf area is correlated to a leaf's dry mass per area. "Leaf mass per area is a measure of the density or thickness of leaves, and it is strongly linked to how quickly a plant turns over its nutrient resources," Royer said. "Thin, cheaply built leaves (low leaf mass per area) are typically associated with plants with fast growth rates, and plants like these are usually most competitive in highly disturbed environments such as riparian corridors because their rapid growth allows them to be more opportunistic." The authors measured the petioles and leaf areas of 93 species of living conifers and 58 species of herbaceous angiosperms and compared the resulting leaf mass per areas to those of previously published woody angiosperms. They found that these three groups could be distinguished based on their leaf mass per areas: for a given petiole width, herbaceous herbs tended to have 43-75% lower leaf mass per area than woody angiosperms, and conifers had 19-58% higher leaf mass per area than woody angiosperms. The beauty of this methodology is that leaf petiole width and leaf area are measurable in many fossil specimens. Royer stated that they then used this methodology to "estimate the leaf mass per area for some of the oldest known angiosperm leaf fossils." They measured 179 fossil specimens representing 30 species from three Albian (110-105 Ma) sites across the United States. "The majority of the fossils measured in our study have low leaf mass per area," noted Royer, supporting the idea that early angiosperms were fast-growing species similar to the flora found in riparian habitats today. If a relationship similar to that of today is assumed, then all of the fossil angiosperm species had leaf lifespans of less than 12 months. "This means the unrivaled capacity for fast growth observed today in many angiosperms was in place by no later than the Albian (110 Ma ago)." "While this doesn't tell us anything directly about the earliest angiosperms—the oldest angiosperm pollen is around 140 Ma old—the Albian marks the time when angiosperms begin to be very diverse and important ecologically," Royer concludes. "It is likely that explosive growth is one reason for the success of angiosperms." Today, angiosperms make up more than 90% of plant species.

Similarly, a press release provided by NESCent (http://www.nescent.org/news) on March 15, 2010 provided a synopsis of a paper about a molecular study that could push back angiosperm origins. Flowering plants may be considerably older than previously thought, says a new analysis of the plant family tree. Previous studies suggest that flowering plants, or angiosperms, first arose 140-190 million years ago. Now, a paper published online in the *Proceedings of the National Academy of Sciences* (http://www.pnas.org), March 15, 2010, pushes back the age of angiosperms to 215 million years ago, some 25-75 million years earlier than either the fossil record or previous molecular studies suggest. "If you just looked at the fossil record, you would say that angiosperms originated in the early Cretaceous or late Jurassic," said Michael Donoghue of Yale University. "Most molecular divergence times have shown that they might be older than that," added Yale biologist Jeremy Beaulieu. "But we actually find that they might be Triassic in origin," said Beaulieu. "No one has found a result like that before." If confirmed, the study could bolster the idea that early angiosperms promoted the rise of certain insects. Modern insects like bees and wasps rely on flowers for nectar and pollen. "The fossil record suggests that a lot of these insect groups originated before angiosperms appeared," said Stephen Smith of the National Evolutionary Synthesis Center. This study shifts the oldest angiosperms back farther in time towards the origin of groups like bees and flies, the scientists say. "If you take our dates and superimpose them on the evolutionary tree for these insect groups, all of a sudden you get a match," said Beaulieu. To trace the origins of flowering plants, the researchers used genetic comparisons of living plants and clues from fossils to reconstruct the relationships among more than 150 terrestrial plant species. Though their results contradict previous age estimates for angiosperms, they support estimates for other plant groups. "Many of the dates that we get correspond really well to the known fossil record, at least for the origin of land plants and the origin of vascular plants and seed plants," said Donoghue. "But we got a much older date for the origin of angiosperms—one that's really out of whack with the fossil record," Smith added. This disconnect between molecular and fossil estimates is not unheard of, the authors explained. "We see the same kind of discrepancy in other groups too, like mammals and birds," said Donoghue. Why the mismatch between different approaches to dating the tree of life? One possibility, the researchers explained, is that the first flowering plants weren't diverse or abundant enough to leave their mark in the fossil record. "We would expect there to be a time lag between the time of origin and when they became abundant enough to get fossilized," said Smith. "The debate would just be how long....Imagine a long fuse burning and then KABOOM! There's a big explosion. Maybe angiosperms were in that fuse state," said Donoghue. "But it's hard to imagine flowering plants would have had a big impact on the origin of major insect groups if that were the case," he added. Another possibility, the researchers allow, is that the molecular methods may be amiss. "If the angiosperms originated 215 million years ago, then why don't we find them in the fossil record for almost 80 million years?" said Beaulieu. "It could also suggest that our dates are wrong....We've done the best analysis we know how to do with the current tools and information," said Donoghue. To improve on previous studies, the researchers used a method that allows for variable rates of evolution across the plant family tree. "Rates of molecular evolution in plants seem to be correlated with changes in life history," he explained. "Older methods assume that rates of molecular evolution don't change too radically from one branch of the evolutionary tree to another. But this newer method can accommodate some fairly major rate shifts." Although researchers have come up with some savvy statistical tricks to account for rate shifts, Donoghue explained, the problem hasn't entirely disappeared. "As we develop better molecular methods, people would like it if the molecular dates reconciled with the fossil record. Then everybody would be happy," said Donoghue. "But instead the gap is getting wider," he said. "And in the end, that might actually be interesting."

An article in the *Fort Worth Star-Telegram* by Jay Board on March 23, 2010 (http://www.star-telegram.com/2010/03/23/2062429/amateur-paleontologist-makes-historic. html) describes how an amateur paleontologist, Kris Howe, on a fossil hunt near the spillway at Lake Grapevine, Texas, found four bones that turned out to be the oldest bird fossils found in North America. His reaction to the bones poking out of the ground was "Wow, that's pretty cool looking. I wish I knew what it was..." The fossilized bones are about 96 million years old and are from a previously undiscovered species of flightless, carnivorous bird that probably resembled a modern roadrunner. The fossils were identified as an enantiornithine bird from the lower Middle Cenomanian (Upper Cretaceous) and the results of the study were published in the *Journal Of Vertebrate Paleontology*, vol. 30, no 1, pp. 293-299 by Tony Fiorillo and Ron Tykoski, paleontologists at the Dallas Museum of Nature & Science. In recognition of the efforts of Kris Howe, the museum scientists named the bird species *Flexomornis howei.* The bird belongs to an extinct group of primitive birds almost all of which retained teeth and clawed hands. Other species have been found inland and in marine sediments suggesting that they were an ecologically diverse group or simply lived adjacent to the shoreline. This species bridges the gap in time and space between older enantiornithine birds found in Europe and Asia, 120-130 million years ago, and younger species from North and South America, about 65-85 million years ago. On a related note, a fossil of a Columbian mammoth was found in 1906 when the shoreline of the lake receded. "In 2005, fossilized dinosaur tracks in sandstone bedrock, first found in 1989, were rediscovered when lake levels dropped. But shortly after word of the discovery became public, someone stole two of the footprints, estimated to be 96 million years old, and damaged another print. In response, the Army Corp of Engineers filled the prints with clay, dirt and rocks so that they wouldn't be visible."