

EDITORIALS and ANNOUNCEMENTS
Non-Peer Review Section

**SOME NOTES ON THE LAST HUNDRED YEARS AND THE NEXT STAGES
IN THE EVOLUTION OF HERPETOLOGY**

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Editor's Note: In honor of his 100th birthday that takes place this September 2012, we invited Hobart Smith to reflect on how the science of herpetology has changed, what important things he would recommend to young herpetologists to be successful, and what he viewed as the future of herpetology. He generously accepted, and what appears below is from a direct interview by David Chiszar, followed by revision by Dr. Smith. The manuscript is being published as submitted. It is hoped by the HCB editorial staff that this rare contribution may provide others with valuable perspectives from a scientist with unmatched experience, productivity, and accomplishment.

My objective here is three fold: (1) to look backward and identify seminal developments in herpetology during my watch, (2) to peer forward and speculate about future developments in the field, and (3) to provide advice to young people about how to prepare for careers in herpetology. None of these charges is particularly easy, but neither are there wrong answers to any of these more-or-less subjective issues, especially the latter two. The key, I think, is to take each charge seriously and to let both heart and mind contribute to them.

LOOKING BACKWARD

Certainly an important step, and the only one in which I was a participant, was the recognition of the fantastic herpetological diversity of Mexico. Of course, this did not happen all at once and numerous people were involved (and still are involved). Also, as the work progressed, it became clear that what was true of Mexican herpetology was also true of all the other departments of Mexican natural history. My first collecting trip (with Ed Taylor) occurred in 1932, and was the forerunner of many other trips by a wide variety of workers. The magic of the Mexican herpetofauna eventually swept many North American, European, and Mexican field workers into the same enthusiastic embrace that has kept me enthralled for three quarters of a century.

*interviewed by David Chiszar.

My first herpetological paper was published in 1931, at which time there were no herpetological journals, except for *Copeia*, which covers both fish and herps. The herpetological journals with which we are now familiar came later, and this must be reckoned as an important development within the field of herpetology. Amphibians and reptiles were not as well known in those days (and earlier) as birds and mammals. The new journals did a great deal to increase the general knowledge of herps. In this context I ought to mention that Howard Gloyd and Edward Taylor were models and mentors to me, stimulating my work and encouraging the accumulation of information about amphibians, reptiles, and their environments.

During the post World War II period, we saw the emergence of phenetics and cladistics, with the eventual domination of the latter in phylogenetic contexts. While this was unquestionably a profoundly important development, it did not come without costs, particularly in the denigration of subspecies by the cladists. Without belaboring this point, let me say that we came to a place where some aspects of variation were seen to be phylogenetically important while other aspects were essentially ignored. Of course, I am referring to categorical distinctions between taxa (i.e., transformation series) on the one hand, and mensural, but not necessarily, categorical variation on the other hand. Although cladists could justify this dichotomy in the treatment of data, it nevertheless flew in the face of older herpetologists who had been taught that all aspects of variation had something to say about evolution.

Closely related to the development of cladistics were the eventual contributions of the geneticists who added a

whole new world of characters to the largely morphological ones already in use. The “problem” here was that an interested reader could not get very far into the research papers without becoming a geneticist or at least becoming quite conversant with the methods and interpretations. This was, of course, a challenge for classically trained taxonomists who frequently ended up believing what the geneticists said without having the ability to be critical consumers.

Herpetology was becoming during the 1970s a collection of highly specialized subfields, and this same transformation was happening in all of the traditional divisions of natural history. Indeed, the changes were rather accelerated in mammalogy and ornithology. I do not mean to present the development of subfields as a bad thing; to the contrary, it was the ideal strategy for inter- and multi-disciplinary cooperation to bring about rapid modernization in fields that for centuries had been addicted to alpha taxonomy. Modernization was, happily, not always associated with demanding technical shibboleths such as we have seen in cladistics and genetics. Some of the new subfields that came along between 1960 and 1980 included behavioral ecology, comparative endocrinology, comparative pathology, energetics, and developmental psychobiology. Toxinology fits into this picture as well, but this subfield started somewhat earlier than those already mentioned. Although these and other specialties have their technical sides, they can usually be understood by normal mortals, except perhaps for toxinology where a fair amount of biochemistry is necessary. Herpetologists could take delight in the work of all these specialists who showed in study after study that amphibians and reptiles were far more sophisticated than previously thought.

Conservation biology and restoration ecology are two recent and related fields that deserve special notice not only because they are shiny new disciplines but also because they represent the final common path for a great deal of knowledge in natural history. Without doubt, workers in these fields are doing what most of us older workers hoped we might someday do, but we never got around to it partly because of our old fashioned but heart felt research commitments and partly because we lacked the training, methodologies and theoretical frameworks. Today, it is gratifying to see these fields prosper and to see them make contributions to the survival of taxa, guilds, clades, and ecosystems.

The profound growth of amateur herpetology has been impressive in both husbandry and breeding of amphibians and reptiles. Indeed, I use the word “amateur” rather sheepishly because the practitioners are every bit as professional in their own way as any academic herpetologist has been in his or her way. Of course, there is a profit motive involved in the breeding and selling of captive herps, but this point ought not blind us to the advances that have been made. Nothing

like this existed when I began my career, and I certainly welcome not only the advances but also the contacts that occur between the breeders of herpetofauna and the academics.

LOOKING FORWARD

I predict that conservation biology and restoration ecology (CBRE) will become the center of natural history in this century. This doesn’t mean that the other aspects of natural history will disappear, rather that they will take on a new “spin” in connecting themselves with CBRE. I don’t use the word “spin” to suggest shallow or tenuous connections or mere lip service. Instead, I think connections, for example between taxonomy and CBRE, have always existed but have been more-or-less latent because journal editors and reviewers have urged taxonomic authors to confine themselves to the task at hand and not to speculate very far beyond their data. This, of course, generates fairly narrow Discussion sections. Now days I see, at least in some journals, that editors and reviewers ask for brief speculation about the conservation implications of the new data, and this can sometimes be a challenge for authors. Times are changing. Additional evidence can be seen in the research involvement of some zoos. This work is on the increase, and virtually all zoo-sponsored projects have direct connections with CBRE. Indeed, at a recent meeting of the American Zoo Association, one speaker from a zoo that provides support for research said that projects must have direct implications for CBRE to qualify for support.

I can see or hope for a few other developments in the future of herpetology. One involves the study of behavior, which has already contributed important insights into amphibians and reptiles, but I think even the active behaviorists would agree that there is much more to do. For example, although we know a fair amount about learning in herps, especially in standardized paradigms, we are only gradually discovering the cognitive processes involved in foraging, migration, defense, mate selection, etc. Such work in mammals, birds, and fish has been impressive, even scintillating, and the few papers I am familiar with in herpetology have been equally dramatic. I hope we can look forward to an accumulation of data and theory within amphibians and reptiles. I think there has been a bias in the “old guard,” who underestimated the cognitive capabilities of herps, with maybe a few exceptions, such as sea turtles and crocodylians. This bias for many years discouraged research or even discussion of cognition, decision making, and behavioral plasticity in amphibians and reptiles. Now it is becoming clear that the bias was unfounded and that our animals are far more sophisticated than many classical workers realized. The new research will play into CBRE

in several ways; one is that the general public might become more likely to support conservation activities for animals possessing human-like behavioral characteristics and flexibilities, even if the cognitive-neural underpinnings are different from ours. One well-known and long-known example is maternal behavior in crocodylians. More recent examples include maternal behavior in some snakes and lizards, and parental care of eggs in some amphibians. But there are even better examples from other domains of behavior, such as foraging, territoriality, and defense. We know, for example, that territory size in some lizards varies with prey quantity and quality, such that the lizards appear to behave optimally, adjusting territory size upward when prey is scarce or of low quality and downward when high quality prey is abundant. Optimality and related theories will continue to inspire research and to reveal the cognitive complexity of amphibians and reptiles. This cannot but help to raise these animals in the esteem of the general public.

Some herpetological research might contribute to human welfare in a direct way. Add the following ideas to the list of potential and realized medical applications that Finley Russell prepared in 1980. Components of snake venoms are being found to attack human cancer cells by inhibiting metastatic processes. Anti-coagulation elements of some snake venoms may have medical applications, especially in fighting clots. Skin chemicals in some anurans may be useful in preventing or treating sunburn. The discovery that various snakes reduce organ sizes during fasts, thus reducing energy demands, has become a target of medical research when it was found that cardiac tissue also shrinks during fasts and then increases quickly when a meal is secured. Perhaps there will be human applications when the physiological mechanisms become known. Regeneration has long been studied in amphibians because the phenomenon is intrinsically interesting and because there may be practical applications. I think we can expect continued progress in all of these areas and in related ones. It is likely that we have only scratched the surface regarding the potential medical applications of herpetological adaptations. Consider, for example, the fact that aquatic turtles can lose well over 50% of their blood volume with few ill effects. The turtles appear quickly to shift water from other compartments to the circulatory system to compensate for the loss of blood volume and to control blood pressure. Although I have not yet seen discussions of how this phenomenon might be applied to humans, the possibility exists and it likely will be explored in the near future. Consider also the phenomenon of caudal autotomy and the rapid healing that occurs along fracture planes.

The lumping of amphibians and reptiles was a custom of Linnaeus's times, and we followed suit. We know today that amphibians and reptiles are as different as

birds and mammals, so it ought to be possible to divide herpetology into two disciplines: amphibiology and reptilology. This, however, is unlikely to occur partly because the lumping of amphibians and reptiles into a single discipline is thoroughly entrenched in academic culture, and partly because herpetology has transformed from a diversity-oriented field to a function-oriented field. The focus on function takes emphasis away from diversity-based separation of amphibians and reptiles.

ADVICE FOR ASPIRING HERPETOLOGISTS

From the previous sections I suspect that young herpetologists can see that there are still worlds to conquer in this field. At the same time, the changes that have already occurred within herpetology ought to have strong effects on your thinking. For example, during the past few decades I have not seen a job advertised for a herpetologist *per se*, except for several zoo or museum positions. On the other hand, I have seen many university and college jobs that herpetologists could fill if they had a few additional arrows in their quivers. In other words, the candidates needed to fit into one or another of the modern inter-disciplinary specialties described above. Likewise, the candidates were expected to teach not only herpetology but also other courses, including service elements like general biology, evolution, anatomy or physiology, but also other advanced courses connected with the person's inter-disciplinary specialty, like cladistics, comparative endocrinology, ethology, behavioral ecology, ecological chemistry (associated with mate finding, reproduction, predation, and avoidance of predation), conservation, restoration ecology, or others. Of course, no one would be expected to teach all of these courses, but candidates would be expected to be able to handle some of them. Indeed, the job descriptions are almost certain to name the one or two areas that would be desired. Graduate students focusing on herpetology could compete effectively for such jobs if they prepared broadly and had the necessary additional coursework.

One way to deal with this new demand for inter-disciplinary breadth besides taking the necessary courses yourself is to spend some time creating course outlines of your own, perhaps even improving on the courses you have taken. In my experience, graduate students are excellent at this sort of criticism, but I have seen very few who have taken the additional steps of preparing detailed course outlines until they must prepare syllabi after having gotten an academic job. Why prepare such outlines in graduate school? Well, there are two reasons. First, careful and detailed outlines complete with references, illustrations, and required readings are a fine way to integrate your knowledge and to prepare for comprehensive exams. Second, streamlined but competent versions of these outlines can be mailed along

with vitas and reprints to search committees. These committees are quite accustomed to receiving vitas, reprints, and letters of recommendation, but they don't often receive course outlines showing that the candidate has thought carefully about future teaching responsibilities. This appears to be true for both graduate students and post-docs who are applying for academic jobs. Likewise, the new specialties usually involve new methodologies for field or lab work or for computer modeling. A candidate's proficiency in such matters ought to be made clear in both reprints of his or her recent studies and in course outlines. In my experience, when such materials have been received, the candidates were noticed and almost invariably placed on the short list.

Obviously, more is required of aspiring herpetologists today than was the case in my day, but at the same time we must recognize that young people who are naturally drawn to new inter-disciplinary specialties are likely pursuing a labor of love not unlike that which drove my work on Mexican herpetofauna. Hence, it may not be too much to ask for these young people to take a few extra steps to make their skills and breath very clear in the form of course outlines rather than to leave these matters to be seen (maybe) in reprints or letters of recommendation. *Non suppressio veri* (don't suppress the truth).

Also, I add some advice with certain reservations. Having worked with numerous students over the years, I have certainly encountered some who had interests in exotic animals and exotic places (not unlike my interests in Mexico). There are a few problems these days with such interests and these issues ought to be considered carefully. An obvious one is that some exotic places are dangerous. In my last trip to Mexico (1994) working on the distribution of *Sceloporus undulatus*, my colleagues and I found a wonderful dirt road leading into exactly the right habitat. We soon discovered that this road was used by car thieves heading south and by drug runners heading north, both groups willing to kill herpetologists taken for enforcement personnel. Such stories, some with tragic consequences, are not infrequent in other parts of the world.

Another problem is, of course, acquiring funds for the work. Money is available for some projects in some places, but it is not abundant. Advice from funding agencies must be carefully sought, as opportunities are limited. Ship time, for example, needed for study of sea snakes and sea turtle movements, is fiercely expensive and very difficult to obtain. Likewise, travel funds needed to get to far-away habitats must be justified by the theoretical significance of the proposed work, and this sort of funding is tough to secure during the current recession. Things might loosen up in the future, but do not expect anything but very gradual change.

Finally, even if you get past the dangers and the financial issues, there is the temporal issue. Field work on exotic animals takes a great deal of time and effort, and this sometimes leads to a sparse publication record, especially in the early years of a project. Unfortunately, this is precisely the time when you will be expected to publish with some frequency to be promoted and tenured. It might be smart and politic to pursue easier work during the early years of an academic career and leave the exotic issues for later. While you are thinking about this, maybe you would be well advised to make clear your local interests to potential employers so that they can have a vision of productivity unhampered by the logistics of distance and time. *Non suppressio veri*.