THE BADGER DIGGIN'S

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Devoted to the Earth Sciences

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Minerals and Biology: We need to think this out again.

by Teri Marché

Because of the way our brains are wired, we humans need to categorize and classify our knowledge of the world. It is the only way we can deal with the otherwise overwhelming complexity that surrounds us. Most of the time it works, but not always.

Take for instance the broad division of nature into animal, vegetable, and mineral. They seem to be totally separate realms, especially the division between life and non-life. So it was a real surprise to read in the February, 2009 issue of *Natural History*, that much of the mineral treasure we enjoy is the direct result of the living beings that inhabit this planet. Consider the surprising statement, "Turquoise could not exist on a lifeless planet." That got my attention.

Citing Robert M. Hazen of the Carnegie Institution of Washington, D. C., the article goes on to lay out three phases of mineral evolution on the Earth.

First: Over 4.55 billion years ago, when the Solar System began to develop, chemical elements came together to form about 250 simple minerals that in turn, coalesced into planets.

Second: About 4.55 billion years ago, a Mars-sized body crashed into the Earth in a violent collision that caused wild fluctuations in the planet's temperature and pressure, starting plate tectonics to churn the surface and releasing volatiles such as water and carbon dioxide. These helped to redistribute elements and enabled the evolution of some 1,250 *new* minerals.

Third: This is where the fun begins. Life appeared, and about 2.5 billion years ago, it became a factor in shaping the world through photosynthesis, which released (and maintained) free oxygen into the atmosphere for the first time. This allowed mineral ores to oxidize into malachite and turquoise and almost 3,000 *other* minerals that "could only appear on a living planet."

While true Darwinian evolution by natural selection was not a factor with minerals, according to Hazen, "mineral evolution is more than simple change over time. The diverse and complex mineral assemblages on Earth today result from a sequence of irreversible physical and biological processes." Thus, two-thirds of the 4,300 minerals known on Earth today "owe their existence to biological processes." We truly live in a marvelous world!

Next Meeting

Our next meeting will be held at 9:45 a.m. on Saturday, September 12, 2009, at the Monroe Public Library, 925 16th Avenue, Monroe, WI. Take the elevator to the second floor.

Program: Show & Tell.

Bring along samples of rocks, minerals, or fossils that you have collected, either this summer, or at another time. Come prepared to share stories of any (mis)adventures associated with your findings.

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Officer Roster:

President
Dan Trocke
4771 County II
Highland, WI 53543
608-935-0597
dtrocke@acscm.com

Vice-President
Teri Marché
5415 Lost Woods Court
Oregon, WI 53575
608-835-2653
tmarche@education.wisc.edu

Secretary
Laurie Trocke
4771 County II
Highland, WI 53543
608-935-0597
lor3@netscape.com

Treasurer
Daisy Peterson
W4647 County FF
Monroe, WI 53566
608-328-1523
daisyjovilu@gmail.com

Editor
Jordan Marché
5415 Lost Woods Court
Oregon, WI 53575
608-835-2653
jordanmarche@hotmail.com

Show Chairperson
Teri Marché
(see above)

Field Trip Chairman
Dan Trocke
(see above)

Officer-at-Large
Tyrel Rouse
131 Langdon Street, Apt. 1
Madison, WI 53703
608-235-2865
karmacop_7@hotmail.com

Show Business by Teri Marché

The dates for the Badger Lapidary and Geological Society's 40th Annual Mineral, Gem, and Fossil Show have been set for 2010! The show will be held on March 27 and 28th at the Monroe High School, Monroe, WI.

Ten dealers have agreed to participate, many returning from last year, and the Monroe County Homemakers will again be there with their great food and raspberry pie!

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Tentative Calendar of Club Events – 2009

Sept. 12 Regular meeting – Show & Tell

Sept. 26 Field Trip: Iowa Minerals and Fossils

Trip Leader: Teri Marché

This field trip will take us to two quarries in eastern Iowa. However, which two is still in question at this time.

Possible sites include the Moscow Quarry near Muscatine, IA for vugs of quartz, and the Four Counties Quarry for Devonian-age fossils. In any case, to fit in two quarries, we will need an early start, and that will require either a ridiculously early trip from Wisconsin (some have done just that) or else an overnight stay in Iowa on Friday, Sept. 25.

I'll have more information for you as it becomes available.

October 10 Badger Lapidary Day Host: Trockes

Dan writes: One of my neighbors, Dave Mellum, owns a limestone quarry near Dodgeville that appears to be full of fossils. Dave said the whole Badger rock club was welcome to visit the quarry as well. So if people are interested, then we could make a group trip there during the Lapidary party. I'll try and stop there some time beforehand so I know what to expect and to make sure it would be worth bringing our group.

Oct. 24 Field Trip: Bat Cave near Beetown

Trip Leader: open

Nov. 14 Regular meeting – program open

Dec. 12 Christmas Party

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MWF Club Events

Sept. 26-27: Oshkosh, WI. Oshkosh Earth Science Club's 38th Annual Show. Sunnyview Expo Center, 500 E. County Road Y, Sat. 9-5, Sun. 9-4. Admission: $2 adults; children 12 and under Free. Contact: Bob Fox (920) 235-4669, foxbooks@northnet.net.

Oct. 3-4: Jefferson, WI. Rock River Valley Geological Society's Annual Show. Jefferson County Fair Park, 503 N. Jackson, Sat. 9-5, Sun. 10-4. Contact: Robert Schweitzer, W. 4240 Hwy 18, Jefferson, WI 53549, ywses@ide.net.

Nov. 21-22: Madison, WI. Madison Gem and Mineral Club's 46th Annual Show. Alliant Energy Center, 1919 Alliant Energy Center Way. Contact: Nevin Franke, (608) 251-2601.

Dec. 12-13: Sheboygan Falls, WI. Glacial Drifters Geologic Society's 5th Annual Show, Sheboygan Falls Municipal Building, 375 Buffalo Street, Sat. 10-5, Sun. 10-4. Contact: Kevin Ponzio, (920) 980-6413.

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Book Review – Andrew Parker, *In the Blink of an Eye: How Vision Sparked the Big Bang of Evolution*. New York: Basic Books, 2003 (paperback ed., 2004)

by Jordan D. Marché II

Explaining the sudden appearance and diversity of the first hard-bodied, multi-celled animals, at the beginning of the Cambrian period (some 543 million years ago), has long been one of the outstanding puzzles of paleontology. This extraordinary event, dubbed the "Cambrian explosion," has been rendered even more intractable by improvements in radiometric dating techniques, which have since refined its duration to only a five-million-year-long interval. As author (and marine biologist) Andrew Parker tells us, the number of *recognized* phyla (i.e., major divisions in classification) then jumped from an apparent count of three to a total of thirty-eight that are present on Earth today (along with a few extinctions). In this work, we are introduced to his fundamental new theory, which argues that the sudden advent of complex vision (that is, of eyes capable of forming distinct images) was responsible for (a) establishment of the first *active* predator-prey relationships and (b) the resulting development of preservable hard parts as a means of insuring an organism's survival against this enormous new selective pressure.

Before presenting the details of his new thesis, however, Parker serves up a major corrective to prior thoughts about the Cambrian explosion itself, and which renders his own contribution all the more plausible. Recent molecular evidence, he argues, implies that the soft-bodied precursors of the remaining thirty-odd phyla must have existed (and indeed diversified) over a considerably longer period of time, anywhere from 120 to 500 million years *before* the Cambrian explosion. But this much slower and more gradual process of *micro*evolution (the development of many different body plans and their associated genotypes) has left no fossil record behind. By contrast, the abrupt appearance of hard parts documents the rapid development of organisms' phenotypes — a process of *macro*evolution occurring within existing genotypes — during that five million year interval. Because the external skeletons (and eyes) of animals are governed by far fewer genes than their internal body plans, this more rapid form of evolution can be brought within the realm of plausibility and thus accommodate the highly shortened timescale of the Cambrian explosion. Nonetheless, a signal event of this magnitude demands a compelling explanation, which has been long in coming.

Parker's solution to this dilemma, however, isn't completely unveiled until the book's final chapter. Styled somewhat like a mystery novel, the book's evidence gradually unfolds through a roundabout series of topics that retrace the author's pathway to recognition and discovery. Following introductory chapters on the history of life and strategies developed for interpreting the fossil record, we are treated to an exploration of the importance of light (as a selective pressure) in modern ecosystems. Here, he documents how, in environments

where light is much reduced or even absent, rates of evolutionary change have been generally much slower. Important differences between pigmentary and structural colors, and their modes of occurrence, are seen to play important roles in his own scientific research and offer support of the theory of complex vision.

Parker's investigation of ostracods (or seed shrimp), and his discovery of luminescent halophores (i.e., organs resembling antennae) among certain groups, leads him to a search for anatomical similarities (and functions) among the fossilized animals of the famous Burgess Shale. It is here that the story again becomes more focused, as the nature and development of eyes, especially those among arthropods such as trilobites, are recounted. Arthropods displayed not only the greatest diversity amongst early Cambrian animals, but were seemingly the first to develop complex eyes (in perhaps as little as a million years time) and use them to advantage in pursuing all types of prey, including themselves. Virtually all pre-Cambrian animals, by contrast, that did *not* employ photosynthetic symbionts to manufacture food, were still blind and could only graze upon, or somewhat passively capture, microscopic organisms or detritus. But with the sudden arrival of true vision, hunting and predation introduced a novel (and powerful) stimulus into every ecosystem where light was dominant. Only through the development of ornaments and armaments (i.e., defensive hard parts) were those previously soft-bodied forms able to survive. This dramatic transformation among the remaining thirty-odd phyla (including chordates of our own lineage), therein led to preservation of the diverse fossil record that has since been recognized (among the Phanerozoic) on a world-wide basis.

Although one seeming paradox (and potential challenge) to Parker's theory can be raised, it too has been satisfactorily answered; namely, the fact that only six out of the present thirty-eight phyla have evolved vision. The author notes in this regard, however, that "over 95 per cent of *all* animal species, taking account of *all* phyla, have eyes" (on p. 289).

A final (and as yet unanswered) question concerns the underlying reason for the sudden development of complex vision. In other words, why did vision <u>not</u> develop sooner in the long history of life; why was it necessary to wait some three billion years of time, if eyes themselves could evolve in as little as one million years? While no convincing answer appears forthcoming, the author has considered (although rejected) several hypotheses, including the effect of 'Snowball Earth', to explain why environmental conditions on our planet may have suddenly favored the reception of sunlight during the Precambrian – Cambrian transition. But this deeper mystery cannot be currently addressed.

In the Blink of an Eye is an enjoyable and highly informative scientific detective story, effectively told by its leading protagonist. Patience (and perseverance) are often necessary, however, for one to work through the circuitous logic and the many asides that are constantly sprinkled throughout the narrative. Minor spelling and grammatical mistakes are not absent, either. While quite well illustrated with line drawings and photographs, the text contains no footnotes or bibliographic references (a move seemingly adopted by the publisher to try and gain a wider popular audience). But aside from these minor detractions, anyone curious to know more about the history of life on Earth, and our latest understanding of evolution's 'Big Bang', will wish to delve into Parker's theory and consider for him/herself its bold explanations and insights.

Badger Lapidary and Geological Society, Inc.
Jordan Marché, Editor
5415 Lost Woods Court
Oregon, WI 53575