Palaeontologia Electronica
http://palaeo-electronica.org

The Future of Paleontology—The Next 10 Years:

Jere H. Lipps

Now there's a title that will either intrigue you or repel you. I am repelled. Why? Because past predictions of where paleontology was headed seemed so, so, ... , well, discouraging at the time and silly now. Papers and speeches on the "twilight", the "decline", the "end", the "deterioration", the "failure", the "hopelessness", or the "bleakness" of various paleontological disciplines and certainly of good jobs in the future were often just too much even to do anything about. I rebelled for a while and then I decided those harbingers of doom were wrong in large part. We are still in business in all aspects of paleontology, the field is increasingly exciting as I see it, and jobs are still available. Not as many jobs as we'd like but perhaps there's a reason for that—we can explore it later in this essay.

Everyone wants to know what the future holds, of course, but that's just impossible. These past projections suggest that it's a waste of time to worry about it! If you are concerned about it, then do something. As far as I am concerned, the future for paleontology is glorious. We're nowhere done with it and it will endure with excitement, I'm sure, for the rest of all of our lives—and our students and kids lives as well. So let's not worry about it. That's my prediction.

Where do we go then, on this, the Tenth Anniversary of the first issue of *Palaeontologica Electronica?* Naturally, I have some ideas! I was attracted to either the past or the future for this editorial but I knew not which when I began. I could extol what this now-established e-journal has accomplished--and it looms large although it is not yet at its full potential—or I could focus on the future of paleontology itself. The past you already know about, unless your head was in the sand, but the future, none of us can know about really. In fact, all those dire messages I've read and heard over the decades, including the advice of my college advisor that I should "leave geology because you'll never get a job in the field", turned out to be very inaccurate (fortunately!).

I'll do neither. Instead, here's a list of subjects that may bloom or may die in the future. Some should die while others should flourish. Only you can make that choice! Here are my examples, for what they are worth, in two categories—the science of paleontology and the sociology of paleontology. Two quite distinct but very important areas with problems we may and probably will be faced with in the next decade, or more likely, even longer. I hasten to note that paleontologists are working on these problems, but I think these examples are still major issues that deserve discussion or have been discussed but just not enough. These could also provide some of the big break-throughs in paleontology in the coming decade. Nevertheless, they are only examples of the kinds of topics that we will be excited about, and I can only tweak your imagination and energy to think even more widely and deeply about what paleontologists can do in the next decade. You can post your own ideas in this journal. or on Paleonet. Go ahead, we'd all be interested.

The Science of Paleontology:

1. The Past is the Key to the Present: Deep time's contribution to modern biology and environmental impacts is great because these things are the result of long historical processes. We need to know that history, because humans have rather messed up the modern environments of Earth, in many places so badly that we have little idea of what the pre-human environment was like. Ecologists deal with these issues, but mostly without knowledge of how things were or were changing in the past. Our fossil record shows that change is normal for the Earth but many environmentalists would

reconstruct deteriorated environments more to their own vision than to what these places may have been like in the past. That is a normal human reaction to the environment as to other things, and the cause of many conflicts over whose values will be honored. Maybe these values are a good objective since most of what humans do is value-driven anyway. In this case, however, the imposition of values on a system should at least acknowledge what these systems were like in the past as a basis for judging how far off the natural ones our values may be and what kinds of changes that may void the value decisions we might expect later. Only paleontology can tell us this. As examples, Karl Flessa and his team have been doing this for the Colorado River Delta for quite some time and Jeremy Jackson and his large group (2001) have done it for marine resources generally.

2. The Past is also the Key to the Future: Deep time may also contain solutions to many of our future environmental and conservation dilemmas. Because the Earth and life are not stable through time and change always is happening, potential future situations have probably happened before. Again, only geologists and paleontologists can know these things. We have a big role to play in predicting the future. Global climate change analyses already take deep time issues into consideration, but so should a variety of solutions to other problems and changes.
3. PaleoBioDiversity. This topic is an example of one of the better studied subjects in paleontology that has yet to achieve its full potential to solve further research problems and, more importantly, the practical modern problem of biodiversity declines. While we know a great deal about each of these subjects, the connections between past diversity increases and decreases and the modern situation remain fuzzy at best. This seems to me like a huge database that offers a great many new surprises as we further delve into it. A search on Google will reveal a list of references to this problem and some of the difficulties entailed in its study.
4. Systematic paleontology: We should not forget that the basic activity of paleontology must remain the documentation of what the fossils are. This is our basic data. Yet systematic paleontology is no longer practiced as extensively as it once was, in spite of efforts to encourage it. This is just not right—we must support smart systematics of fossils, no doubt about it. While other topics in paleontology may be more generally important, systematics remains the foundation of all we do. No one can work in paleontology without knowing what the organisms are, how they are built and function and how they may be related to one another. This is, in most respects, the history of life on Earth. We need great synthesizers of systematic data and inferences in order to develop testable systematic, i.e., evolutionary, and environmental hypotheses. Systematics should be revitalized but more broadly than before. It is important, but where is it taught?
5. Molecular Paleobiology: The integration of molecular biology and paleontology is proceeding, but somewhat slowly. Molecular biologists, who are generating hundreds if not thousands of molecular phylograms based on living species, may think they are working with time, although it's all relative. So paleontologists are necessary to help calibrate their molecular phylogenetic trees. This is not so easy because the last common ancestor does not differ from the preceding and succeeding forms. Some time is necessary for evolution to enhance the differences. Thus the last common ancestor may look like neither of the descendants; the differences show up later. And it is those differences that are the most important in understanding evolution and history of the groups. Only a paleontologist can constrain these problems. They need our help, as much as we theirs.
6. Extinctions and Radiations: I have a feeling that we are a long way from really understanding the mass extinctions of the past and the subsequent radiations that endowed the Earth with a diverse biota once again. We may have some wrong ideas about these two linked processes. Perhaps the most deceptive is the idea that extinctions leave "vacant niches". They don't. Niches are properties of species not the environment. True, all extinctions change the environment, hence eliminate species, but the subsequent environments are not open to survivors because they are different from those that preceded them. Ecological opportunities may be open but usually restricted as I read the record, but "empty niches" are not available for species to merely move or evolve into. The new conditions require considerable evolution

as species appear in new environments. It is this period of evolutionary readjustment to the new ecologies that remain enigmatic, perhaps even more so than the extinction mechanisms themselves. These extinctions—CO2 crises, asteroid impacts, or even human predation later on—are well enough circumscribed. But why should the Permo-Triassic event leave a record that appears to be complete devastation, yet the new forms are not so distantly related from the previous set of organisms? No new phyla appeared. When and where were the ancestors of the newly radiating forms? More thinking and perhaps more focused field work help.

The Sociology of Paleontology:

7. Electronic journals: E-publication can provide rapid and more unique information exchange. We have not yet seen this potential fully developed; instead most e-journals are merely the same old kind of printed paper we've had around for hundreds of years, but they appear on your computer screen instead of paper. There are advantages in this—ease of access for many, ease of searching, cross-linking, etc. But the potential is far greater. *Palaeontologica Electronica* (PE) leads this field in both paleontology and science in general. It is not simply a paper on the net. It offers all kinds of advantages in video, color, sound, 3-D diagrams and images, close comparisons by mouse-overs and image manipulation by the user, rapid feedback and discussion, and most likely a good number of other applications most of us have not thought of. Not many of these have been used yet. The potential is enormous and probably beyond comprehension right now. The new generation of paleontologists raised on video games, the internet, and MTV, will surely convert those skills and new traditions into a better way to communicate paleontology. If you can't communicate your results effectively, your research is worthless. The key to science is communication if we are to exchange the views, data and interpretations necessary to make progress. And e-publications with the full range of options will make that communication more effective. Take advantage of it, in fact, propose new methods of communication that the Internet makes possible and do it. *Palaeontologica Electronica* will welcome those new ideas.

Soon we may see immediate publication of papers as soon as they are accepted. No longer should we wait for a particular date or accumulation of a certain number of pages for an issue. We can post the papers as they are accepted. Indeed, they need not even be posted on a dedicated server, but on general use servers where the articles all follow one another no matter what journal or society issues them. Each organization would keep their own editorial personnel and policies, posting manuscripts to a central server under their own auspices that would later be assembled into volumes. The publication of papers would no longer be delayed by publication waits. All special communications (editorial matters, instructions, editorials, etc) could be inserted at appropriate times and assembled into the final volume at the end of the publication year. E-publication was supposed to bring us rapid publication, but so far that remains to be seen. It was supposed to be cheaper too, but that is not always the case.

We must also find a new business model for on-line publications. Among society journals from AAAS's Science to the Cushman Foundation's Journal of Foraminiferal Research, paid subscriptions through memberships have fallen off when the journals have gone on-line, so much so that some journals have themselves been threatened with extinction. The non-profit business models vary. *GeoScienceWorld,* an aggregate of non-profit geology journals including many in paleontology, and *BioOne,* a similar aggregation for biology, both assess charges against their subscribers, while PLoS, the Public Library of Science publishing eight biological journals, seeks its expenses from authors who can afford to pay, and Geoscience E-Journals, a consortium of world-wide non-profit publishers of geology journals including PE, makes papers available on-line for no cost at all. Commercial publishers' electronic journals are often tied to hard copy subscriptions with fairly heavy costs to the subscriber. Most electronic journals, however, do not pay for themselves yet. The only ones that do, like *Palaeontologica Electronica,* are run by unpaid volunteers, much like the society journals were in the past, and that's the only reason they make it. Paleontologists must support their own on-line journals with submissions, labor, subscriptions and or fees, as the other option of publishing with commercial journals is becoming increasingly difficult because of their exorbitant costs. These high subscription costs of for-profit journals is driving library costs higher, with the subsequent dropping of some journals. None of this is good for science.

We will see how all these models sort out, as we make our choices as consumers and providers of their services, but let's not let our journals go under while we wait.

8. Protection of Paleontologic Resources: We have two important kinds of resources—those collected and already in museums and those still in the field. Both are under threat today. Some museums are under-staffed and/or underfunded. The collections, sometimes made over previous hundreds of years, are deteriorating. Occasionally, museums are refurbished for other purposes (most often in universities but even in national collections) and the collections disposed of or moved to other less desirable quarters. You may well know some of these. Some kind of action on the part of professional and avocational/amateur paleontologists is warranted to reverse this and to impress upon the powers-that-be the value both educational for the public and children as well as for research on the materials that make it possible to explain them. A second and major problem is the deterioration and destruction of paleontologic field resources under development and collecting, both professional and avocational/amateur, pressures. Paleontologic resources include far more than merely the fossils we wish to study. They also include the context in which fossils are found. We should try to preserve these features as parks (like in the GeoParks of Europe, certain National Parks in the US, and many other places), World Heritage sites (check the list for fossil sites), or merely small protected sites deemed important locally. Indeed, such an effort is underway by the International Palaeontological Association to identify and urge the protection of scientifically outstanding paleontological sites around the world. This effort includes sites also already under protection, for in many cases these resources deteriorate for lack of attention or funds. Paleontologists worldwide can support these two efforts in order to ensure that the scientific data of paleontology remains intact for future scientists, educators and the general public.
9. Media and Paleontology: Science writer Mike Martin assured me last month that fossils (i.e., dinosaurs) remain one of the top media science topics. Recent surveys in the US show that 70% of the public is highly interested in science topics, even though the public remains about 90% scientifically illiterate. So much of modern life depends on a well informed and reasoning public that cannot be duped by rhetoric and slander. What's the best way to do that fast? I suggested previously that we might try to develop prime-time TV programming featuring not only paleontologists, although that would be ideal, but scientists in general. My suggestion, which I repeat again, is to promote science-based, prime-time TV programs that will capture the imagination of the general public, so that they become interested enough to learn a bit of science. The market is there, but the production is not. Just look at the popular CSI series which is a crime story based on forensic science. Its popularity has lapped over into increased enrollments in forensics at colleges and universities across the US, demands for DNA evidence in trials, and a desire for additional knowledge about the subject (which is partially provided on the CSI web site). Unsurprisingly, TV programming has big impact on the general public and what better medium could we use to accomplish a more scientifically-literate population, perhaps even worldwide, fast?
10. Anti-Science: The world seems saturated in anti-scientific dogma—creationism, intelligent design, pseudoscience, medicines for which no data support their worth, evidential decisions made instead on religious beliefs or rhetoric, the mix of religion with science, . . . Some impact paleontologists quite directly—creationism and ID are the most prominent. Indeed ID and creationism is getting some pretty scary support—not surprisingly George Bush, but Tony Blair, too, has endorsed it in schools. Support for anti-science by our leaders should not be acceptable in these scientifically and technologically advanced times. We must continue to work for freedom from bias in our science and all those anti-scientific endeavors are biased. Paleontologists because of their topic commonly command large, attentive audiences, and have made a difference already. Now we have various denominations celebrating Evolution Sunday, so scientists are not alone in their defense of their fields.
11. Paleontologist Diversity: We've discussed this in the past on PaleoNet but without much resolution. For paleontology internationally to succeed, all people no matter what their gender, ethnicity, race, nationality, or belief might be should participate. Women continue to be discriminated against in the western democracies

and even more so in some developing economies. For certain minority groups, participation in science is beyond their grasp for a variety of reasons. All of this is a loss to intellectual advancement and should change. Paleontology, as a small discipline, could set an example for taking the just and intelligent road to full participation by all. Support activities, hires, and policies that make it easier to recruit, hire and retain all kinds of people everywhere. We can be a model for the new international scientific workforce.

12. Religion and Paleontology: Paleontologists have on occasion addressed religion, and a more general "War between Science and Religion" has been going on for hundreds of years (White, 1896). More recently, paleontologist Steve Gould thought science and religion could and should remain as separated "magisteria", not an unpopular view. Evolutionary biologist Richard Dawkins (2006) and writer Sam Harris (2004, 2006) would like to do away with religion altogether with evidence and reason the basis of societal decisions. The evolutionary philosopher Daniel Dennett (2005) suggests that science can study religion (or "the belief in belief", as he notes) effectively, in spite of some theists' views that religion cannot be studied scientifically. The evolutionary biologists David Sloan Wilson (2002) examines morality and religion as adaptations for group functioning. I point these books out, because science can study religion, why people join them and why they believe in them. In our modern complexly interconnected world, religion needs to be understood. Paleontologists possess the tools and might be able to make contributions to this debate, should they care to. We understand historical methods, contingencies, and mechanisms of selection. These contributions can be a personal reevaluation, an essay expressing your thoughts, or even a more technical paper on the subject. All would be welcome, at least by those who would like to understand. It may even help in our new, uncertain international world.

13. Jobs: We always think we need more jobs, and that's true because we train more science students. However, one important study suggests that we don't need anymore scientists at all because we don't have the jobs for them (Teitelbaum, 2003;). Four threads have driven the idea that more scientists are needed, when in fact other objective data suggest that they are not. This has had serious impact on science in general and on paleontology. We have more students, we have more post-docs staying in those positions longer, and we have more dissatisfaction among them both. Among scientists, more are beginning their own independent careers much later in life, causing them to endure financial difficulties at every turn. More researchers are generated that demand more grants, so that now the success rates on submissions is less than 10% in many programs. This means that many young people will not have the resources necessary to develop successful careers. If Teitelbaum is correct as his evidence suggests, then we need to be honest with our students at all levels, we need to direct them to opportunities other than the traditional paleontological jobs, and we need to promote the use of paleontologists in other disciplines, the environmental sciences being one of the most important. Academia will accommodate many, as retirements increase in the next few years, but only the truly excellent people. Self-evaluation is needed as well. In spite of these bleak words, I am optimistic that in paleontology we can develop the field and opportunities more creatively than in the past as far as jobs are concerned.

So there's a short list. Anyone could add to it. Nor do I expect that you will agree with this list—it is not a list of important problems, only those that I find urgent or intriguing. Other topics should come to your mind as they do to mine, since we all have different ideas about our field. Take advantage of PE and post your own views in the discussion to this editorial. My topics and likely yours can be better honed and made more useful to our very special discipline of science by further communication. Together we can mould paleontology through the next 10 years to continue as an exciting and effective science that complements and enhances other fields as well as our own interests, and at the same time makes it possible for people to participate fully as well-employed scientists who are interested in their field broadly and their society. The next 10 years should be far more interesting than the last in almost any aspect of paleontology and its interface with societies around the world. I look forward to them.

REFERENCES

Dawkins, Richard. 2006. *The God Delusion.* Boston, New York, Houghton Mifflin, 406 p.

Dennett, Daniel C. 2006. *Breaking the spell: religion as a natural phenomenon.* New York, Viking, 448 p.

Harris, Sam. 2004. *The end of faith, religion, terror and the future of reason.* New York, W. W. Norton and Co., 348 p.

Harris, Sam. 2006. *Letter to a Christian nation.* New York, Alfred A. Knopf, 96 p.

Jackson, Jeremy B. C. et al. 2001. Historical overfishing and the recent collapse of coastal ecosystems. *Science* 293:629-638.

Teitelbaum, Michael S. 2003. Do We Need More Scientists? *The Public Interest,* 153: 40-53.

White, Andrew D. 1896. *A history of the warfare of science with theology in Christendom.* New York, D. Appleton and Co., Vol. 1, 415 p., vol. 2, 474 p.

Wilson, David Sloan. 2002. *Darwin's cathedral, evolution, religion, and the nature of science.* Chicago, University of Chicago Press, 268 p.