Priscum

NEWSLETTER OF THE PALEONTOLOGICAL SOCIETY

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Interview with Penrose Medalist Steven Stanley

In 2013, Steven Stanley became the first palaeontologist in two decades to be awarded the Geological Society of America's Penrose Medal. Dr. Stanley now splits his time between the University of Hawaii and the Smithsonian National Museum of Natural History. I finally caught up with him in March.

Giant Clam • Richard Ling via Flickr • Creative Commons

You grew up outside of Cleveland, Ohio, near classic exposures of Paleozoic rock. How did your earlier experiences with geology influence you? Or, more generally, what drew you to paleontology?

It's true that I was drawn to nature, living on twenty-four acres along what has since been designated a National Scenic River, the Chagrin, which flows into Lake Erie several miles east of Cleveland. A low cliff of the Late Devonian Chagrin Shale bordered part of our property, but I never found any fossils in it. The ones I saw in the back rooms of the Cleveland Museum of Natural History looked like dusty old dead things.

I became more interested in the glacial erratics that had washed out of till. They were a large, varied sample of Canadian

Stanley Interview, cont.

bedrock. Many were crystalline boulders slashed by veins of igneous rock. At the age of eight I obtained a little book called The First Book of Stones and began to learn about rocks and minerals. I was able to collect minerals in Colorado after my sophomore year and on the Upper Peninsula of Michigan after my junior year.

We were required to write a thesis at the boy's school I attended in a suburb adjacent to Cleveland. Most students produced a thesis in some area of literature or history, but I wrote mine on the geologic and economic history of the Chagrin River Valley, where I lived. There had been gristmills and sawmills along the river before electric power displaced them. I clambered up tributaries with waterfalls spilling over the Berea Sandstone and learned the regional stratigraphy from state publications. I also learned some geomorphology and hydrology from various sources.

I went to Princeton knowing I would major in Geology, but being interested in minerals, I thought I would get into mining geology. Then I took the introductory Biology course sophomore year as well as Al Fischer's Invertebrate Paleontology course. George Gaylord Simpson had written our biology textbook, Life, with my professor, Colin Pittendrigh, as second author. As one might expect, evolution was a major theme of both the book and the course, and Pittendrigh was famous all over the campus for his dynamic lectures. For the course we also read Simpson's The Meaning of Evolution. I was hooked. Evolution was intellectually exciting. And then Al Fischer brought fossils to life. As an undergraduate I discovered that I loved doing research and aimed at an academic career in paleontology.

If you had not become a paleontologist, what profession do you think you would have chosen?

I don't like thinking about this because I love doing what I do and wouldn't trade it for anything. If I had never had the opportunity to do what I do, I would nonetheless have had to do something creative because I am an intensively creative person. The thing that comes to mind first is landscape architecture. In fact, I'm an amateur landscape architect. I've built stone walkways and patios and planted scored of trees and shrubs. When people ask me if I could do something for their property, I tell them they can't afford me! I do think I could make a living at it. I guess being a writer would be another possibility. I get compliments from editors on my writing. Of course, articles, textbooks, and popular writings demand different writing styles, but I enjoy adopting each of them.

You are best known for your work documenting the paleontological evidence for punctuated equilibrium. How did these ideas originate and what was their impact?

I'm going to begin my answer by mentioning the 1972 Eldredge and Gould paper, but people should understand that Niles Eldredge was actually responsible for the punctuational model. It was in his dissertation and a dissertation publication. Steve Gould liked the idea and arranged to give a talk and publish another paper with Eldredge, and that's the paper that got all the attention. But that 1972 paper stated that the fossil record could not decide whether the punctuational model or the gradualistic model was correct. They simply thought the punctuational model was more in line with biological thinking. Actually, the resulting outcry said otherwise. Eldredge and Gould implied that evolution was basically either phyletic (anagenetic), which means occurring within established species, or is concentrated in speciation events. In fact, both modes of change must have occurred. The question was how much has been contributed by each mode.

One day in 1972, shortly after my father-in-law died, I was in Charlottesville at my mother-in-law's house. It was a quiet time, and at some point I began to cogitate in a soft chair in a room by myself. I decided that Eldredge and Gould had sold paleontology short, saying that we could not test the punctuational model with fossil data. I thought of three tests, all of which, it turned out, favored the punctuational model. One of these was somewhat weak, but the other two were strong. The test of adaptive radiation noted that major evolutionary changes had occurred during intervals of time that were brief relative to the longevities of component species. Phyletic evolution would have had to produce successive chronospecies of very short duration for gradualism to prevail. It had not done so. The early Cenozoic mammals were a prime example, with species typically lasting for more than a million years without appreciable change, whereas distinctive new higher taxa were arising in just a few million years. Rapid branching events had to be responsible. The second test entailed examination of higher taxa

Stanley Interview, cont.

that had survived for long intervals of time at low diversity: with very few speciation events. If most major evolutionary changes entailed speciation events, then there should be relatively little change in these segments of phylogeny. Here, to be fair, one must look only at segments of phylogeny documented by a series of fossil occurrences. As predicted for the punctuational model, these segments of phylogeny were virtually stagnant. Examples turned out to be portions of phylogeny representing snapping turtles, alligators, aardvarks, and amiid fishes. The living representatives are what we call living fossils.

Then I contemplated the fact that if the punctuational model is valid, phyletic evolution must be too feeble to produce large-scale trends for higher taxa. So how could divergent speciation events produce these trends? I realized that the trends could result from what I came to call "directed speciation" – a preponderance of speciation events moving in one direction, or from what I later termed "phylogenetic drift" – a chance shift in one direction that would be analogous to genetic drift at the individual level. However, neither of these mechanisms was likely to operate effectively on a large segment of phylogeny for any length of time. Instead, most large-scale trends must have resulted from a disparity in characteristic rates of speciation and extinction among taxa of different morphologies and ecologies. To be a winner in this game, species of a given kind must be characterized by relatively high rates of speciation or low rates of extinction or both. Here, in what I came to call "species selection," species take the place of individuals in natural selection at the individual level, speciation takes the place of birth, and extinction takes the place of death.

So these ideas appeared during a pensive interval in a soft chair.

Young people need to push aside their computers from time to time and find a quiet place simply to think for a while. Websites regurgitate old ideas. People generate new ones.

Is there a paper that you are particularly proud of, which has not received much attention?

I'm glad you asked that question. Not one paper but, would you believe, six? Actually, one of these contributions is part of a book chapter, taken together with an abstract. This general issue has been a source of frustration for me.

First, there is my 1975 paper called "Clades versus clones in evolution: why we have sex." This was published conspicuously in Science in 1975. An editor tried to make me change the title but I refused! The same material constituted an entire chapter of my 1979 Macroevolution book. My central point was that asexual taxa tend to suffer fatally from their inability to undergo rapid, divergent speciation. Asexual taxa have arisen sporadically in the world, but they have soon died out because they have diversified very slowly, as clones. Taxa of low diversity generally do not survive for long on a geological scale of time. Rapidly divergent speciation is possible for sexual taxa because of genetic recombination. This allows a sexual clade to expand adaptively much more rapidly than an asexual clone. A sexual clade can thereby persist for a long time, withstanding sporadic extinctions of its species, while a clone can be expected to die out rather quickly.

I was very explicit in saying that I was not proposing that selection at the individual level is not happening, but only that its most important role is in speciation events. Nonetheless, it's clear to me that it is because my conception elevated the role of sexual reproduction to the level of macroevolution that biologists, who are accustomed to interpreting everything at the level of the individual, have failed to pay attention to it. In a talk at a meeting in 1990, I revisited this subject. John Maynard Smith spoke a bit later. At the time he was probably the world's most eminent mathematical population biologist. He began his talk by saying, "I have no problem with what Steve Stanley says. I just don't think he has the whole story." I thought, "Couldn't he just write that down somewhere -- that I have a partial explanation for the prevalence of sexual reproduction in eukaryotes." But I knew he never would. He didn't, and now he's deceased. And my at-least-partial explanation for the function of sex remains largely ignored.

Second, there is my paper on the functional morphology of trigoniid bivalves, published in Palaeontology in 1977. After finishing my dissertation on the functional morphology of the bivalve shell, which allowed me to recognize the life habits of nearly all extinct bivalve species, I found myself confronting the trigoniids, wondering why they had such strange shapes. I decided to take them on. Usually my

Stanley Interview, cont.

research begins with a hypothesis about which I feel quite positive -- what you might call an insight, although sometimes it doesn't pan out -- but I confronted the trigoniids without a clue as to why nearly all of them were orthogyrous or opisthogyrous rather than prosogyrous (their beaks don't point forward). Also, why did the group display so many curious forms of shell ornamentation – a variety of knobs and ridges? The large hinge teeth with secondary dentition I could explain immediately: they functioned to keep the valves aligned at the wide angle of gape required for extrusion of their thick, muscular foot. (The foot can be observed in Neotrigonia, the only living trigoniid genus, which I travelled to Australia to study.) I soon recognized that the large teeth, radiating from the beak area, precluded a prosoygrous morphology: the latter condition wouldn't have provided space for the teeth. In 1975, in the very first issue of Paleobiology, I had presented experimental work explaining the shape of a typical burrowing bivalve -- the genus Mercenaria. Here, with the aid of films of burrowing clams and what I called a "burrowing machine," I showed that the animal's progyrous shape accelerated the burrowing process by gripping the sediment as the animal rotated backward, after rotating forward, to take a downward step. Experiments with model trigoniids showed that the ridges and knobs on their shells compensated for the lack of a prosogyrous shape, gripping the sediment during backward rotation to accelerate burrowing.

The cardiids (cockles) evolved a different, much simpler solution to the problem imposed by the wide gape required by a large, muscular foot. They simply evolved projecting lateral teeth, far from the beak, to maintain approximate valve alignment at wide angles of gape. Then, marginal denticulation or the marginal terminations of shell corrugation completed the alignment as the valves came together.

So the morphology of a typical trigoniid represents a coadapted complex, complicated as it may be. Everything had come together. My trigoniid paper hasn't received many citations because it concerns a single family of animals, but of all the research projects I have undertaken, it is one of the ones of which I am most proud, partly because at the start I hadn't a clue. I think it would provide a great example for teaching how we can assess the functional morphology of strange, extinct forms of life.

The third example relates to two related publications in which I introduced a big idea: a 1974 GSA abstract and my chapter in Patterns of Evolution, edited by Tony Hallam in 1977. I'm uncomfortable presenting this example for reasons that will be apparent, but I'm going to include it in the interest of fairness. This big idea has not been ignored. Nearly everyone accepts it and considers it to be very important. The problem is that it has been widely attributed to someone else when, in fact, I was its sole originator.

The big idea is that during the Mesozoic, the advent of three groups of highly efficient predators -- crabs, predaceous gastropods, and teleost fishes -- altered the ecologic structure of the marine ecosystem, causing the decline of a variety of taxa. In the 1974 abstract I argued that these three predators were responsible for the decline of the brachiopods after their partial recovery from the terminal Permian crisis. In the 1977 chapter I reiterated this point and also attributed to the same cause the decline of crinoids after a similar partial recovery and also the decline of endobyssate bivalves. Geerat Vermeij heard a talk I gave on this topic at a minisymposium at Johns Hopkins in 1976, and the next thing I knew he had written a manuscript, applying the idea to gastropods and labeling the general event the Mesozoic Marine Revolution. The problem was that he cited my chapter in the Hallam volume so obliquely that it was not clear that the idea of the Mesozoic Marine Revolution was entirely mine. I just didn't use that label. I have explained this situation to a few people who have responded by giving me the credit I deserve. I hope that others will follow suit.

The fourth example is a paper entitled "Gastropod torsion: predation and the opercular imperative" published in 1982. I produced this while in Germany taking part in Dolf Seilacher's research program, so it was published in Neues Jahrbuch für Geologie und Palaontologie. Presumably this mode of publication has contributed to the relatively small amount of attention my contribution has received, although I have since summarized the central ideas elsewhere. In addition, it's mainly gastropod specialists who pay attention to torsion. Torsion is the defining morphologic feature of the Gastropoda and was thus present in the first members of the class. My central point was that the evolution of torsion also accounts for the group's great success: it is not only their defining feature but also their key adaptive feature because it permitted a snail to seal itself inside its

Stanley Interview, cont.

shell with an operculum. Today marine snails that lack an operculum either use a hard substrate as one (limpets) or ward off predators with poison (opisthobranchs). My key point is that torsion arranges the snail body so that the foot goes into the shell last and the animal's posterior can bear an operculum. In coiled monoplacophorans the head went in last so an operculum was precluded and the animal's soft parts could be reached by predators. Living monoplacophorans crawl around with an elongate, trunklike body. They look much like a mobile mushroom and are highly vulnerable to predation. It's no wonder that there are only 11 known living monoplacophoran species and that they are all refugial. They live in the deep sea. The gastropods are a major class of animals and owe their great success to the origin of torsion and the addition of an operculum which torsion made possible. I think this contribution is a really important one, but it has been little appreciated.

The fifth example is my Presidential Address to the Paleontological Society, published in the Journal of Paleontology in 1995 – just the part of this paper that offers an explanation for the cause of the modern ice age in the Northern Hemisphere. I recognized that the north polar region is cold today because the upper Arctic Ocean is little affected by warm currents from the south. Lacking a strong influence of such waters, the uppermost layer of the Arctic Ocean is brackish because of the inflow of freshwater from large rivers, most of them in Russia. I call this "the Arctic Pond." Because of its high degree of isolation, the Arctic Pond remains very cold at its high northern latitude, and I maintained that its existence, keeps us in the modern ice age of the Northern Hemisphere. The reason that Atlantic waters do not disrupt the Arctic Pond is that the warm, northward flowing Atlantic waters are relatively dense and sink just north of Iceland to return southward. They constitute part of the great conveyor belt that Wally Broecker has discussed extensively. A small portion of the conveyor belt waters flow into the Arctic Ocean, but they descend below the Arctic Pond and circle around to rejoin the conveyor belt and flow southward. A halocline separates them from the Arctic Pond, leaving the latter quite cold.

> "My view is that the ultimate goals of paleontology are to provide a picture of the history of life, to relate this history to past environmental change, and to establish principles of macroevolution. "

Waters that well up in the central Pacific form a segment of the conveyor belt. Then they flow diagonally across the Atlantic and turn northward, with the Gulf Stream forming a segment of the conveyor belt. The reason that the conveyor belt fails to flow into the Arctic Ocean today is that its waters become slightly hypersaline on the Atlantic side of Central America, where the trade winds sweep up evaporative water and pass it at high altitude to the Eastern Pacific, where they reduce salinities to levels slightly below the global sea water average. The resulting hypersaline waters on the Atlantic side carry their density to the far north, with a minor amount of freshwater dilution. If in our minds we travel back to the Pliocene, to a time when the Isthmus of Panama was not in place, a large portion of the hypersaline waters of the trade wind belt would have flowed into the Pacific, so that the northward-flowing conveyor belt northward would have been weaker and its waters less dense. I suggest that the conveyor belt waters therefore flowed into the Arctic Ocean rather than descending near its margin, as they do today, and they kept the Arctic Ocean relatively warm.

Some workers have suggested that the strengthening of the conveyor belt when the Isthmus of Panama formed caused the ice age by increasing moisture in the atmosphere and, hence, causing the buildup of glaciers. The problem with this scenario is that the Arctic region had a temperate climate right up until the onset of glacial expansion. It had to cool down before for glaciers could expand, and that's what my model accounts for. A simple increase in precipitation could not have caused glacial expansion.

As support for my conclusions, I cited a North American group and a Russian group, both of whom concluded that if the Soviet Union diverted huge rivers that had been flowing into the Arctic Ocean – and this diversion had been contemplated for a time – all Hell would break loose because the elevation of salinities in the Arctic would allow warm Atlantic

Stanley Interview, cont.

water to flow fully into the shallow Arctic Ocean, eliminating its stratification. Yes, I concluded, the Arctic Pond would disappear, and we would rush headlong back into the pre-northern-ice -age Pliocene, with catastrophic global warming and sea level rise beyond anything that anyone now anticipates for the near future.

Of course, I'm not an expert in oceanography or meteorology, just a paleontologist, and as such, I might seem to lack credibility. On the other hand, a fresh point of view is sometimes enlightening, and I think my conclusions make sense. Publishing them in the Journal of Paleontology, as I did, presumably severely reduced the attention they received. As I now describe my ideas, I'm thinking that, because I view them as potentially so important for our future, I should get in touch with oceanographers who might agree.

The final example is actually in the area of physical anthropology. When Darwin contemplated which of the two most quintessential human qualities, upright posture and the big brain, came first, he logically concluded that upright posture did because until the hands were free to make tools and manipulate things, a big brain would have been of little use. This seems logical, but some years ago, it occurred to me that there was a more fundamental reason why upright posture had to preceded the evolution of our large brain. This has to do with the way in which we develop most of our large brain. It is through a delay in our early development. Monkeys, apes, and humans have a very high rate of brain growth before birth. For all of us, brain weight in utero is sustained at about ten percent of body weight. For monkeys and apes, this high rate of brain growth declines dramatically at birth, but we humans retain the high fetal rate for about a year after birth. As a result, the brain of a one-year-old human is more than twice as large as the brain of an adult chimp. Now, I'll shift gears and describe the mode of life of our australopithecine ancestors. When I was getting into this field, all sorts of evidence was appearing to show that australopithecines, like chimps, were semi-arboreal. Australopithecines had relatively long arms and short legs; prehensile toes; long, strong fingers; and narrow shoulders that would have put their center of gravity not far from their shoulder sockets. Furthermore, their inner ear bones would have given then no balance on the ground for moving faster than at a lope or jog. Like chimps, they would have had to climb trees to obtain food and avoid predators. They would have been less adept than chimps in trees and more adept on the ground.

Using evidence for body and brain size at birth and in adulthood, I showed that gracile australopithecines had a pattern of development very similar to chimps and orangs, whereas the pattern of development of early Homo was closer to ours. Thus, I argued that early Homo represented an entirely new kind of animal. Now back to the origin of the big brain. The relatively mature neonates of australopithecine, like neonatal apes, could have clung to the hair of their climbing mothers' heads. But there is no way that australopithecines could have grown the large brain of Homo while remaining semi-arboreal because an australopithecine mother could not have held onto a helpless infant with one hand while trying to climb with the other. An australopithecine population had to be fully terrestrial to give rise to Homo. Back to the start of the modern ice age of the Northern Hemisphere. The resulting cooling of the ocean, through weaker evaporation, led to a drying of climates in Africa, where, as a result, forests shrank. Nearly all gracile australopithecine populations died out, but one somehow survived fully on the ground and happened to undergo the changes leading to Homo.

This contribution was presented in a paper in Paleobiology and in my book Children of the Ice Age: How a Global Catastrophe Allowed Humans to Evolve. I believe that my ideas here make eminent sense, but they have been all but ignored by physical anthropologists.

How has paleontology changed since you began?

Wow! Where to begin? Well, when I was an undergraduate in the early 1960's, other physical geologists were viewing paleontology as a stagnant and not very vibrant field. Describing and naming fossil taxa and using them to date rocks were the dominant activities. Other geological disciplines had been modernizing. In the 1950's experimental petrology had done for geology what genetics had done for biology: it made it an experimental, not simply an observational, field. And it entailed thermodynamics. Structural geologists were employing engineering principles, and sedimentologists were employing hydrological

Stanley Interview, cont.

principles. Paleontology needed to join its neighbors by becoming more conceptual.

Walter Bucher of Columbia University, though a structural geologist, had enjoyed working with fossils in Germany as a young man and wanted to do something about paleontology's problem. Others joined him, and in 1957 this push from the outside resulted in production of the giant two-volume GSA Memoir 67, Treatise on Marine Ecology and Paleoecology. It had become clear that paleontology, especially invertebrate paleontology, had to become more biological. This began happening in a big way in the mid-1960's, when I was a grad student. My dissertation was exclusively on the functional morphology of living bivalves, but no paleontologist blinked an eye because people knew how important it was to be able to reconstruct the life habits of extinct animals from their skeletal morphologies. What was happening amounted to a renaissance for paleontology. The label "paleobiology" came into widespread use. In 1971 Dave Raup and I wrote a textbook that facilitated the teaching of principles of paleontology instead of simply morphology and taxonomy. Much to our surprise, nearly everyone adopted it.

Initially the new emphasis for invertebrate paleontology was on paleoecology, but it was soon apparent that there were severe limitations here: we usually lacked a good record of soft-bodied organisms or ones with highly patchy fossil records, including ones at the bottom and top of the marine food web (phytoplankton and fishes). Also, we couldn't measure key environmental variables.

I would say that the renaissance culminated with the assertion in the nineteen-seventies that evolution was highly punctuational. I don't say this because I was heavily involved here but because it is clear that we had a major impact on the field of biology, and this was something that was quite new. When I was a graduate student, biologists had relied almost entirely on the books of George Gaylord Simpson to indicate what paleontology had to say about evolution. I had over fourteen hundred reprint requests for my first paper on the punctuational model -- virtually all of them from biologists.

A second renaissance was well underway by the early 1980's: the study of ancient life in the context of paleoclimatology and paleoceanography. Paleobotanists had done some work on paleoclimates before this, but paleoceanography was so weakly developed that it had not even been recognized as a distinct field of science in the 1970's. The journal Paleoceanography appeared in 1986. Until these fields were expanding, almost no paleontologists worked with stable isotopes. Soon the label "geobiology" became widely employed.

The study of mass extinctions has exploded during my professional life. Ones that we now regard as major events were not even recognized when I was in grad school.

Of course, technology has also advanced remarkably. Paleontology has become much more quantitative during my career. Ready access to computers and useful software packages are relatively new aspects of our research. When I was in college, very few undergraduates had access to computers. To do statistical analyses for my senior thesis, I had to compute standard deviations for t-tests laboriously by hand on a cumbersome machine. Even when I was in a doctoral program, graduate students could work only with a mainframe computer in another building and were required to work with punch cards. Other technological advances have also opened new avenues of research. Obtaining isotopic measurements has become vastly easier, morphologies can be readily digitized in three dimensions, and x-ray tomography even allows us to reconstruct the shapes of imbedded fossils. SEM imaging has risen from a primitive state to the point where large physical models of tiny fossils can be created from digital measurements.

In your opinion, what are the most exciting areas of paleontology today?

My view is that the ultimate goals of paleontology are to provide a picture of the history of life, to relate this history to past environmental change, and to establish principles of macroevolution. Contributions to macroevolutionary theory have diminished in recent years. On the other hand, quite a few exciting advances are now being made that relate faunal and floral changes to paleoclimatology and paleoceanography.

And certainly among the most exciting of these changes are what we call mass extinctions. In recent years the terminal Permian event has replaced the terminal Cretaceous event as the one attracting the

Stanley Interview, cont.

most attention and as the one for which the most revealing new information is appearing. Some of this is quite exciting, and so are advances in our understanding of other mass extinctions.

Are there directions that you believe paleontology should be going in, but is not?

I would like to see more projects that combine the study of terrestrial floras and entire vertebrate faunas, with plants providing the environmental context and trophic relationships being reconstructed.

American paleontologists need to make a greater contribution to pre-Cretaceous paleoceanography, and they need to relate the history of life within particular regions to changes in the structure of the ocean and other varables. Stable isotope studies must play a significant role here, but very few American paleontologists are undertaking them. Much more is happening in Europe in this area, partly because for some reason on that continent there were many interesting Mesozoic and Cenozoic marine and brackish basins. Americans can conduct research on these basins -- when appropriate with European collaborators – even if we lack such a smorgasboard of opportunities on our continent.

It disappoints me that people who study ancient marine invertebrates know very little about the ecology of living marine invertebrates. I wish this could be rectified because I frequently see conclusions being reached that are unrealistic. As an undergraduate I took a summer course in Marine Biology at the University of Miami and when working on my dissertation spent many months at three marine labs and in adjacent marine habitats. And then for many years we had a marine ecology program in my department at Johns Hopkins, where I rubbed shoulders with our faculty, students, and visitors. In fact, I taught a Marine Ecology course there myself in 1971, before we had the program, and again thirty years later, in 2001, after the program was gone. Perhaps short courses could at least partly remedy the deficiency I describe. I would invite my colleagues to have a close look at my 2008 “Matters of the Record” paper in Paleobiology entitled “Predation defeats competition on the sea floor.” Beginning with the publication of Robert Paine’s papers in the mid-nineteen sixties, classical competition theory has been thoroughly discredited.

As I moved from macroevolution to other areas of research (diminishing returns), I predicted that the most exciting area of evolutionary biology would soon be “evo-devo”: the area that focuses on developmental biology and in particular on how simple changes early in ontogeny have major evolutionary consequences. History has proved me right. Creative thinking may reveal opportunities for fruitful paleontological research in this area. Some interesting work here has already been done on trilobites.

You have written several books for general audiences. Why did you choose to write popular books in addition to your academic work?

One reason is that I love to write, and I love most to write the way one does for a general audience. But there is a more fundamental reason, which is that we need not only to impress those who fund our research, but we need also to sustain popular interest in our field. By the way, early in my career, when someone asked what academic field I was in, I would describe what I did without mentioning the word “paleontology” because no one knew what that was. But ever since Jurassic Park hit the big screen, I field the question by simply saying that I’m a paleontologist, and everyone says, “Wow!.” I never tell them that I don’t work on dinosaurs. We’ve become heroes during my lifetime, but we’ve got to cash in on our position.

How would you describe the relationship between paleontology and the other branches of geology? Has it always it been that way?

This is a complex issue but also a very important one. In the old days, paleontology was seen as having a critical role in providing a biostratigraphic framework for studies of Earth’s history. But then in the 1950’s and 1960’s, as I’ve already described, paleontology came to be viewed as unintellectual. In some circles paleontologists were viewed as stamp collectors. In the 1960’s, the first paleontological renaissance, which I’ve already discussed, liberated us from this kind of label, although it has taken many years to turn outside opinions around, and even now some old timers assume that nothing has changed.

Clearly the injection of more biology into our field was a highly positive development in an intellectual sense. On the other hand, ironically it was a negative

Stanley Interview, cont.

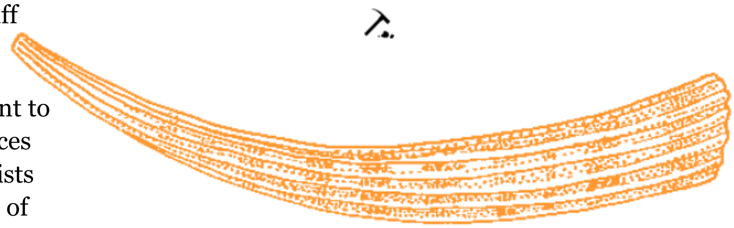
development in a political sense because it pulled us away from physical geology, our traditional home. Now physical geologists tend to view us as biological while biologists still tend to view us as geological. We are in no-man's land, or today we should probably change that to no-person's land. Most of our conceptual contributions now are of a biological nature, and I can tell you that very few physical geologists care a whit about paleobiology. I see this in the Geology Section of the National Academy of Sciences. After I was elected to the Academy in 1994, Ernst Mayr told me that it was the biologists (evolutionists) who elected me – that the Geology Section had given me a poor vote, although because I was the joint nominee of two sections the geology vote was high enough for me to make the general ballot. I nonetheless chose to join the Geology Section. My analyses relating bivalve form to life habits had represented the largest body of work any one worker had ever produced on the functional skeletal morphology of a single class of animals. I had also made major contributions for bivalves in the area I call evolutionary ecology, and my Macroevolution book had clearly had the largest impact in its field of any book on this subject since the publication of Simpson's Major Features of Evolution. But these sorts of things don't excite physical geologists.

The only way that paleontologists can impress prominent physical geologists is by making paleontological contributions that have a significant impact on physical geology. My body of work relating the influence of secular changes in seawater chemistry as to whether aragonitic or calcitic taxa have performed as major reef builders and sediment producers is an example. When I arrived at the Goldschmidt conference on geochemistry in 2004, a former Johns Hopkins student bounced up and declared, "Everyone's talking about the work you and Lawrie Hardie are doing!" He was talking about geochemists. Too bad I hadn't gotten into this stuff earlier.

Despite my discouraging comments, it is important to understand that, whether or not you like the choices that have been made, there are more paleontologists in the National Academy than there are members of many other subdisciplines of geology -- more paleontologists than stratigraphers, sedimentologists, geomorphologists, non-isotopic low-temperature geochemists, paleoceanographers, geohydrologists, or even structural geologists. Paleontologists are spread among the Geology, Evolution, and Botany sections (for strange historical reasons that no longer exist, there is no corresponding zoology section). I also classify a couple of people in the Anthropology Section as paleontologists because they work on early, non-hominid primates.

And then there's the Penrose Medal, my reception of which has led to this interview. When I received the medal, in 2013, it had been twenty years since it had gone to a paleontologist. That previous recipient was Al Fischer, my undergraduate mentor, but he did not receive the award for his paleontological work. He received it for two other areas of research. He was a pioneer in the recognition of Milankovitch cycles. In fact, people refer to cycles portrayed by his graphical method of analysis as Fischer cycles. Also, with his student Mike Arthur, he was first to make the immensely important observation that our global climate has oscillated between greenhouse and icehouse conditions over hundreds of millions of years. In fact, Al now calls himself a stratigrapher. Even if we call Al a paleontologist, the twenty-year gap between 1993 and 2113 is by far the greatest interval between paleontological Penrose medalists since George Gaylord Simpson received the medal more than sixty years ago. Here too the voters are now mostly physical scientists who care little about paleontological research unless it has an impact on physical geology. I very much doubt that I would have received the Penrose had I not gotten into that biomineralization research area, which ranges from plate tectonics to geochemistry, biology, paleontology, and sedimentology. Please don't kill the messenger. I simply think members of our community need to have a realistic perspective on the position of our discipline

I thank you for permitting me to air these thoughts.



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Interested in requesting funds for your conference session or fieldtrip?

Organizers of Paleontological Society sponsored events can request funds from the Society to support students attending fieldtrips and speakers (who would not normally attend) of conference sessions. Contact Program Coordinator Tom Olszewski (tomo@geo.tamu.edu) for details.

Student Research Grant Awardees for 2015

Emily Artruc, SUNY College of Environmental Science and Forestry, *Growth rate and ecology of the giant heteromorph ammonite* Diplomoceras maximum *using stable isotopes of accretionary shell carbonate* (Allison R. "Pete" Palmer Award)

Thomas H. Boag, University of Toronto, *The demise of the Ediacara biota - terminal Neoproterozoic extinction scenarios from the Schwarzrand Subgroup, Namibia* (Steven M. Stanley)

Stephanie Bosch, Miami University, *Oxygen isotope values ($\delta^{18}O$) in terrestrial gastropod shells: a proxy for paleoclimatic change in the San Pedro Valley, southeastern Arizona* (Steven Jay Gould)

Angeline Catena, Case Western Reserve University, *Using Paleosols and Ichnofossils to Test Causes of Neotropical Provinciality* (Kenneth E. & Annie Caster)

Elizabeth G. Clark, Yale University, *Functional Morphology of Paleozoic Brittle Stars* (N. Gary Lane)

Camilla Crifò, University of Washington, *Herbaceousness vs. arborescence: inferring the growth habit and ecology of early flowering plants using leaf morphological and physiological traits* (Ellis L. Yochelson)

Elle Derwent, James Madison University, *Systematic Classification of the Macrofauna from the Mt. Kindle Formation, NWT Canada* (Robert J. Stanton & James R. Dodd)

Scott D. Evans, University of California-Riverside, *A reopening of the Ediacaran preservational window? Investigating softbodied preservation in the upper Devonian of Naples, NY* (James M. & Thomas J. M. Schopf)

Serjoscha W. Evers, University of Oxford, *The morphology, systematics and sensory anatomy of* Australochelys*, and its importance for early turtle evolution* (Rodney M. Feldmann)

Sakineh A. Fard, Texas A&M University, *Paleobiology, Redox conditions and Sequence Stratigraphy of Permo-Triassic Boundary Sections in Iran* (MAPS Outstanding Student Research)

Daniel J. Field, Yale University, *Geometric and functional evolution of the avian musculoskeletal system* (Steven Jay Gould)

Alexa Goers, University of Kansas, *Trace-fossil associations of carbonate shoreface environments: a conceptual ichnofacies model* (Richard Osgood)

Juliet Hooten, University of Connecticut, *Late Devonian bioeroder and brachiopod fossils to test coupled extinction model* (Richard K. Bambach)

William Jessop, University of Oxford, *Archaeocyathids and the evolution of suspension feeding in the Cambrian* (Allison R. "Pete" Palmer)

Bridget Kelly, University of North Carolina-Wilmington, *Isotopic and taphonomic study of fossil* Glycymeris *bivalve shells: implications for naticid gastropod predation habits and paleoreconstruction of the North Carolina Pleistocene* (Ellis L. Yochelson)

Dan Killam, University of California-Santa Cruz, *Photosymbiosis and environmental specialization among the Lithiotid bivalves during the Lower Jurassic* (Arthur J. Boucot)

Ashley Manning-Berg, University of Tennessee-Knoxville, *Preservation of Organic Matter in Proterozoic Microbial Mats* (Kenneth E. & Annie Caster)

Marko Manojlovic, University of California-Santa Cruz, *Quantifying lithological preferences of Middle Jurassic brachiopods and the role of substrate in the mid-Mesozoic brachiopod decline* (G. Arthur Cooper)

Student Grant Awardees, cont.

Win Mclaughlin, University of Oregon, *Biostratigraphic analysis of Neogene deposits in the Northern Tien Shan Mountains of Kyrgyzstan* (MAPS Outstanding Student Research)

Arthur S. Minar, Pennsylvania State University, *Comparing the Floristic Composition of Sundaland's Fossil Tropical Rainforests before and after Australian Contact* (MAPS Outstanding Student Research)

Samuel H. Neely, University of North Carolina-Wilmington, *Shape Analysis of Pliocene Bivalves from the Tjörnes Peninsula, Iceland, and East Anglia, England, Across the Trans-Arctic Invasion* (Ellis L. Yochelson)

Nadia Pierrehumbert, University of Chicago, *Determinants of spatial and temporal variation in Pennsylvanian-Permian marine communities of Kansas, USA* (Kenneth E. & Annie Caster)

Sarah Sheffield, University of Tennessee, *Understanding the Evolutionary Relationships Between Diploporitans And Other Stalked Echinoderms* (N. Gary Lane)

Fiann Smithwick, University of Bristol, *The morphological evolution of the Actinopterygii through the end-Triassic extinction event* (Richard K. Bambach)

Jack R. Stack, Ithaca High School, *Reexamination of Lost Paleozoic Fish Sites of the Michigan Basin to Assess Fish Diversity* (Rodney M. Feldmann)

Emily Tilby, University of Oxford, *The Cambrian animal* Myoscolex *and the earliest fossilized muscles* (Harry B. Whittington)

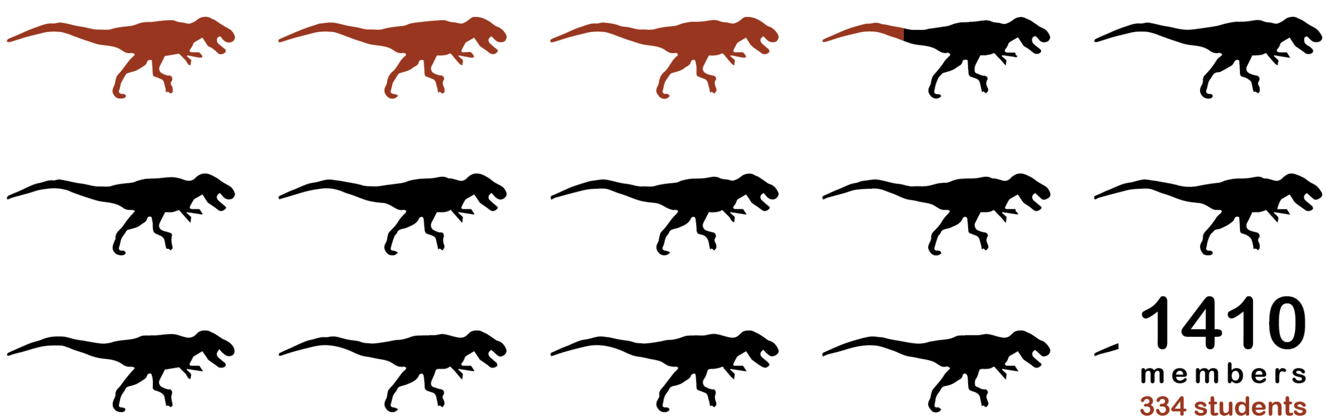
Margaret Veitch, University of Michigan, *Determining Predation Pressure Changes Across Time in Bourgueticrinids* (Kenneth E. & Annie Caster)

Anna M. Weiss, University of Texas-Austin, *Novel Ecosystems and Survival During the Paleocene-Eocene Thermal Maximum* (Kenneth E. & Annie Caster)

Shelby Willeby, University of Buffalo, *Morphometric Analysis of* Triarthrus beckii *in the Antes Shale of Central Pennsylvania* (Steven Jay Gould)

David F. Wright, Ohio State University, *Phylogenetic Paleobiology and Phenotypic Diversification of Pan-Cladid Crinoids* (N. Gary Lane)

2015 Membership in the Paleontological Society



1 *T. rex* = 100 people, based on the tyrannosaur body mass estimates from Hutchinson *et al.* (2011, DOI: 10.1371/journal.pone.0026037) and an average adult human mass of ~80 kg.

PS Sponsored Sessions at GSA

Geological Society of America Annual Meeting, 1-4 November, Baltimore, Maryland

SYMPOSIA

P1. Celebrating the Genius of William 'Strata' Smith: Bicentennial Anniversary of Smith's Revolutionary Map, *George H. Davis, Renee Clary, Suzanne O'Connell*
Smith's 1815 Geological Map of England and Wales and Part of Scotland stands as a milestone in the geological sciences. Smith's genius influenced geology's formative period, and beyond! The session explores "Smith" fundamentals in relation to our science today. Keynote Speaker: Hugh S. Torrens

P3. Earth-Life Systems at the Dawn of Animals, *James D. Schiffbauer, Marc Laflamme, Simon A.F. Darroch*
Geobiologists, evolutionary biologists, paleontologists, sedimentologists, geochemists, and Earth systems scientists are assembled to showcase high-impact research, identify the frontiers of current research, and present key questions to be addressed in future prospects on the rise of animals across the Precambrian–Cambrian transition.

TOPICAL SESSIONS

T12. From Peat to Coke: Honoring the Legacy of William Spackman, *Jen O'Keefe, Frederick Rich, Anne Raymond, John C. Crelling*
William Spackman spent his career applying paleobotany, palynology, organic petrography, and geochemistry to cradle-to-grave studies of coal systems, including coking and industrial applications. This session focuses on coal system science from wetland environments to coke.

T41. Digital Dirt: Evaluating and Minimizing Discrepancies that Accrue between Digital Data and the Natural World they Represent, *Walton A. Green, Benjamin Kotrc, Luke Mander*
This session is intended to attract case studies in digital data acquisition and quality control from any area of the geological sciences in which data accuracy critically affects theories about the natural world.

T46. Using Digitized Data in Geological and Paleontological Research, *Talia S. Karim, Gil Nelson*
Digitization programs in paleontology and geology are producing large amounts of easily accessible data. This session will present developments in the research uses of digitized geoscience data and recent advances in data-publishing and mobilization.

T97. Specimen-Based Research and the Reality of Paleontological Resource, Specimen and Data Management: Strengthening Partnerships among Federal Land Managers, Repositories, and Researchers, *Kathy A. Hollis, Brian T. Huber, Hans-Dieter Sues, Julia F. Brunner, Vincent L. Santucci, Scott E. Foss*
The goal of this session is to promote a better understanding of mutual interests in paleontological resources and what practices need to be in place for better science and resource management, including data accessibility and sharing, among all stakeholders.

T138. From the Caspian to Mediterranean: Environmental Change and Human Response during the Quaternary (IGCP 610), *Valentina Yanko-Hombach, Tamara Yanina*
The session provides cross-disciplinary and cross-regional correlation of geological, archaeological, environmental, and anthropological records to explore interrelationships between environmental change and human adaptation in the Caspian–Black Sea–Mediterranean corridors during the Quaternary.

T139. Insights from Microfossils, from Traditional to Novel Approaches (Posters), *Miriam E. Katz, Katharina Billups*
Traditional uses of microfossils are central to many research applications, while novel geochemical approaches utilizing microfossils have exploded in recent years. This session highlights both traditional and innovative microfossil applications in terrestrial and marine environments, including modern analogs.

T142. The Middle Paleozoic World, *Adam David Sproson, David Selby, James R. Ebert*
This session will explore new research related to changes in paleoclimatology, paleoceanography, paleoecology,

GSA Sponsored Sessions, cont.

sedimentology, stratigraphy, geochemistry, and tectonic evolution during the Silurian and Devonian periods.

T144. 200 Years and Going Strong: The Role of Paleontology in Geologic Mapping (Posters), *Lucy E. Edwards, Dee Ann Cooper, Roger W. Cooper*
In celebration of the 200th anniversary of the publication of William Smith's geologic map of Britain, this session illustrates how fossils continue to be important to geologic mapping in the 21st century.

T145. Conodonts from Black Shales and Other Rocks: In Honor of Anita G. Harris, *D. Jeffrey Over, Stephen A. Leslie, Randall C. Orndorff, John E. Repetski*
Conodonts continue to be in the forefront of research in Paleozoic and Triassic rocks. All aspects of current conodont-related research are welcomed; the session honors Anita Harris, whose own research spanned most of the field.

T146. Palynology, *Peter P. McLaughlin Jr., Iain Prince, Lanny H. Fisk , Karen Bogus*
This session features presentations from the field of palynology, including pollen, spores, dinoflagellates, other organic-walled microfossils, and associated particulate organic matter and kerogen, and encompassing both fossil and modern materials.

T147. Biotic Interactions and Their Influence on Long-Term Evolution, *Paul D. Taylor, Lee Hsiang Liow*
Biotic interactions such as competition, predation, and symbiosis are important ecological processes with consequences for long-term evolution but that require innovative approaches to infer in the fossil record because they are seldom directly preserved.

T148. Cenozoic Evolution of Tropical Biota and Environments: A Session Honoring the Contributions of Ann F. Budd, *James S. Klaus, Kenneth G. Johnson, Francesca R. Bosellini, Thomas Stemann*
A session honoring the contributions of Ann F. Budd to understanding the systematics, paleoecology, and macroevolutionary history of Cenozoic marine biota of the tropics in response to changing oceanographic and climatic conditions.

T149. Co-Evolution of Life and Planet: Broad–Scale Controls on Biodiversity, *Peter J. Harries, Richard J. Twitchett*
This session will explore links between the evolving Earth system, including the geosphere, atmosphere, and biosphere throughout Earth's history, with particular emphasis on factors controlling and influenced by biodiversity at various spatial and temporal scales.

T151. Foraminiferal Responses and Recovery from Environmental Stressors, *Michael Martínez-Colón, Benjamin J. Ross, Natasha Méndez-Ferrer*
This session seeks to highlight mechanisms responsible for spatial, temporal, or physiological responses to natural and anthropogenic environmental disturbances.

T152. Geobiology of Critical Transitions: Integrating Fossils, Proxies, and Models, *A. D. Muscente, Natalia Bykova, Jesse S. Broce, James D. Schiffbauer*
"Geobiology of critical transitions in Earth history" will bring together research on critical transitions throughout the geological record to further the understanding of interactions between the biosphere, lithosphere, and atmosphere during transformative intervals in Earth's history.

T153. Mass Extinction Causality: Records of Anoxia, Acidification, and Global Warming during Earth's Greatest Crises, *David P.G. Bond, Paul B. Wignall, Mike Widdowson*
This session explores the paleontology, stratigraphy, and geochemistry of mass extinctions, high-resolution records of anoxia, ocean acidification, and global warming, and their mechanistic links to the ultimate drivers of change (e.g., large igneous province eruptions).

T154. Phanerozoic Evolution in the Oceans: Effects of Warming and Chemical Changes, *Jere H.*

GSA Sponsored Sessions, cont.

Lipps, Malcolm Barrie Hart
The history and evolution of benthic and pelagic marine organisms have been impacted significantly by the five major and ~25 lesser Phanerozoic extinction and radiation events, resulting in new ecosystems and biotas.

T155. Timing of the Origins and Evolution of Unicellular Eukaryotes, *Malgorzata Moczydlowska-Vidal, Stanley Awramik, Heda Agic*
Search for affinities of unicellular eukaryotes by paleobiologic, biochemical and ultrastructural methods, and timing of major lineages origins by fossil record with the aim of reconstructing the tree of life and reconciling with molecular clock estimates.

T156. Earth Underfoot: New Frontiers in Ichnology and Zoogeomorphology, *Ilya V. Buynevich, Stephen T. Hasiotis, Brian F. Platt*
This session will feature recent discoveries in trace fossil research, neoichnology, and zoogemorphology, including novel techniques for identifying and characterizing traces in a variety of media, from continental to deep marine settings.

T157. Eat, Prey, Love, and Burrow: Tracing Animal Behavior through Time, *Adiël A. Klompmaker, Devapriya Chattopadhyay, Patricia H. Kelley*
Varied evidence allows interpretation of fossil animal behavior (e.g., ichnofossils, animals "caught in the act") geochemistry. This session presents research on any type of behavior (e.g., feeding, mating, locomotion, symbiosis) throughout the history of life.

T158. Perspectives on Multi-Element Skeleton Taphonomy: Case Studies, Approaches, and Advances, *Matthew B. Vrazo, James R. Thomka*
This session will explore new methods and concepts within taphonomic studies of organisms with multi-element skeleton (e.g., arthropods, echinoderms, vertebrates) for both ancient and modern ecological and environmental reconstruction.

T159. The Fossil Record of Parasite-Host Interactions: New Perspectives and Approaches, *John Warren Huntley, Kenneth De Baets*
Parasitism is ubiquitous among living organisms and there is a growing appreciation of its role in shaping the history of life. This session highlights advances in the study of parasites and hosts in deep time.

T160. Topics in Paleoecology: Modern Analogues and Ancient Systems, *Darrin J. Molinaro, Carolyn M. Furlong, Amelinda E. Webb, Gary J. Motz*
This session will highlight the diversity of paleoecological research, organized within the framework of biotic interactions/predation, community/organismal ecology, fidelity/conservation paleobiology.

T161. Echinoderm Paleobiology: Diversity, Form, and Phylogeny, *David F. Wright, Selina R. Cole, Jeffrey R. Thompson*
This session will address broad, cutting-edge topics in the understanding of echinoderm evolution and paleontology. This complex topic will include trends in phylogeny, morphology, paleoecology, macroevolution, taphonomy, and systematics.

T184. African Environments across Space and through Time: Integrating Modern and Ancient Climate Data for Insights into Terrestrial Ecosystem Dynamics, *David Patterson, Sophie B. Lehmann, Naomi E. Levin*
This session seeks to better understand the relationship between African climate and terrestrial ecosystem dynamics in both modern and ancient contexts.

T190. Paleoecological Patterns, Ecological Processes, Modeled Scenarios: Crossing Temporal Scales to Understand an Uncertain Future, *Miriam C. Jones, Simon Goring, Debra A. Willard*
This session will explore the visions, challenges and applications of paleoecological research that uses information at multiple spatial or temporal scales to improve predictive models of ecosystem, climate, and/or biogeophysical

GSA Sponsored Sessions, cont.

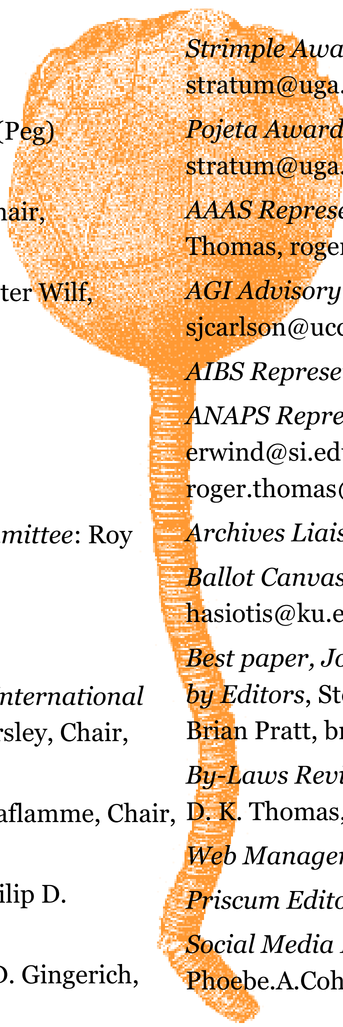
change.

T194. New Horizons in Paleogeography: Principles, Innovative Methods, and Application to Resource Exploration, *Adam D. Woods, Wan Yang*
Paleogeography is an interdisciplinary and inclusive field that integrates data from across the geosciences. This session will examine innovative paleogeographic principles and methods, modern and ancient analogs, and the application of paleogeography to resource exploration.

T199. Tracks in the Mud: Advances and Techniques in Vertebrate Ichnology, *Matthew R. Bennett, Peter L. Falkingham*
Vertebrate tracks, whatever the substrate or track-maker (ancient human or extinct dinosaur), catch the imagination. The community of engaged researchers is interdisciplinary, and this session will reflect this sharing knowledge, experience, and best practice.

T212. Deconstructing Rodinia: Neoproterozoic-Cambrian Geologic Evolution of Laurentia's Margins, *Chris Holm-Denoma, Arthur J. Merschat*
This session aims to bring together scientists with broad interests and ideas regarding the breakup of Rodinia and its impact on the geosphere and biosphere, especially in regard to the Neoproterozoic-Cambrian geologic evolution of Laurentia's margins.

Thanks to those who served as Society committee members, liaisons, representatives, and managers:



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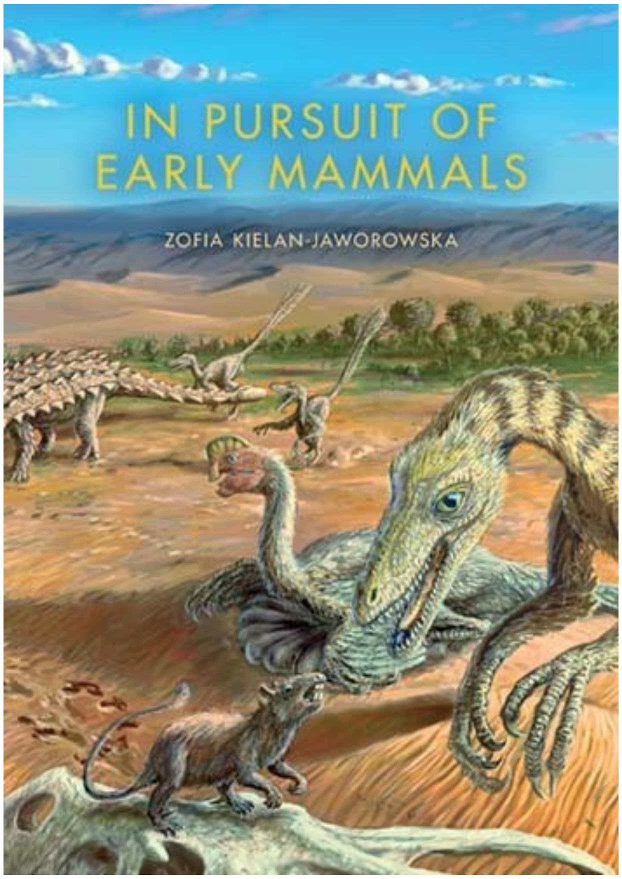
Book Reviews



Kielan-Jaworowska, Z. 2013. In Pursuit of Early Mammals. Indiana University Press, Bloomington, IN, 272 pp. ($42.00 cloth, $34.99 e-book with 30% PS discount.)

Reviewer: Stephen Brusatte (University of Edinburgh)

Professor Zofia Kielan-Jaworowska passed away in March 2015, just a few weeks short of her 90th birthday. I hope most readers recognize her name, because she was one of the giants of 20th century paleontology, but also a kind and humble person whose accomplishments are sometimes overlooked. She was born between the wars in Poland, survived her country's brutal occupation during World War II, and went on to a brilliant career at the Institute of Paleobiology of the Polish Academy of Sciences during the dark days of Polish communism. During the 1960s, she led a series of fossil-hunting expeditions to the Gobi Desert, at a time when few women were employed as paleontologists, much less fronting field parties to remote, dusty, unexplored areas of the world. These expeditions were a resounding success, as her teams discovered incredible Late Cretaceous dinosaurs and mammals that rewrote the orthodoxy on how these groups were evolving during the run-up to the end-Cretaceous extinction.

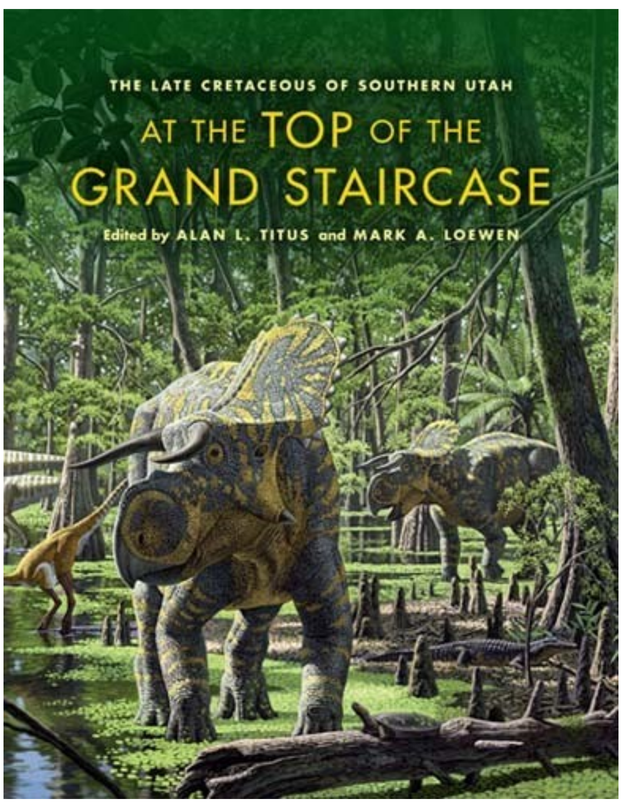
Zofia was a friend and mentor to many of us in the field, and I was privileged to get to know her while working in Poland a few summers ago. One of the highlights of my young career is being invited to share a nice meal with Zofia, her husband, and her feisty little lapdogs in their home in the Warsaw suburbs. As we munched on a bounty of Polish cakes and bread, Zofia regaled us with stories of her adventures in the field, and then took us into her study, where boxes of Cretaceous mammal bones were neatly stacked across every desk, shelf, and chair. Even in her advanced age, Zofia was able to recount where every specimen was found, and she clearly delighted in showing a 'dinosaur guy' like me the nuances of mammalian dental morphology. It deeply saddens me that other young scientists will no longer have the chance to get to know this remarkable scientist and human being.

But while Zofia herself may be gone, her impeccable knowledge of fossils and her field stories will live on in the many books and papers she's written. Just a few years before her death, she finished her final book, In Pursuit of Early Mammals. I was sent this book to review last summer but various procrastinations kept me from reading it, and only very recently, with a heavy heart after Zofia's passing, did I finally crack it open. It's a great read, and a wonderful tribute to Zofia's career. Part textbook, part personal narrative, this book succeeds in blending genres because of the warmth of the author. Whether she's talking about how mammals evolved their distinctive ear bones, or how she built a cabin out of plywood during a particularly cold field season in the Gobi, you know that a remarkable, passionate person is telling a story of science and adventure in her own words.

This book really stands apart as a story about how science works and about how scientists make new discoveries and push the boundaries of their field. For those of us interested in the history of paleontology,

Book Reviews

this book is a treasure trove of information on the Gobi expeditions: when they occurred, which sites they visited, who comprised the teams, when important specimens were found, what excitement and tribulations the teams had to contend with in the wind-swept wastelands of one of the world's biggest deserts. Zofia introduces the reader to many of her colleagues, and provides fascinating biographical sketches of many of the other giants who have studied Mesozoic mammals over the past century, many of whom were her close personal friends. While reading these passages, I harken back to those days as a child, sitting on the knees of my elderly aunts and uncles, learning about family history from the people who lived it, the people who would take those secrets to their graves if they didn't write it down or pass it on. It feels like a special privilege reading Zofia's stories, and it's a relief to know that these tales won't be forgotten.



Titus, A.K. & M.A. Loewan, eds. 2013. At the Top of Grand Staircase: The Late Cretaceous of Southern Utah. Indiana University Press, Bloomington, IN, 656 pp. ($59.50 cloth, $51.09 e-book with 30% PS discount.)

Reviewer: Cynthia D. Crane (Aurora Fossil Museum Foundation)

The last three decades have experienced a resurgence of geological and paleontological investigations in the southern Utah region known today as Grand Staircase -Escalante National Monument. This volume, At the Top of Grand Staircase: The Late Cretaceous of Southern Utah, provides a comprehensive foundation for future research ventures on Campanian-age strata worldwide. Editors Alan Titus and Mark Loewen have completed the excellent service of compiling a suite of various research topics—ranging from stratigraphic reviews and correlations to taphonomic studies—on this key scientific region.

Through incorporating the historical accounts within the modern research, a more thorough and standardized up-to-date overview of the geology of the region has been established. This work sets a precedent for future investigations and correlations, not only within the local area of the Grand Staircase-Escalante National Monument region but also across contemporaneous sites throughout North America. It is interesting to note that this region of the world offers the most robust geologic record of late Mesozoic environments, flora, and fauna, thus allowing for detailed investigations and interpretations.

Scratching the surface of the plethora of research possibilities, the first few chapters set the stage for an engaging read. Coupled with the geological accounts and chapters on the flora and fauna, including specific studies on freshwater fish, turtles, mammals, crocodiles, and theropod dinosaurs to name a few, this volume on the Grand Staircase-Escalante National Monument region provides a reference to assist in solving the Late Cretaceous paleontological puzzle of Southern Utah.

In closing, this volume presents the modern investigations in a very concise and structured manner. Although it is somewhat technical in nature, even the fossil enthusiast will be able to decipher its meaning and learn from the material presented.

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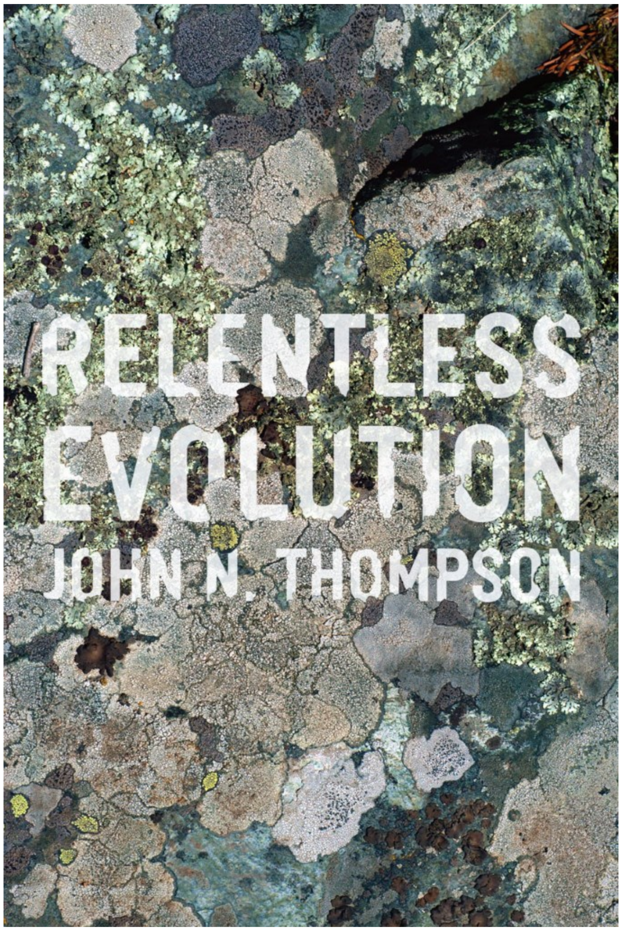
Kudos to the editors Alan Titus and Mark Loewen for compiling such interesting and engaging information into one nicely bound volume.



Thompson, J.N. 2013. Relentless Evolution. The University of Chicago Press, Chicago, IL, 512 pp. ($70.00 cloth, $24.50 paper, $7–$30 e-book with 30% PS discount.)

Reviewer: Hermann W. Pfefferkorn (University of Pennsylvania)

This book makes the point that evolution is "pervasive, relentless and often surprisingly fast" in a masterful treatment relying almost exclusively on investigations of living organisms. The 100 pages with ca. 1600 references give an idea of the scope of the synthesis that is presented. Methods are presented and evaluated, with numerous examples from a large variety of studies. Adaptive evolution is the center and starting point, and selection is discussed early. This includes stabilizing selection, the form that we as paleontologists are probably most familiar with. However, while some deep-time results are mentioned, all examples are from the Recent and describe the current state of knowledge of the very complex processes of coevolution of organisms across environmental and geographic gradients. The conclusion presented is that "much speciation appears to be ecological speciation." Thompson also points out that multispecific coevolution is in an early phase of research and that evolution of new lifestyles within large webs of organisms also plays a major role. This book is an excellent summary of what is known about evolution within short time frames and where the research is heading.

It is noteworthy that the term "macroevolution" does not occur in the index of this book even though the word "macroevolutionary" can be found as an adjective on page 336. The view presented is essentially that of current processes in their whole complexity. The viewpoint is different from that of a paleontologist but we can profit from this book. It shows what can happen after a mass extinction during an adaptive radiation when niches are open and competition reduced.

In the last chapter, John Thompson points out that "we are changing the Earth so quickly and in so many ways that we are imposing strong selection on a large proportion of the Earth's biodiversity all at once" (p. 387). He expresses it carefully, but it appears to me that we are creating and living in a major mass extinction and simultaneous adaptive radiation. His book presents a detailed introduction to our current knowledge of the mechanisms at work and I can recommend the book to any paleontologist. It also becomes obvious how little of these processes we might be able to elucidate in the fossil record or how much we have to advance our methods to understand processes of the past at the same level as those described in this book.

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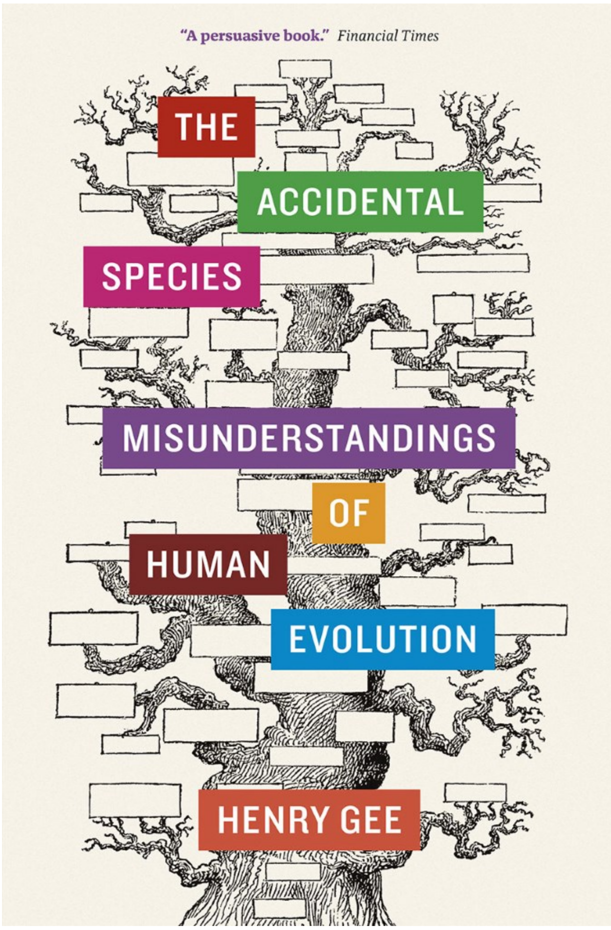

Gee, H. 2013. The Accidental Species: Misunderstandings of Human Evolution. University of Chicago Press, 224 pp. ($18.20 cloth, $10.50 paper, $10.50 e-book with 30% PS discount.)

Reviewer: Dee Ann Cooper (University of Texas at Austin)

Henry Gee opens The Accidental Species with intriguing information about the discovery of an unusually small and surprisingly modern species of hominid, *Homo floresiensis*. He uses this to illustrate the subtitle, Misunderstandings of Human Evolution. Splendidly and humorously, Gee explains the improbability of ever finding the legendary "missing link", so longed for by the general public, and explains the bias of the fossil record in a manner readable by most with some background in science. He acknowledges the mistakes and out-and-out hoaxes of historical evolutionary studies and how much "interpretation" has led to "misinterpretation".

Since acquiring "Early Man" (Time-Life Series) in 1965 at the age of 17, I have been enthralled with the evolutionary history of Homo sapiens. Unfortunately, the famous "March of Progress" foldout in that volume, illustrated by Rudolph Zallinger, harmed more than helped the understanding of human evolution. It forever fixed the image of "that gorilla slowly changing into a man" into the fears of creationist believers. Many have come to believe that belief in evolution and belief in religion are mutually exclusive concepts. Henry Gee refers to that illustration in The Accidental Species and discusses the "misunderstandings" it created. He points out that it was not intended to indicate a direct line of succession, but a "relationship" and offers an elegantly simplified cladogram as a way of explaining better and debunking the popularized misinterpretations of Darwin's and more recent evolutionary theories.

He includes a succinct overview of the various hominid ancestry hypotheses and how the fossil evidence does and does not support them. The idea that Homo sapiens has distinct characteristics that empower it with a superior-species status are nicely discredited without the reader feeling diminished. On the contrary, he maintains that the "accidental" traits acquired are in and of themselves special. Gee argues that scientists have been guilty of subjective thinking when analyzing the history of our own species, suggesting that "We just kind of turned out this way". He illustrates his premise with detail and an ironic approach.

This is the short, not overwhelming, supplemental text that needed to be written. Everyone from the educator to the interested amateur who finds him or herself in the creationist dilemma now has something thought-provoking to offer for a "good explanation". When someone starts "protesting on religious grounds" or bringing up that old "March of Progress" theory, they can be referred to this book that is, essentially, the history of the theory of human evolution demystified.

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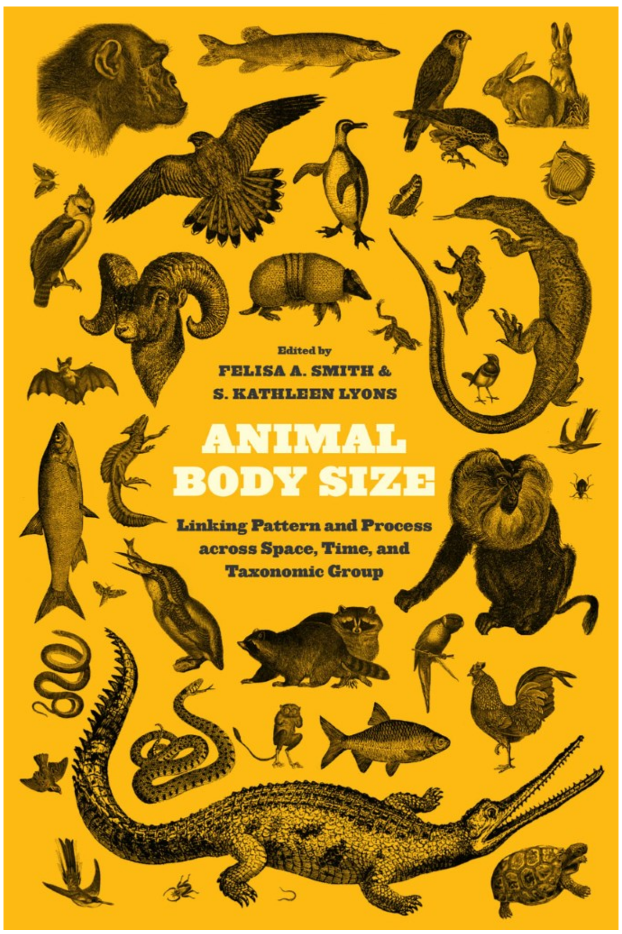
Throughout, Gee makes snide remarks at how "creationists" will take what he writes out-of-context, somewhat provocative remarks that lessen this much-needed work.

His notes are numbered within each chapter and can be found at the back of the book. This too is detrimental, especially for younger or less-experienced readers of academic works. Good old-fashioned footnotes would be an improvement in style.

I highly recommend The Accidental Species: Misunderstandings of Human Evolution for your bookshelf, despite these small shortcomings. Henry Gee "wraps up and ties with a bow" a concept I have been trying to teach for years.



Smith, F.A. & S.K. Lyons, eds. 2013. Animal Body Size: Linking Pattern and Process across Space, Time, and Taxonomic Group. University of Chicago Press, Chicago, IL, 280 pp. ($35.00 cloth, $4.90–$28.00 e-book with 30% PS discount.)

By Tomasz Borszcz (Polish Academy of Sciences)

Well established researchers Felisa Smith and Kathleen Lyons did a fantastic job bringing nine synthetic chapters on animal body size together in a single book. All chapters are written by experts. Smith and Lyons (or Lyons and Smith) not only edited this book but also contributed several chapters. I enjoyed—and learned a lot by—reading it. It's monothematic about being all about size, but put into more general ground attractive beyond the single topic. Body size is widely regarded as a crucial parameter of living organisms, with interest to both ecology and evolution. Animal size is rather straightforward to measure but our knowledge is still featured by numerous gaps, thus each account is welcome. New methods like automated compilations of body size data from literature and published illustrations (Peters et al., 2014) likely will facilitate process of data assembling in the near future. It is especially promising as data collection is extremely time consuming and only large databases yield insight into more general patterns (Smith and Lyons chapter). Body size is widely acknowledged as important due to a number of reasons, including its influence on morphology, physiology, ecology, fisheries, diversification and evolution of organisms on different spatial and temporal scales, among others. Thus I believe there is no need to convince anybody whether the new book should be published or how important it is.

The book opens with the Preface followed by the Introduction section on 'being the right size' written by the editors. Here, the readers are provided with the first sense of the variability of body size in organisms and the brief glimpse into history of research on body size. Six of the chapters are devoted to vertebrates, with special focus on mammals with only two on terrestrial invertebrates (land snails and insects). Such asymmetry could be expected given the book front-cover image, featuring sketch drawings of more than 35 differently sized species, mostly vertebrates.

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Collection of chapters is divided into two parts, the first focusing on patterns and trends and the second revolving around the processes, mechanisms, and consequences of body size. Notable is the lack of sections devoted to marine invertebrates, body-size patterns in modern seas, and more effort on fossil data, as these already offer ample evidence of body-size patterns. These provide a variety of direct evidences on the evolution of body size on a long geological timescale, including for extinct taxa (see Box 1). What really helps in navigating among chapters is the useful Index at the end of the book, but abstracts for each chapter with 'take home messages' are missing.

Chapter 1, written by Gaston and Chown, focuses on insect body size with nice overview of data from the fossil record. Well done ecologists! Patterns presented on modern organisms suggest both an increase and decrease in body size (or their parts) along latitudes and altitudinal gradients. Further, data on insect body sizes superimposed on a cladogram shows that wide variation observed between families is lessened within particular families, and genera tend to be more similar in size. Chapter 2 by Nekola and colleagues analyzed body size versus latitude relationships in land snails from rich collections from New Zealand, Europe and North America. Their new study establishes that such relationships do not exist within the species, and high-latitude communities are represented by greater proportion of small bodied taxa and smaller individuals. In light of their assembled data, they found a rather weak altitudinal variation in gastropod body sizes. They concluded that Bergmann's rule does not apply as a general pattern in land-snail biogeography. Large-scale analysis in Chapter 3 by Maurer suggests that structure of body-size distributions in birds is scale dependent and is influenced by the size of continents. I wonder if it works also in smaller scale in the sea, for example in the differently sized Arctic fjords with abundant Recent benthos, and if patterns of body size of bottom fauna are reproduced by zooplankton? Chapter 4 by Safi et al. tackles an overview of evolution of body size

Further reading on studies of body size in the fossil record

Heim N.A., M.L. Knope, E.K. Schaal, S.C.Wang, & J.L. Payne. 2015. Cope's rule in the evolution of marine animals. Science 347: 867–870.

Klug C., K. De Baets, B. Kröger, M. Bell, D. Korn, & J.L. Payne. 2015. Normal giants? Temporal and latitudinal shifts of Palaeozoic marine invertebrate gigantism and global change. Lethaia 48: 267–288.

Novack-Gottshall, P.M. & M.A. Lanier. 2008. Scale-dependence of Cope's rule in body size evolution of Paleozoic brachiopods. PNAS 105: 5430–5434.

Niedźwiedzki G., P. Gorzelak, & T. Sulej. 2011. Bite traces on dicynodont bones and the early evolution of large terrestrial predators. Lethaia 44: 87–92.

Sogot C.E., E.M. Harper, & P.D. Taylor. 2014. The Lilliput effect in colonial organisms: Cheilostome bryozoans at the Cretaceous–Paleogene mass extinction. PLoS ONE 9: e87048.

Urbanek A. 1993. Biotic crises in the history of Upper Silurian graptoloids: A palaeobiological model. Historical Biology 7: 29–50.

Thierry J. 1974. Etude quantitative de la dynamique des Collyritidae (Echinoidea) du Jurassique de Bourgogne. Bulletin de la Societe Geologique de France 7: 385–395.

Kier P.M. 1965. Evolutionary trends in Paleozoic echinoids. Journal of Paleontology 39: 436–465.

Trammer J. 2005. Maximum body size in a radiating clade as a function of time. Evolution 59: 941–947.

Trammer J. 2012. Two phases in the evolution of the body size of dinosaurs. Journal of Geography and Geology 4: 75–78.

Trammer J. & A. Kaim. 1997. Body size and diversity exemplified by three trilobite clades. Acta Palaeontologica Polonica 42: 1–12.

Trammer J. & A. Kaim. 1999. Active trends, passive trends, Cope's rule and temporal scaling: new categorization of cladogenetic body size changes. Historical Biology 13: 113–125.

Payne J.L. 2005. Evolutionary dynamics of gastropod size across the end-Permian extinction and through the Triassic recovery interval. Paleobiology 31: 269–290.

Payne J.L., N.A. Heim, M.L. Knope & C.R. McClain. 2014. Metabolic dominance of bivalves predates brachiopod diversity decline by more than 150 million years. Proceedings of the Royal Society B: Biological Sciences 281: 20133122.

Payne J.L., A.B. Jost, S.C. Wang, & J.M. Skotheim. 2013. A shift in the long-term mode of foraminiferan size evolution caused by the end-Permian mass extinction. Evolution 67: 816–827.

Peters S.E., C. Zhang, M. Livny, & C. Ré. 2014. A machine reading system for assembling synthetic paleontological databases. PLoS ONE 9: e113523.

Smith A.B. & C.H Jeffery. 1998. Selectivity of extinction among sea-urchins at the end Cretaceous period. Nature 392, 69–71.

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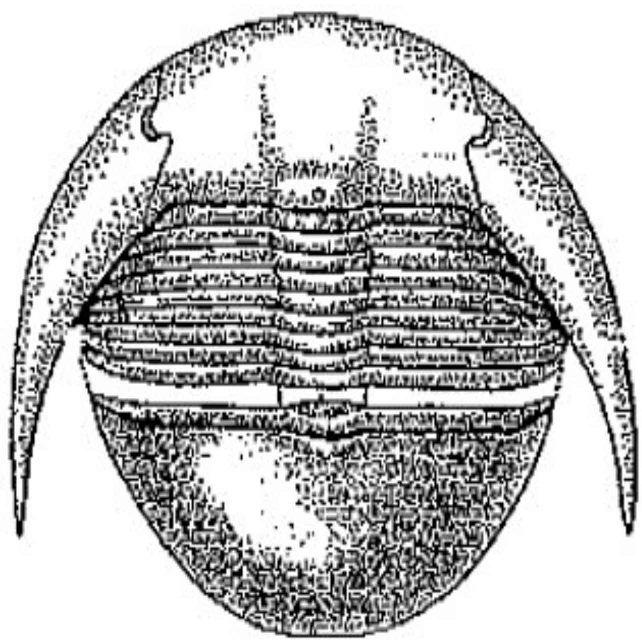
in bats. Body mass in those animals range from less than 2g to over 1kg and commonly show a right-skew (on a logarithmic scale) with constraint likely imposed by the limitations of flight. This chapter also highlights that there is a strong phylogenetic signal, and species' body mass is influenced by the mass of its ancestor. Such a conclusion could be an adventure for palaeontologists, as the new phylogenies appear frequently for the major clades, thus providing a great framework for conducting body-size studies in fossil taxa. In Chapter 5, which closes the first part of the book, Lyons and Smith focus on spatio-temporal macroecological patterns of body size in mammals. They notice that overall shape of the distribution developed early in the evolutionary history of mammals and remained consistent until the Pleistocene extinction. This chapter reminded me about the Lilliput effect that has been overlooked throughout the book (but see Box 1). According to the hypothesis of Urbanek (1993), post-extinction forms are smaller than predecessors, likely as response to the severe conditions during the biotic crisis (see comprehensive review in Sogot et al., 2014). The synthesis in this chapter argues that the relationship between body size and range size is recoverable in the fossil record, and concludes that discrepancies between modern patterns and these observed in the fossil record could be attributed to anthropogenic extinction of the late Pleistocene megafauna. One of the difficulties in studying body-size patterns in fossil material is how to cope with a potential bias imposed by size-sorting due to selective transportation of dead remains. Chapter 6 by Ernest delves into size distributions in mammalian community assembly. Since the nature of species size distributions are highly conserved, according to Ernest, this distribution may be a crucial aspect of how mammals assemble, regardless of habitat type or species composition. It is interesting to think, for example, whether marine invertebrates follow such a pattern and whether it is related to the past composition of their assemblages or rather to their Recent configurations in communities. In Chapter 7, Maurer and Marquet were interested in processes responsible for patterns we observe in body-mass distributions. The generality is that the size of a biological system affects and is affected by most processes that take place within it, including biotic and abiotic environment as well as internal and extrinsic factors. Maybe it does not explain too much, however, such a conclusion well illustrates the complex nature of body-size dependencies. Chapter 8 by Smith and others is centered around the influence of flight on body-size diversity and heritability. Their remarkable study confirms that body size of birds is highly heritable, in contrast with data on mammals. Therefore they ascertain that functional or biomechanical limitations are less constraining in terrestrial animals. Brown et al. uses Chapter 9 as a preliminary account to combine life histories of mammals with metabolic scaling and body sizes. Interesting! Such a marriage seems to be productive in terms of new insight into general themes and the variability of life histories, with interest well beyond variations in the class of mammals. All chapters are summarized in a final note, "The way forward", again written by the editors. Smith and Lyons point out that an historical perspective is largely missing for most groups (but see Box 1). It sounds like an invitation for paleontologists



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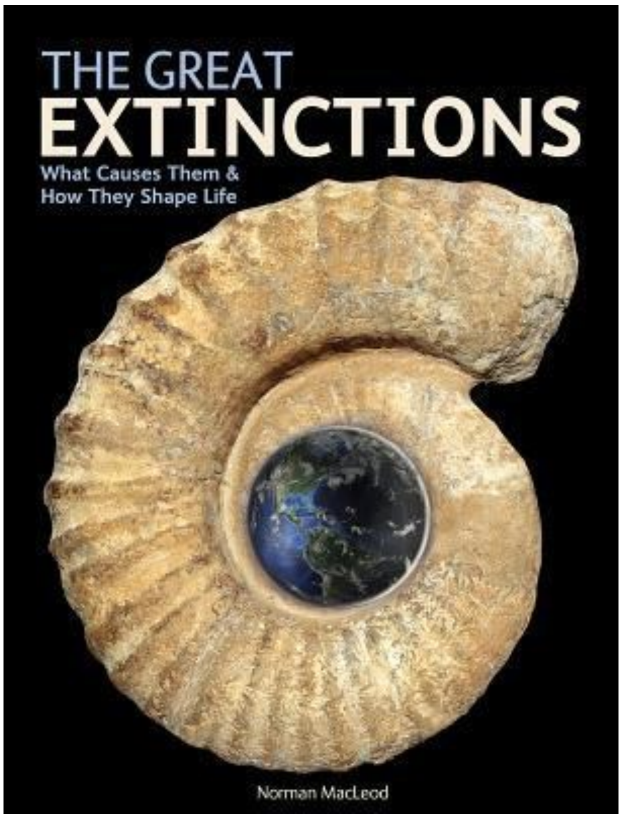
to the round table as we have much to say in this matter.

In my view, this volume is definitely a "must-have-and-read" book for all interested in ecology, evolution, paleontology or biology in general. It provides an invaluable reference point for starting researchers interested in working on body-size trends. The price is reasonable and proportional to the content. The copy I have is without a dust cover, but there would be no dust on this book on any shelf.



MacLeod, N. 2013. The Great Extinctions: What Causes Them and How They Shape Life. The Natural History Museum, London, UK, 208 pp. (£14.99.)

Reviewer: Alexei A. Rivera (Germantown, MD)

It has long been recognized that a wide variety of taxa are no longer with us. But perhaps only in the last thirty years or so, beginning with the empirical case that a gigantic asteroid collided with the Earth ending the Age of Dinosaurs, has the concept of extinction captured the public imagination at large. More recently, rapidly declining populations of threatened plants and animals have prompted many in the scientific community to declare a major anthropogenic extinction as occurring in our own time. Norman MacLeod, a micropaleontologist at the Natural History Museum in London, examines these and related topics in The Great Extinctions.

The initial chapters of this beautifully illustrated volume provide a useful summary of the principal features of extinction. Here, MacLeod elucidates the crucial difference between the anagenetic transformation of one species into another and the actual termination of lineages, the simple mathematical equations typically employed to estimate rates of extinction, and the nature of mass and background extinctions. Next is an overview of the proximate and ultimate causes of extinction. Marine anoxia, volcanic eruptions, and other abiotic killing mechanisms receive attention as expected, but unfortunately absent in this section is any meaningful treatment on potential biotic triggers of extinction. There is convincing evidence, for example, that global cooling induced by the proliferation of terrestrial coal swamps initiated a mid-Carboniferous mass extinction, while microbes might have played a deadly role in numerous ancient crises.

A roster of notable extinctions, arranged chronologically from Precambrian time to the present day, comprises the subsequent bulk of the book. Each of these chapters reviews the geologic setting of the crisis in question, the types of victims it claimed, as well as its timing and possible causes. This survey is admirable in terms of breadth, but is weakened by uneven and sometimes tendentious coverage. Surprisingly, it barely mentions the devastating Guadalupian event, a mass extinction distinct from the terminal Permian and one of the largest to have transpired in the Phanerozoic Eon. Tabulate corals, brachiopods, crinoids, and others were heavily afflicted. Yet the Paleocene-Eocene Thermal Maximum, a later interval distinguished by comparatively minor episodes of dying, draws intense scrutiny. In contrast to most researchers, MacLeod also rejects the sudden and catastrophic Chicxulub

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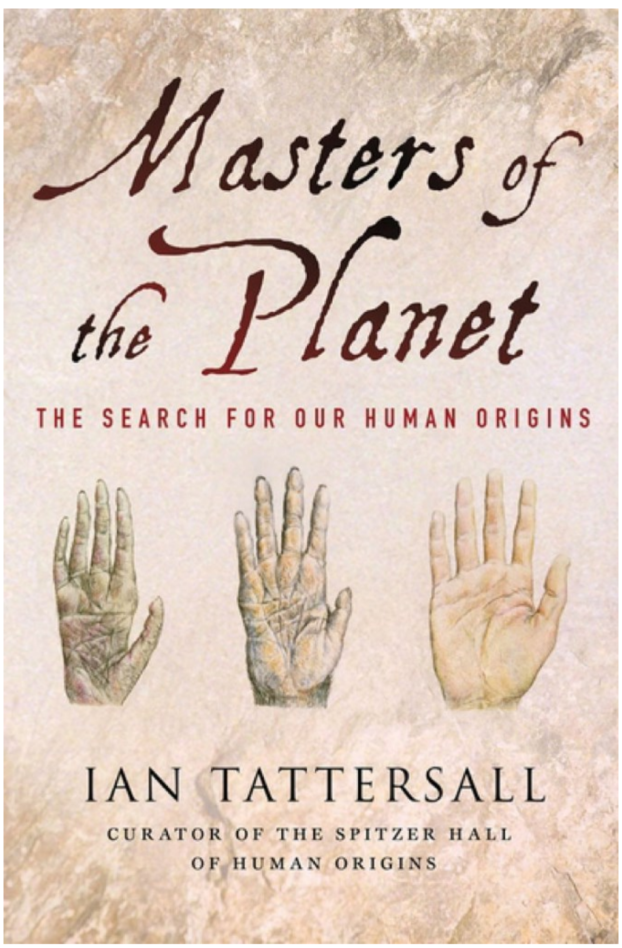
bolide impact as a prime suspect in the terminal Cretaceous mass extinction. Instead, he implicates multiple interacting causal factors, including sea-level regression and the protracted alteration of atmospheric and ocean chemistry via the massive outpouring of the Deccan Traps in India.

Those who study extinction may not necessarily agree with all of MacLeod's arguments or his interpretations of the available data. Why was the Signor-Lipps effect, for instance, not invoked as a plausible explanation for the seemingly gradual extinction patterns observed below the K/T boundary (pp. 126–28)? But the main value of this book, as I see it, is its ability to reach a broader audience beyond the arcane world of specialists in the earth sciences. For those who seek an accessible introduction to the history of life and insight into the inevitable fates of species, The Great Extinctions largely satisfies.



Tattersall, I. 2012. Masters of the Planet: The Search for Our Human Origins. Palgrave Macmillan, New York, NY, 288 pp. ($26.00 cloth.)

Reviewer: Alexei A. Rivera (Germantown, MD)

The term 'Stone Age' conjures visions of bestial cave men, but what does twenty-first-century science actually say about human origins? Ian Tattersall, a paleoanthropologist at the American Museum of Natural History, interprets the human story as read from the archives of prehistory in Masters of the Planet.

Interspersed with line drawings and black-and-white photographs, the book is divided into fourteen chapters. Quickly dispelled is the obsolete notion of a ladder-like ascent from apes to man. Instead, the pattern of ancestry and descent within the hominid family is now depicted as a bush-like phylogeny (p. 12). To his credit, Tattersall has kept abreast of recent research regarding the admittedly less than pristine hominid fossil record. He describes key discoveries, all of which were made in the last decade or so, including fragmentary remains (Sahelanthropus and Orrorin) dating to late Miocene time that represent the earliest known hominids, the diminutive meter-tall 'hobbits' (Homo floresiensis) from the tropical island of Flores in Indonesia, and the so-called Denisovans, long-lost Neanderthal cousins catapulted into the scientific spotlight by the unexpected finding and subsequent mitochondrial DNA analysis of a single finger bone.

What is lacking, however, is any substantive explanation for the sudden appearance of the genus Homo, a fundamental problem in paleoanthropology. One leading theory suggests that the onset of the late Neogene Ice Age was closely related to this event. Triggered by changes in oceanic circulation caused by the tectonic uplift of the Isthmus of Panama approximately three million years ago, the Northern Hemisphere glaciation initiated extensive vegetational deterioration in Africa, particularly the shrinkage of forests. Australopithecines that normally sought refuge in trees either adapted to the expansion of the

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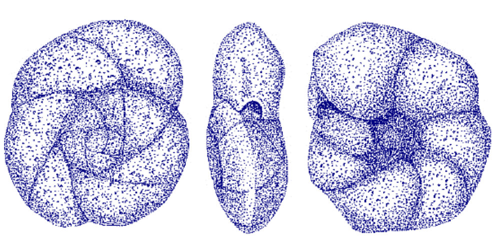
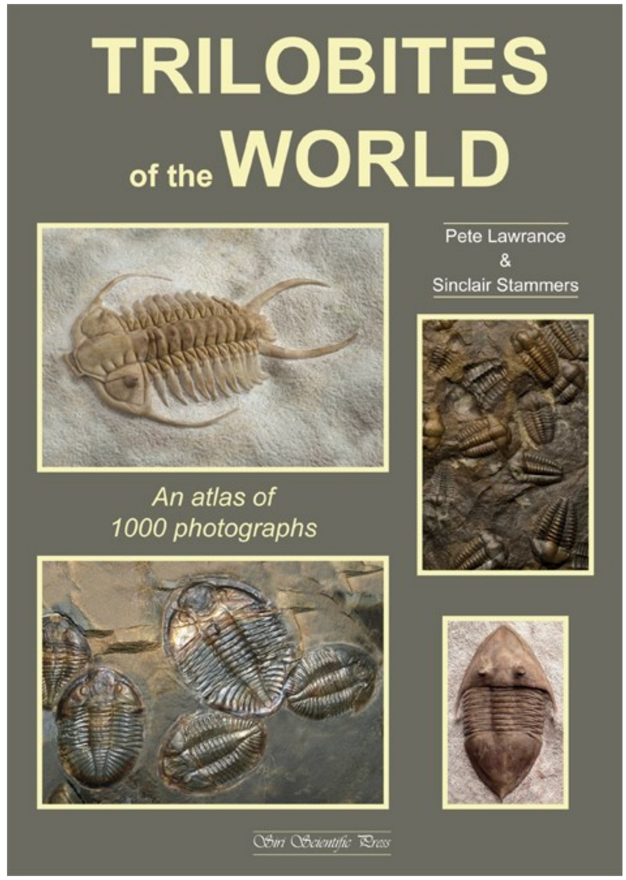
African savannah or fell victim to its numerous predators, which included several types of saber-toothed cats. According to this scenario, such an ecological imperative might have allowed the development of the large brains characteristic of advanced hominids.

Expressed more abundantly in later chapters, the primary argument coursing throughout this book is that the domain of symbolic cognition belongs exclusively to Homo sapiens. The famous Upper Paleolithic paintings at Lascaux and Altamira, as well as various other artifacts, clearly demonstrate that the anatomically modern Cro-Magnon people of Europe possessed a technological and cultural sophistication surpassing the comparatively stagnant Mousterian culture of their Neanderthal counterparts. But evidence indicates that Tattersall's conclusion that Neanderthals (Homo neanderthalensis) lacked this capacity (pp. 179-84) is premature. Inside the Shanidar Cave in the Zagros Mountains of Iraq is a Neanderthal burial deliberately adorned with flowers. Personal ornaments, colorants, and decorated bone tools from the Grotte du Renne in north-central France and a cross-hatched rock engraving in Gibraltar, all attributed to Neanderthals, reinforce the case that abstract thought is not unique to our species.

Although I disagree with some of Tattersall's views, Masters of the Planet represents a diligently researched assessment of the major features of hominid evolution. It can serve as a useful reference for paleontologists who are 'outsiders' to this field of study and as an introductory account for the interested lay-reader.





Lawrence, P. & S. Stammers. 2014. Trilobites of the World: An Atlas of 1000 Photographs. Siri Scientific Press, Manchester, UK, 416 pp. (£45 paper; available directly from publisher at www.siriscientificpress.co.uk.)

Reviewer: Jakob Walløe Hansen (Natural History Museum of Denmark; University of Copenhagen)

Always having been a source of amazement to me—and still remembering the moment when I, at the age of 12, found my first specimen in the Silurian deposits of the Baltic island of Gotland (Sweden)—trilobites have stood as the fossil to me. Therefore I was very glad to get the opportunity to review this volume. Being fortunate enough to having found many other specimens since then—the latest being a Buenellus higginsi—I truly enjoy the huge satisfaction and pleasure of re-earthing something that hasn't seen the light of day for millions and millions of years.

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I'm sure that it is with the same sense of joy that collector Pete Lawrence and photographer Sinclair Stammers have collected their thousands and thousands of trilobites, on the basis of which they have presented a stunning array of trilobite photos in their new volume Trilobites of the World. The book contains 1000 colour photos of almost 700 species—and they are amazing, in many ways! For trilobites come in various sizes and morphologies, and they come in numbers, very high numbers: around 20.000 described species, and still more yet to come. This makes them by far the most successful, diverse and morphologically complex group of animals of the Palaeozoic.

This and many other interesting facts are included in this wonderful atlas. As the authors say: this book is for trilobite enthusiasts. And quite so! It does not waste time on an introduction to trilobites, other than the most basic one. However, it does yield a good portion of information as to where to go look for trilobites. And that exactly might be the focal point of the book; acting as an identification key, in an entertaining and non-scientific manner.

The atlas covers trilobites from every corner of the world as well as the whole timespan of the trilobite reign through a very thorough introduction to the major trilobite deposits, a comprehensive reference list, and finally an appendix, which highlights the trilobites included in the book. The photos are all in color and accompanied by short descriptions.

These marine creatures, whose divergence, new studies indicate, could show implications for the Cambrian Explosion, are one of the most iconic fossil groups around, and the photo atlas emphasizes this point. Thus it becomes a very welcome addition to the many other books on trilobites that have been published over the last few years.

Acadoparadoxides, Bettonolithus, Calymene...; if you should ever want to indulge in trilobite names and illustrations, this is definitely one of the better ways to go about business. Enjoy!

In case you were wondering: Percent occurrence of the words "paleontology", "paleobiology", and "geobiology", found in Google Books written in English between 1800-2000.

Books Available for Review

The following volumes are available to Paleontological Society members in exchange for writing a review for *Priscum*. Reviews should be informative, engaging, and 400–800 words long. The tone can be informal and casual, appropriate to recommending or critiquing a book to friendly colleagues. (Longer reviews are allowed, but please request ahead of time.) Reviews should be submitted by May 1 for inclusion in the Spring/Summer issue or Dec. 1 for inclusion in the Winter issue. Reviewers must be a current member of the Paleontological Society before beginning review. If interested in reviewing one of these volumes, please contact book review editor Phil Novack-Gottshall (pnovack-gottshall@ben.edu). Reviews will be assigned on a first-claimed basis to individuals with appropriate knowledge and experience with book content.

Bose, R. 2013. **Palaeobiology of Middle Paleozoic Marine Brachiopods: A Case Study of Extinct Organisms in Classical Paleontology.** SpringerBriefs in Earth Sciences. Springer.

Bose, R., and A. Bartholomew, 2013. **Macroevolution in Deep Time**. SpringerBriefs in Evolutionary Biology. Springer.

Copestake, P. and B. Johnson. 2014. **Lower Jurassic Foraminifera from the Llanbedr (Mochras Farm) Borehole, North Wales, UK.** Monograph of the Palaeontographical Society No. 641.

De Baets, K., C. Klug, D. Korn, C. Bartels, and M. Poschmann. 2013. **Early Emsian Ammonoidea and the age of the Hunsrück Slate (Rhenish Mountains, Western Germany).** Palaeontographica Beiträge zur Naturgeschichte der Vorzeit Abteilung A 299.

Gangloff, R.A. 2012. **Dinosaurs under the Aurora.** Indiana University Press.

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Eldredge, N. 2015. **Eternal Ephemera: Adaptation and the Origin of Species from the Nineteenth Century Through Punctuated Equilibria and Beyond.** Columbia University Press.

Fariña, R. A., S. F. Vizcaíno, and G. De Iuliis. 2013. **Megafauna: Giant Beasts of Pleistocene South America.** Indiana University Press.

Főzy, I. and I. Szente. 2013. **Fossils of the Carpathian Region.** Indiana University Press.

Lomax, D.R. and N. Tamura. 2014. **Dinosaurs of the British Isles.** Siri Scientific Press, Manchester.

Mohibullah, M., M. Williams, and J.A. Zalasiewicz. 2014. **Late Ordovician Ostracods of the Girvan District, South-West Scotland.** Monograph of the Palaeontographical Society No. 640.

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Memorial to Dr. W. A. "Bill" Cobban, 1916-2015

By Neal L. Larson[1], Neil H. Landman[2] and Stephen C. Hook[3]

Dr. W.A. "Bill" Cobban, one of the most highly respected, honored and published geologist-paleontologists of all time, passed away peacefully in his sleep in the morning of April 21, 2015 at the age of 98 in Lakewood, Colorado. Bill was an extraordinary field collector, geologist, stratigrapher, biostratigrapher, paleontologist and mapmaker who spent nearly his entire life working for the U.S. Geological Survey (USGS). In a career that spanned almost 75 years he fundamentally changed our understanding of the Upper Cretaceous Western Interior through its fossils making it known throughout the world.

William Aubrey "Bill" Cobban was born in 1916 near Great Falls, Montana. As a teenager, he discovered a dinosaur in the Kootenai Formation catching the attention of Barnum Brown, premier dinosaur collector at the American Museum of Natural History, where the dinosaur now resides. A few years later, as Bill told, he read about the discovery of fossil bones in Shelby, Montana during excavation of the Toole County Courthouse. The bones turned out to actually be baculites and other iridescent ammonites. These ammonites made such an impression on Bill they would change his life forever. He attended Montana State University in 1936 where he met a geology professor who encouraged an already developing love for geology and paleontology and received his B.S. in Geology in 1940.

Immediately after graduation Bill went to work for Carter Oil Company (now Exxon) in Shelby as a geologist, stratigrapher and mapmaker. He married Ruth in 1942 and began a family. During that time, he met John Reeside and Ralph Imlay of the U.S. Geological Survey who traveled from Washington each summer to do field work in the West. They convinced Bill, in 1946, to pursue his Ph.D. at Johns Hopkins University in Baltimore under the guidance of Harold Vokes, a specialist on fossil molluscs. Bill was able to work on his Ph.D. while being partly and then fully employed by the USGS and received his Ph.D. in 1949. The works that emerged from Bill's dissertation were detailed studies of the ammonites and stratigraphy of the Colorado Group, especially from the Sweetgrass Arch in Montana. Bill produced USGS Professional Paper 239 in 1951 on these scaphitid cephalopods from the Colorado Group and therein presented one of the best-documented examples of sutural evolution showing the transformation of the first lateral saddle from symmetrically bifid to asymmetrically bifid to asymmetrically trifid to symmetrically trifid.

During his initial years at the USGS, Bill mentored under John B. Reeside, Jr., the father of modern Western Interior biostratigraphy. Working with Reeside, Bill learned first hand the importance of biostratigraphy and the significance of identifying distinct species from different zones. While at the Survey he began organizing and cataloguing the collections that he and close friends and colleagues James Gill and Glenn Scott made. These geologists spent their lives collecting,

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mapping and publishing on the geology, stratigraphy and the invertebrate fauna of the Western Interior Upper Cretaceous (Cenomanian-Maastrichtian) marine sediments. The collections that these men assembled are unequaled anywhere and their research defined our ideas of biostratigraphy and ammonite diversity within the marine Western Interior.

Another early landmark publication was Bill's 1960 USGS Professional Paper with John Reeside on the gastroplitid ammonites of the Mowry Shale. Therein, Bill documented the enormous variation in these ammonites and challenged the traditional notions that ammonite taxonomy emphasized type concepts, instead embracing the concept of biological variation within a species. This idea would form the basis in many of his later works.

For many workers, Bill's 1966 publication with James Gill on the Red Bird Section of the Pierre Shale was one of the most notable in his career. He and Gill succeeded in subdividing the thick, homogenous, black marine shales of this formation into a sequence of identifiable biostratigraphic ammonite zones, which formed the basis of ammonite zonation of the Campanian of the US Western Interior and the standard to which the world tries to correlate. This paper also contained Bill's famous diagrams of the shifting western shorelines of the Western Interior Seaway in Wyoming from the lower Campanian through the lower Maastrichtian.

For scaphite workers, few of Bill's papers compare to his 1969 classic publication on *Scaphites leei* and *Scaphites hippocrepis*. Although sexual dimorphism was a popular theme in ammonite studies for more than a century, particularly with respect to Jurassic ammonites, Bill demonstrated unequivocally the existence of sexual dimorphism in scaphites. Relying on carefully collected specimens and focusing on collections from single concretions, Bill recorded the presence of two morphs for each species, distinguished by differences in the shape of the mature body chamber. This paper resulted in the re-interpretation of scaphite taxonomy and evolution worldwide.

Bill loved working in the Upper Cretaceous of New Mexico. From 1960 to 1990 nearly one third of his papers (135 in this time frame) came from the geology of New Mexico. Topics included stratigraphy (intertongued Dakota/Mancos, Juana Lopez and the Tres Hermanos Formations), correlation (Gallop Sandstone) and systematic paleontology (*Collignoniceras woollgari woollgari* and the ammonite faunas of southwestern New Mexico). The 1989 paper by Cobban, Hook and Kennedy documented in stratigraphic detail the most diverse, late Cenomanian ammonite fauna in the world, an amazing 31 genera and 64 species! Bill discovered that southwest New Mexico was a key area during the Late Cretaceous because here the coldwater boreal faunas of the Western Interior intermingled with the warm water Tethyan faunas of Europe and Africa, thus providing a means of international correlation.

Cobban and Kennedy's 1976 publication on the aspects of ammonite biology, biogeography, and biostratigraphy was another brilliant work. In this paper Bill enlightened the world with his understanding and ideas of ammonite biology, morphology, mode of life, sexual dimorphism, post-mortem taphonomy and taxonomic problems. He also utilized his great experience in the field to discuss the importance of ammonite fossils in biostratigraphy and their significance in geographic distribution as well as in Continental Drift. This was the first paper that Kennedy and Bill coauthored but it would not be their last. Over the next 57 years the two would collaborate on 96 more papers and correlate some faunas from the Western Interior to those of Europe thus establish International correlated ages and zones.

Perhaps one of his finest works came in 2006. After a career of collecting, research and examinations, he and his co-authors produced a masterpiece that will be utilized worldwide by geologists and paleontologists for decades. This opus is an all-in-one culmination of all of Bill's geologic, biostratigraphic and radiometric work. Entitled: *A USGS Zonal table for the Upper Cretaceous middle Cenomanian-Maastrichtian of the Western Interior of the United States based on ammonites, inoceramids, and radiometric ages* it compiles the complete, complex zonation of the marine Upper Cretaceous of the Western Interior with their corresponding ages.

During his career, Bill visited and collected more Cretaceous outcrops

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than any other geologist past, present or future. From his records he helped create a USGS database that contains over 14,000 Mesozoic mollusk localities from the Western Interior and nearly 1000 other localities he visited in the southern, southeastern and eastern United States. At every locality, Bill took measurements (whenever possible), collected fossils and made impeccable notes. His publications showed his uncanny abilities of observation, interpretation and deduction. Bill shared his knowledge with all those around him and with everyone who visited him at Denver or accompanied him in the field.

Bill is responsible for naming and defining most of the 71 Upper Cretaceous ammonite zones of the Western Interior. Along with colleague John Obradovich, he was able to assign the most accurate and widely accepted Ar/Ar dates to most of the Upper Cretaceous bentonite layers. These zones and their corresponding ages are recognized and used by geologists worldwide as the standard for Upper Cretaceous zonation of the US Western Interior. Bill was involved in the systematic descriptions of hundreds of invertebrate fossils naming at least 35 genera, 2 subgenera, 215 species, and 11 varieties of ammonites along with 18 species of inoceramids.

Bill was a disciplined researcher who authored and co-authored more than 335 papers on the invertebrates, biostratigraphy and geology of the North American Late Cretaceous. Bill published 68 papers as the sole author but preferred working with other people. Over a span of more than 70 years he collaborated with over 110 other respected geologists and paleontologists worldwide to publish scores of peer-reviewed papers. He continued to publish up to the time of his death.

At the age when most of his peers retire, Bill was really getting started at writing. Most of his papers, more than 200 of them, came after age 65. He continued to drive to work every day and go out in the field until age 95 when he suffered a badly broken arm after falling from a ladder. From then on his life changed. He and his wife would move from their home of more than 65 years into an assisted living facility. Ruth would not last a year, but Bill kept on going, although not to work. Colleagues continued to send him papers to review and co-author that they had been working on prior to his move and he would add his ideas and thoughts, but without regular access to his library and collection he could no longer do the same work and include the same insight that drove and inspired him for decades.

Bill was also one of the most esteemed paleontologists that ever lived. He had four ammonite genera, one bivalve genus, one plant genus and 18 species of invertebrates named in honor of him. In 1974 he received the **Meritorious Service Award**, the second-highest departmental honor award that can be granted to a career employee in the Department of the Interior. In 1985 he was awarded the **Distinguished Geologist Pioneer Award**, which is awarded by the Paleontological Society to recognize outstanding contributions in paleontology. In 1986 he was given the **Distinguished Service Award**, the highest departmental honor award that can be granted to a career employee of the Department of the Interior. In 1990 he was awarded the **Raymond C. Moore Paleontology Medal** by the Society for Sedimentary Geology (SEPM) International, in recognition of "Excellence in Paleontology”. In 2004, his peers at the 6th International Symposium on Cephalopods Past and Present honored Bill with a **Lifetime Achievement Award** for his unselfish, meritorious work on the Late Cretaceous ammonites of North America. In 2006 a paleontological symposium was held at the Colorado School of Mines as a **tribute to the life and career** of Dr. W.A. “Bill” Cobban. In 2007, he was given the **Dallas Peck Award** for a lifetime achievement of scientific excellence in the US Geological Survey's geologic division. And in 2011 the Geological Society of America hosted two special symposia dedicated to Bill Cobban at their annual meeting.

Bill was preceded in death by Ruth-his wife of 75 years, both parents, a grandson Colt Baird and close colleagues Jim Gill, John B. Reeside, Glenn Scott and Jake Hancock. He is survived by his daughter Georgina Egbert, sons Robert and Bill and by hundreds of close friends and colleagues who were fortunate to have gotten to know him. Dr. Cobban will forever be remembered through his many publications especially and dearly remembered by each and everyone who had the opportunity to visit this great man and the collections he compiled and organized at the Denver Federal Center in Building 810. His fieldwork on the ammonites

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and geology of the Upper Cretaceous Western Interior will never be equaled; his contributions and insight will be utilized for generations. He left this world a much better place and all who knew him were enriched by his friendship, patience, wisdom and knowledge. There was no one quite like Bill and he will be greatly missed!

For a complete, updated listing of Bill's bibliography; his published genera and species; and genera and species named in honor of him go to http://www.aaps-journal.org/pdf/Larson-Cobban-historical-paper.pdf

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"Using Raup's analysis of helical coiling show how variations of his four parameters might lead to disjunct coiling of gastropod shells. What might be the selective advantage of disjunct coiling to a gastropod?"

"Romer described two distinct morphological entities and treated them as different parts of the same species. Kesling described two distinct morphological entities and treated them as male and female individuals of the same species. Wilson described two distinct morphological entities and treated them as gamont and agamont forms of the same species. Beerbower described two distinct morphological entitites and treated them as ecologically determined variants of the same species. Linsley described two distinct morphological entities and treated them as mature and immature members of the same species. Berry described two distinct morphological entities and treated them as separate species. What criteria are available to a paleontologist which allow him to make these kinds of decisions?"

From Linsley, R.M., 1970, Undergraduate paleontology in a liberal arts college; or, "How many thousand genera do they really need to know?", *Proceedings of the North American Paleontological Convention 1969*.

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Ideas for *Priscum* content?

Do you have any ideas for content for the *Priscum* newsletter? If so, please contact Matthew Powell (powell@juniata.edu). We are interested in including a wide range of content of possible interest to members of our Society. Consider anything from a short description of a future GSA symposium or field trip you are planning to an op-ed sharing a cantankerous viewpoint on a topical issue, an idea for a regular *Priscum* feature, or memorable photos of fossils or fieldwork.