The Paleontograph

A newsletter for those interested in all aspects of Paleontology
Volume 2 Issue 3 April, 2013

From Your Editor

Welcome to our latest issue. I've been very busy at my day job as well with fossil stuff but I finally found the time to put another issue together. This month we have some great articles from Bob as well as one from my longtime friend Alan Russo. Alan is the guy I credit with showing me the way in my early days as a fossil collector. I can truly say that much of this is his fault. He is also a talented photographer as you will see from the pictures with his article.

The nice weather is slowly coming to New York. My fossil fever is coming on and I can't wait to get dirty. I'm going to try and switch it up this year and hit some spots that I have not been to in a while.

Next week is the big fossil show in New Jersey. I think that given time, this show will become one of the big shows worldwide. If any of you are going, please stop by and say hello. I'm Lost World Fossils in booth 333. I'm attaching a flyer to this email.
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The Paleontograph was created in 2012 to continue what was originally the newsletter of The New Jersey Paleontological Society. The Paleontograph publishes articles, book reviews, personal accounts, and anything else that relates to Paleontology and fossils. Feel free to submit both technical and non-technical work. We try to appeal to a wide range of people interested in fossils. Articles about localities, specific types of fossils, fossil preparation, shows or events, museum displays, field trips, websites are all welcome.

This newsletter is meant to be one by and for the readers. Issues will come out when there is enough content to fill an issue. I encourage all to submit contributions. It will be interesting, informative and fun to read. It can become whatever the readers and contributors want it to be, so it will be a work in progress. TC, January 2012

Edited by Tom Caggiano and distributed at no charge

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Evolution and Belief--A Review

Bob Sheridan February 19, 2013

By now we have seen many books, aimed at a popular audience, explaining how the facts support the idea that all life on earth evolved from a common ancestor, and how the mechanism for evolution is almost certainly natural selection. I have reviewed several for The Paleontograph. The peak time for such books was about five years ago. I could speculate that was because, during the George W. Bush administration, religious conservatism was also at a peak, and popular science writers felt they needed to fight back against a "War on Science." Or it could be a complete coincidence.

I admire how well the authors of these books present reams of very complicated evidence, from disparate fields of study, in a clear way. Some of this evidence was cited by Darwin himself 150 years ago. Some evidence is new, based on molecular biology and other fields of study Darwin never dreamed of.

Apart from presenting the facts, any given author may push a particular philosophical "frame." One particular sub-type of those books, particularly those by Richard Dawkins, argues that the Theory of Natural Selection allows one to be an intellectually-fulfilled atheist. Therefore, to take this another step, it almost requires one to become an atheist. I have some sympathy for this viewpoint, but it can be taken too far, especially if one considers it a license for the author to tell people in the target audience how foolish and irrational their beliefs are. This probably works against author's purpose of reaching the audience and perhaps changing their mind.

Another particular sub-type of those books are those that argue that:

1. Evolution is obviously "true".
2. Believing in evolution and having a belief in a personal god are not contradictory.

One of the earliest of that type was "Finding Darwin's God" by Kenneth R. Miller (1999). To me the logic is obvious. Ultimately, Science cannot address the supernatural, morality, or any other idea not subject to disproof. Also, the only type of religious thought in direct contradiction to evolution (and geology, astronomy, etc.) is Biblical literalism, which is a minority view, although a very vocal one in the United States. Five hundred years ago, thinking the sun was the center of the solar system was taken as contrary to religion, but everyone got over it eventually. We probably will do the same with evolution.

A new book in the "non-contradiction" sub-type is "Evolution and Belief" by Robert J. Asher. Asher is the Curator of Vertebrates in the Museum of Zoology, Cambridge. He also "confesses" to be a practicing Anglican, but doesn't have a belief in literal miracles. One especially good logical point he makes is the distinction between "cause" and "agency". The most vivid example from the book is this: We know that light bulbs work by electricity flowing through a filament and heating it until it emits visible light. However, this knowledge does not rule out the idea that there was a person Thomas Edison who invented such a device.

One interesting bit of history in the introduction has to do with Williams Jennings Bryan, the prosecutor at the Scopes "monkey trial." Bryan is often portrayed as a fundamentalist fool, in particular in the play (and movie) "Inherit the Wind." However, the truth is not even close to that portrayal. Scopes was teaching from a textbook "A Civic Biology," which used evolutionary theory as an argument for eugenics. Bryan, a populist and what we would now call a social liberal, but definitely not a Biblical literalist, opposed teaching evolution in school because it might lead, by encouraging eugenic thought, to massive social inequality. This makes him a much more sympathetic character.

The meat of "Evolution and Belief" covers the type of evidence for common ancestry and against "design" (in the sense that each species is a separate creation specific to its environment). Nature is full of such examples and no one book can cover them all. I will mention only two sections that struck me as different.

As an example of the anatomy of animals more closely reflecting their ancestry than lifestyle, Asher cites the skulls of the galago (Africa), the tarsier (Asia), and the squirrel monkey (South America). All hunt insects by night and have enormous eyes. The galago has a tooth comb (elongated lower incisors) and open eye sockets consistent with being related to lemurs. The galago also has a reflective layer behind the retina, the tapetum. The tarsier is a more advanced primate, near the ancestry of monkeys and apes, that lacks a tapetum and has short incisors and a closed eye socket. The squirrel monkey is a fairly advanced primate and has features associated with them: large brain, etc.

Cont'd

Belief Cont'd

There is a short chapter on whales. The major point is not there are many fossil whales with a mixture of primitive and advanced characters (although there are and these are discussed), but that baleen whales sprout teeth as embryos, and still carry genes for enamel production, although they have no teeth as adults. This brings up the whole field of pseudo genes, which we know about only because so many genomes have been sequenced. Pseudogenes are DNA segments that resemble known genes but are "broken" or not expressed. Their presence means organisms are carrying things that have no functional use. (This is the molecular biology equivalent of Darwin's example of "vestigial organs".) Clearly this is contrary to the idea of conscious design. In the words of the author "You don't find a mainsail stuck inside a stealth bomber somewhere because such a mechanism has no relevance to the end product in the mind of a human engineer".

This book has a number of useful tables. One is a list a hundreds of fossil and living animals that show a mosaic of primitive and advanced features. This is presumably to show, once and for all, that the creationist claim that there are no "intermediate forms" is totally false. In this it summarizes the content of books like "Evolution. What the Fossils Say and Why It Matters" (2007). There is also a list of several dozen examples, published in one year, where "novel information" appears in the genome (hermaphrodism in nematodes, color vision in certain mammals, etc.). This to counteract the persistent creationist idea that natural selection cannot create anything.

So, a thumbs up for this book, which is as least as good as all the others in this genre.

Now a final comment on this trend in scientific literature. Why do we need book after book on evolution with a theological "hook"? Whatever the book, I consistently find the theological bits unconvincing on either side of the aisle: We cannot rule out an ultimate Designer of Life, but there is no objective evidence for one either. Or even if there is a Designer, there is no unambiguous way to know whether such an entity cares about individual human beings. It is purely an issue of personal belief on the part of the author. This is not science, so it should not be included. We don't see the author discussing religious view in books about astronomy, geology, or quantum mechanics, which are equally contradictory to Biblical literalism.

Ultimately, it has to be a matter of target audience. Science writers and publishers believe that there is a segment of the population that accepts all type of scientific results, but is stuck on evolution specifically because it would require them to give up their religious world view. If it was suggested that they would not have to give up that world view, they might go along if the evidence for evolution was presented in a certain way. I hope this true and more people can be persuaded.

Sources:

Asher, R.L.
"Evolution and Belief. Confessions of a Religious Paleontologist"
Cambridge University Press, New York, 2012,
300 pages, $25 (hardcover).

Miller, K.R.
"Finding Darwin's God. A Scientist's Search for Common Ground Between God and Evolution."
Cliff Street Books, 1999, 338 pages $25 (hardcover)

Prothero, D.R.
"Evolution. What the Fossils Say and Why It Matters."
Columbia University Press, New York, 2007.
382 pages $30 (hardcover)

Worm Eggs in Moa Coprolites

Bob Sheridan March 4, 2013

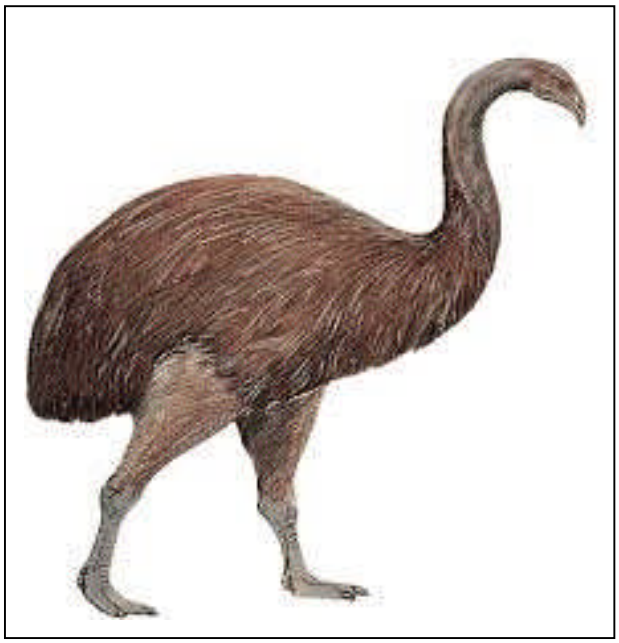
Just a few weeks ago I reviewed a paper about tapeworm eggs in Permian shark coprolites. This week I came across the paper by Wood et al. (2013), which describes various worm eggs in moa coprolites. Moas are large flightless birds that lived in New Zealand, but went extinct ~1300 AD, shortly after the arrival of humans in New Zealand. There were several genera of moa (for example, Dinornis, Anomalopteryx, Megalapteryx, Pachyornis), which varied in size from 2 to 12 ft. tall. The fact that their extinction is so recent and their fossils so well preserved makes the moa an attractive case for testing extinction theories.

Cont'd

Moas and Worms Cont'd

These authors examined 84 coprolites from various locations around the southern island of New Zealand. Given that DNA is easily extracted from moa bones and coprolites, one can match individual coprolites to a species of moa. Samples of the coprolites were boiled in KOH for ten minutes to release inclusions which were examined by light microscopy. One can see at least three types of eggs in the coprolites. Type 1 is oval to barrel-shaped and about 60 micrometers long. This is seen in four species of moa. Type 2 is also oval, but larger (70 micrometers) with a spiny outer covering. This is seen in three species of moa. Type 3 is elongated (60 micrometers)with polar pores. This is seen in two species of moa. All eggs resemble those of some species of nematode worm. The authors feel that the lowland specimens of moa (in particular those from the Dart River Valley) include more and more variety of eggs in their coprolites.

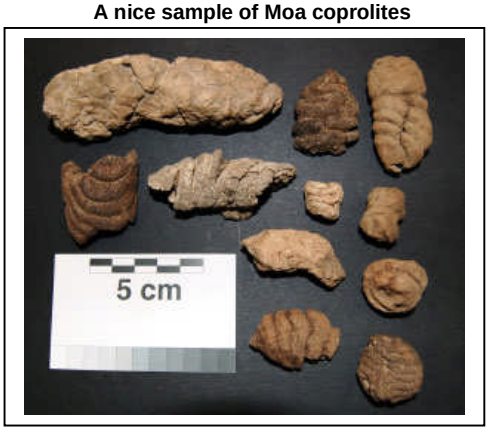
The Moa



The coprolites can be analyzed for parasite DNA. The method for doing so is PCR, which starts out with a "primer", a short stretch of sequence similar to the sequence one is looking for. Thus one can amplify only one type of DNA and ignore the rest. The sequence for the primer is 18S (coding the ribosome) DNA from modern parasires. There are six DNA sequences which were isolated.
Some are similar to those of modern parasitic protozoa like Calyptospora and Cryptosporidium.

Some are similar to modern parasitic nematodes like Trichostrongylus and Heterakis. One is similar to modern trematodes (flukes) like Notocotylus. These types of parasites infect extant ratites like the ostrich, as well as other birds from New Zealand. That the sequences from the coprolites is not identical to known modern species may imply that the moas had their own particular parasitic species, or it may mean that the DNA from the coprolites has degraded with time.

A nice sample of Moa coprolites



The study of parasites in moas and their relationship to parasites from ratites on other continents, or their relationship to parasites of local New Zealand birds can potentially address two questions. The first question is the origin of ratites. Since ratites are flightless, they obviously cannot easily travel to an island like New Zealand. One school of thought postulates a "vicariant" origin where flightless ratites originated in Gondwana (in the Cretaceous?) and continued to inhabit individual land masses like New Zealand when Gondwana broke up. The alternate idea is "dispersal" where ratite ancestors, still able to fly, originated on one continent and spread to the others. After they settled down in new continents, they independently became flightless. The second question is whether parasites become extinct when their hosts become extinct. The authors comment on these issues. However, the evidence is not good enough to resolve them.

Sources:

Wood, J.R.; Wilmshurst, J. M.; Rawlence, N. J., Bonner, K.I., Worthy, T.H.;
Kinsella, J.M.; Cooper, A.
"A Megafauna's Microfauna: Gastrointestinal Parasites of New Zealand's Extinct Moa (Aves: Dinornithiformes)"
PLoS ONE 2013, 8, e57315

The Jurassic Insect Strashila

Bob Sheridan March 9, 2013

One problematic class of fossil insects is the strashilids, which have been found in the Jurassic of China and Russia. They are problematical because, until recently, they could not be placed in known insect orders. A new paper by Huang et al. describes very complete strashilids from the Daohugou beds of China (165 Myr.--Middle Jurassic). Ten new specimens of what the authors are calling *Strashila daohugouensis* are preserved in fine grained limestone. There appear to be two types, nine of one and 2 of another. The two types undoubtedly represent male and female because there is at least one mating pair (without wings).

Both male and female have a small oval head with large compound eyes, short antennae and a long segmented abdomen. They also have large membranous wings. The mouthparts are very small, indicating that perhaps these organisms were not supposed to eat as adults, but more on that later.

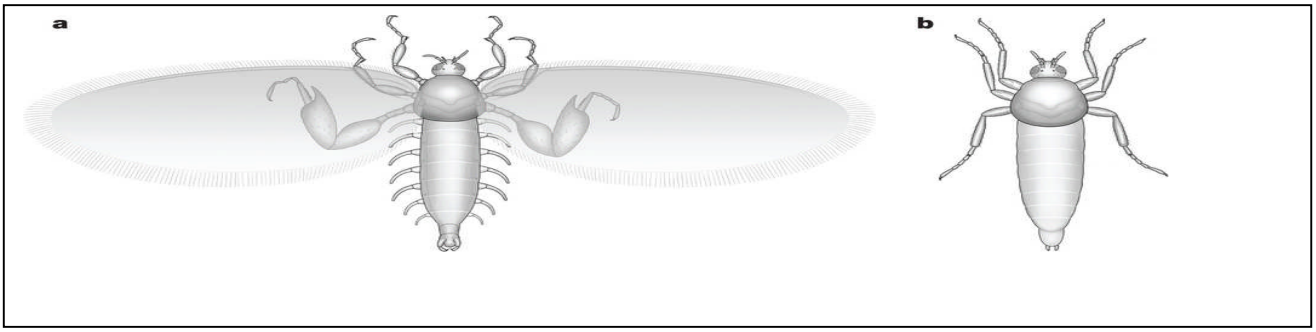
Strashila daohugouensis

The male differs in two major ways. First, the third pair of legs shows a great widening of the metafemur and metatibia, and the metatibia has a pincer at the distal end. Presumably these are for attracting a mate as well as grasping the female. Also, the male has eight pairs of feathery spines on its abdomen, most likely gills. Insect genitals are fairly characteristic, and those of the male resemble those of nematoceran flies. Overall, there are enough unambiguous characteristics that one can assign strashilids to the Diptera, the class of insects that includes flies and mosquitoes.
The authors relate the lifestyle of Strashila to that of a class of modern flies called nyphomyiids. These spend most of their life as aquatic slender caterpillar-like larvae. However, they are winged as adults and mate in the air or on land shortly after emerging from a pupa. The wings fall off after mating. The authors imagine Strashila as losing their wings and mating in water very soon after becoming adults, which is consistent with wingless mating pairs being found in lake sediment and with neither male or female having effective mouthparts. They consider the "gills" on the male to be a juvenile characteristic retained from the larval stage. (However it must be noted that most paedomorphic characters among modern animals occur equally in both sexes.)

The fact that strahilids have wings, and have a probable aquatic lifestyle, makes an earlier idea that they are some kind of ectoparasite seems unlikely.
Sources:

Huang, D.; Nel, A.; Cai, C.; Lin, Q.; Engel, M.S. "Amphibious flies and paedomorphism in the Jurassic Period."
Nature 2013, 495, 94-97.

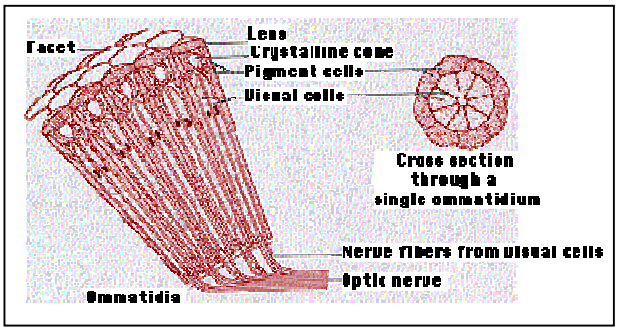
A: Male B: Female with wings shed



Microstructure in Trilobite Eyes

Bob Sheridan March 17, 2013

The first thing we need is a discussion of the arthropod eye. Most arthropods have compound eyes that are composed of many (thousands to tens of thousands) of units called ommatidia packed tightly together. Each ommatidium is a tapered cylindrical structure several hundred micrometers long and about one-tenth as wide, with a hexagonal cross-section. At the top of the ommatidium is a lens with a rounded top and a conical bottom. Most of the length of the ommatidium is filled with 6-9 long light-sensitive cells packed tightly together. The collective name for these cells is the rhabdom. Each cell in the rhabdom has an axon at the bottom that connects to nerves that lead to the brain. An ommatidium may be of the "appositional" or "superposition" type. In the appositional type, which is the most common, the walls of the ommatidium are covered with pigmented cells, so no light enters except through the lens.



Your Basic Compound Eye

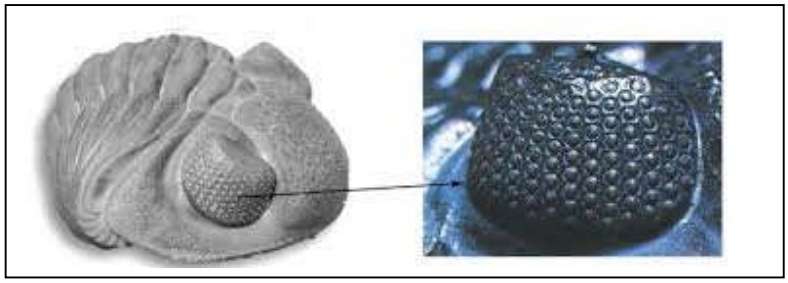
It is much harder to discern the structure of arthropod eyes in fossils because almost always the only the chitinous surface is preserved. The internal parts do not fossilize. A recent paper by Schoenemann and Clarkson (2013) is among the first to show that this is not always true. They used high resolution CT scanning using synchotron radiation to examine cross-sections of the eyes of a number of trilobite fossils from three genera: Geesops (Middle Devonian), Barrandeops (Lower Devonian), Chotecops (Lower Devonian). For Geesops, one sees in a cross-section through the upper third of the compound eye, a series of "rosettes" about 500 micrometers in diameter with a star-shaped inner core surrounded by six or so wedge-like shapes. Barrandeops is similar except that the rosettes are about 200 micrometers in diameter, and there are up to twelve wedge-like shapes around the central core. The one specimen of Chotecops has the outermost surface of the eye broken so that one may see the shapes below the surface.

Generally speaking, the reconstructed microstructure of the trilobite eye based on the scans closely resembles that of modern appositional ommatidia except that the cells are larger than in most insects and crustaceans. In size and in having a central cell with a star-shaped cross-section they most resemble the ommatidia of the horseshoe crab Limulus, in particular. This is not surprising given that both are considered primitive chelicerates. So the trilobite eye may represent the most basic version of the arthropod eye.

Sources:

Schoenemann, B.; Clarkson, E.N.K.
"Discovery of some 400 million year-old sensory structures in the compound eyes of trilobites."
Scientific Reports 2013, 3, 1429

A Gallery of Trilobite Eyes



Florissant Fossils

Alan Russo

Approximately 35 million years ago, the Florissant area of Colorado was a lush Redwood forest full of abundant plant and animal life. It was also a time of active volcanism in that part of the world. About 34 million years ago a large eruption and a mudslide blocked off an area of the valley and created a lake approximately 12 miles long. The area around the lake became a super lush forest surrounded by Giant Redwoods, other conifers, hardwood trees and all the plant and animal life you would expect to find around a Lake/Forest Ecosystem. Over time, eruptions slowly buried the area in layer after layer of volcanic ash, trapping and eventually fossilizing countless plant and animal species. Today Florissant has some of the best preserved fossils of soft bodied plants and animals in the world.

My first trip to Florissant Fossil Beds occurred during a vacation to Colorado in the 1980's. Whenever I travel I seek out places to collect and explore fossils, so this trip was no exception. I didn't have high hopes for collecting in this area as it is a National Park, but I thought it would be cool to check out anyway.

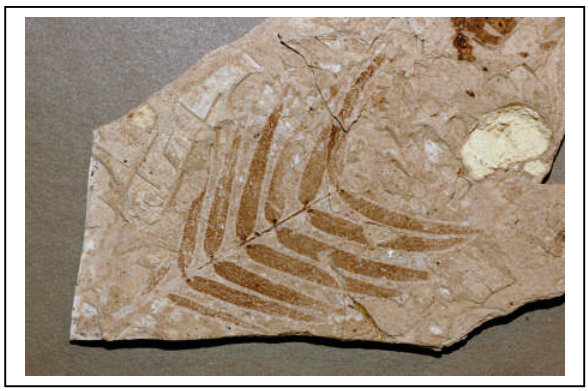
On the road to the park, I saw a small hand written sign on the side of the road pointing up a long driveway reading something like 'Dig Fossils Here'. I instantly logged this into my memory banks and continued to the park. Back then, the park was quite primitive, the "office" was a small trailer and the trails in need of repair. I hurried through the park because it started raining and the thought of collecting some of those cool fossils was in the back of my mind. I found my way to the driveway and followed it to a small house; I knocked on the door and no answer. I was a little bummed. As I was about to leave, a woman came around the side of the house, and I inquired about the digging. Turns out she had a small outcropping of the fossil layer in her backyard and allowed people to dig for a small fee. She explained though, "you can't see the fossils when the rock is wet, so it would be better to come back when it wasn't raining". I explained that I would like to try as I was on my way back home from vacation and I would not be able to come back. When I went inside to pay, she had a small collection of fossils she and her family had collected over the years and I got excited about what I might find. I went out back and began to split some rock. It started raining harder and she was right, I couldn't see anything in the rock. I was a bit disappointed. Than it occurred to me I should just collect a bunch of rock and split it at home when it dried out! So, I proceeded to overload my van with more rocks than I really should have.

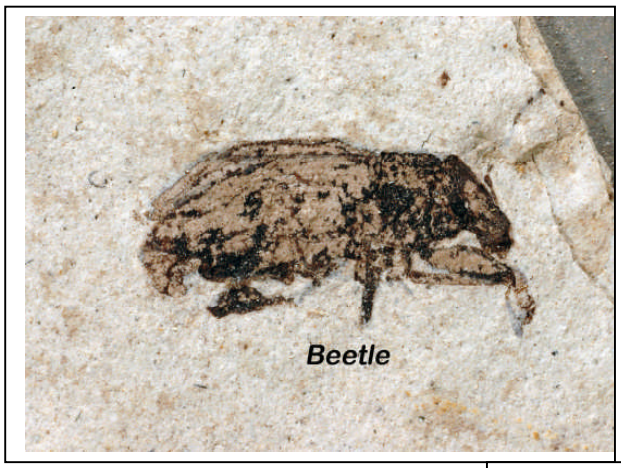
Fast forward to the early 2000's (I'm too lazy to go look up the exact date), another vacation and collecting trip brings me to Colorado and the Florissant area. I wondered if the lady and the sign would still be there. It was! (A different sign really) I was glad to see she was still allowing collecting on her property. I continued to the park and found it had been drastically updated. A new visitor's center with a great fossil collection, new trails and lots of signage to guide you around. The day was beautiful and dry and I couldn't wait to go collecting.

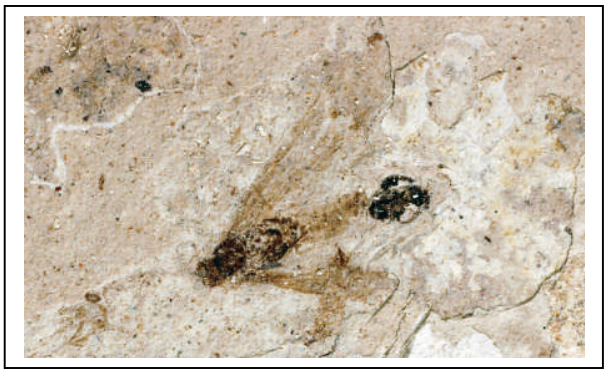
The operation at the collecting site had been updated and had been taken over by her daughter. Also, they were a bit famous now because someone found a fossilized bird on their property, so this was an official business now. This time there were rules, you couldn't spend your time loading up your car with as much rock as you can carry, darn! Really it was ok, it was a beautiful day to just sit, relax, get dirty and split some rock. I wound up loading my van with some rock to split at home anyway, but not nearly as much as I did last time.

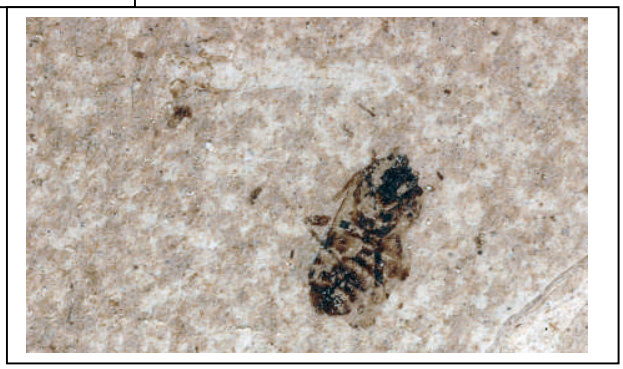
As I often say "Life often gets in the way of living". As much as I would love to not work and dedicate my life to my hobbies, we all know that's not going to happen. Most of the rock I brought back in the 1980s is still in my shed un-split, it is right next to all the other milk crates full of fossils I had planned on "getting to" one of these days. But every so often, I go back to those Florissant Rocks, and as soon as I find the first insect or leaf fossil, the fever comes back and I "play around" till life gets in the way again, knowing I will get back to working on them again someday.

Fossil collecting is a hobby for me. I do it because I love Natural History and all things connected with it. I don't need to know the scientific name of something to know it is just plain cool. It's amazing just how many Fossils you can find in one piece of Florissant rock. The work is tedious, as some of the layers are microscopically thin and I use a razor blade as my "chisel". The photos below are just a few of my cool Florissant finds and I have no idea what most of the names are or if I'm right about what I think the specimens look like!

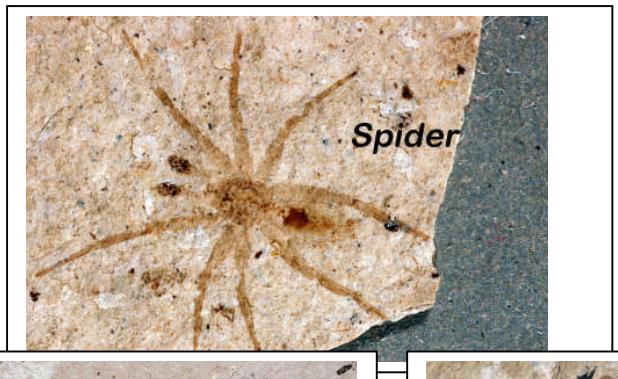



Beetle



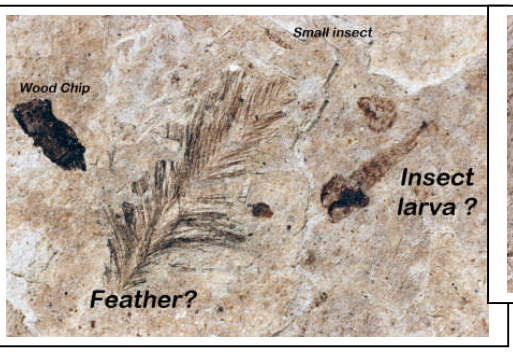



Smaller bee(outlined in red dots)
on top of a larger bee?


Spider


Redwood leaves?


Thorn?


Small insect
Wood Chip
Insect
larva ?
Feather?


Insect wing.


Smaller bee(outlined in red dots)
on top of a larger bee?