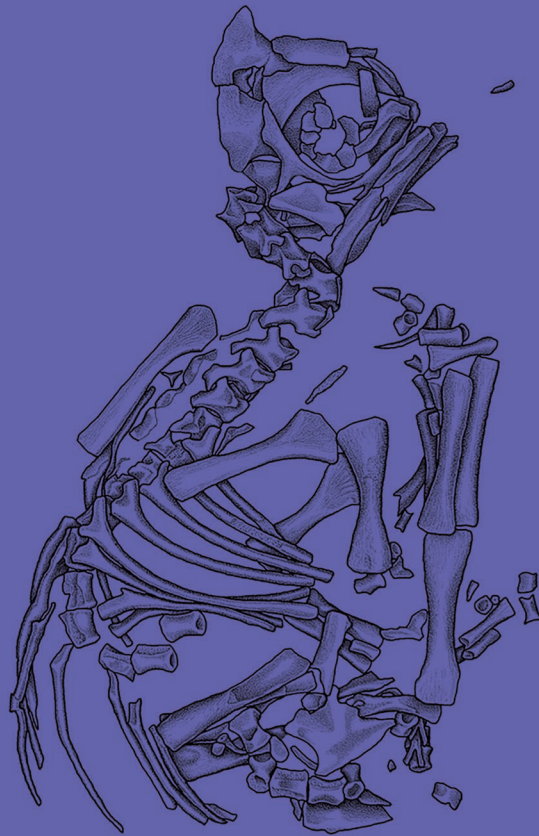


**Diane Scott: extraordinary researcher
and scientific illustrator in vertebrate paleontology**

Robert R. REISZ & Michael DEBRAGA



**THE IMPORTANCE OF SCIENTIFIC ILLUSTRATIONS
IN PALEONTOLOGY: A TRIBUTE TO DIANE SCOTT**

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PERSONAL LIFE HISTORY

EDUCATION AND LIFE

Born on February 6, 1957, in Etobicoke, Ontario, Canada, Diane Scott, who is of English and Ukrainian heritage, initially struggled with reading during her childhood. However, a visit to the Etobicoke Bookmobile unveiled the type of book that truly captivated her—a well-illustrated guide to human diseases. This book served as the catalyst for her journey into literacy, blending science and imagery in a way that would chart the course for a research career spanning over four decades.

Diane's insatiable thirst for knowledge has always encompassed a wide array of interests, ranging from birds, gardening, and cooking, to animals, science, and household repairs. Her unwavering commitment to sharing her extensive knowledge almost appears effortless, as she tirelessly assists not only her family, friends, and former colleagues but also her neighbors, with even veterinarians seeking her guidance.

Graduating with honors from Martin Grove Collegiate in 1976, Diane earned a Bachelor of Science degree from Erindale College (now UTM), University of Toronto, in 1980. During her undergraduate studies, her remarkable abilities in vertebrate dissection and illustration were recognized by Dr Malcolm Heaton, a postdoctoral fellow under Prof. Robert Reisz. Because of her impressive talents, she was swiftly hired as a summer student, where she promptly showcased her exceptional skills in meticulous technical work and precise observational drawings.

Always eager to confront new challenges, Diane enthusiastically embraced the art of scientific illustration and quickly adapted to the demands of vertebrate paleontology research. She embarked on the journey of learning the intricacies of fossil preparation under a dissecting microscope. Her dedication bore fruit when she was appointed as a full-time research technician upon graduation, subsequently advancing her role to become a research assistant and collaborative researcher in the ensuing years.

MENTORING ROLE

Her passion for imparting knowledge has matured over decades spent mentoring and instructing students across various academic levels, from undergraduates to postdoctoral candidates at UTM. Her mentorship transcends traditional academic boundaries, encompassing training in fossil preparation, scientific illustration, scientific reconstructions, as well as comprehensive guidance on approaching paleontological projects, pet care, and navigating the complexities of student life.

Numerous individuals, including students, technicians, and graphic artists under her guidance, have flourished in their respective careers. They have achieved success as preparators, museum professionals, accomplished graphic designers (e.g. Ms A. Shinya [Field Museum technician] in Reisz & Fröbisch 2014 and Mr Dupuis [graphic artist] in Reisz *et al.* 2011), dedicated veterinarians, and physicians (e.g. Drs A. K. Brar [MD] in LeBlanc *et al.* 2015, P. Urban



Fig. 1. — Photograph of Diane Scott with Professor David Mazierski at the University of Toronto Mississauga Biomedical Communications exhibit dedicated to her artwork.

[DVM] as a 2016 undergraduate research student, S. Maho [MD] in Maho *et al.* 2019). Many others have also embarked on prosperous journeys in academia, attributing their accomplishments in part to Diane's invaluable mentorship.

While the list above offers only a glimpse of the technical support Diane was well-equipped to provide, it fails to capture the extent to which her support transcended conventional mentoring practices. Diane Scott frequently engaged in extensive discussions with newcomers to the lab, delving into various aspects of fossil preparation and, most notably, illustration techniques and reconstructions. In a paper featured in this Festschrift, Diane's approach to fossil reconstruction is thoroughly examined, showcasing her most significant contributions to the honing of skills in individuals whose paths crossed with hers. What endures over time is Diane's unwavering dedication to her craft, which played a pivotal role in enhancing the effectiveness of all the peer-reviewed papers she contributed to, thanks to her keen attention to anatomical detail.

The impact of Diane's mentorship during the early careers of a number of paleontologists in the early 90's at Erindale (now UTM) have been profound. Illustration and, notably, reconstruction were crucial aspects of their work. Working in the lab, they honed their own skills as illustrators, working closely

with Diane to scrutinize their drawings, and addressing her critiques proved invaluable. It instilled in them a heightened sense of critical analysis, not only of their own reconstructions but also those of other paleontologists, refining their approach to paleontological research. This example from their own experience is just one among many, as they have come to realize that everyone fortunate enough to collaborate with Diane, whether as a student or a professional, would echo a similar sentiment about the nature of their interactions. Diane's feedback and guidance, delivered with precision and care, have left an indelible mark on the individuals whose paths have crossed with hers (Fig. 1, photo of Diane Scott with former student and now associate professor Dave Mazierski at an exhibition of her work at Biomedical Communications, department of Biology, University of Toronto Mississauga).

EDUCATIONAL OUTREACH

Diane's willingness to share her time and expertise goes well beyond her mentoring and professional duties. In fact, her enthusiastic and supportive nature would manifest itself by her support for educational initiatives. The university community outreach efforts have included collaborations with local school groups, particularly the Peel Summer Academy.

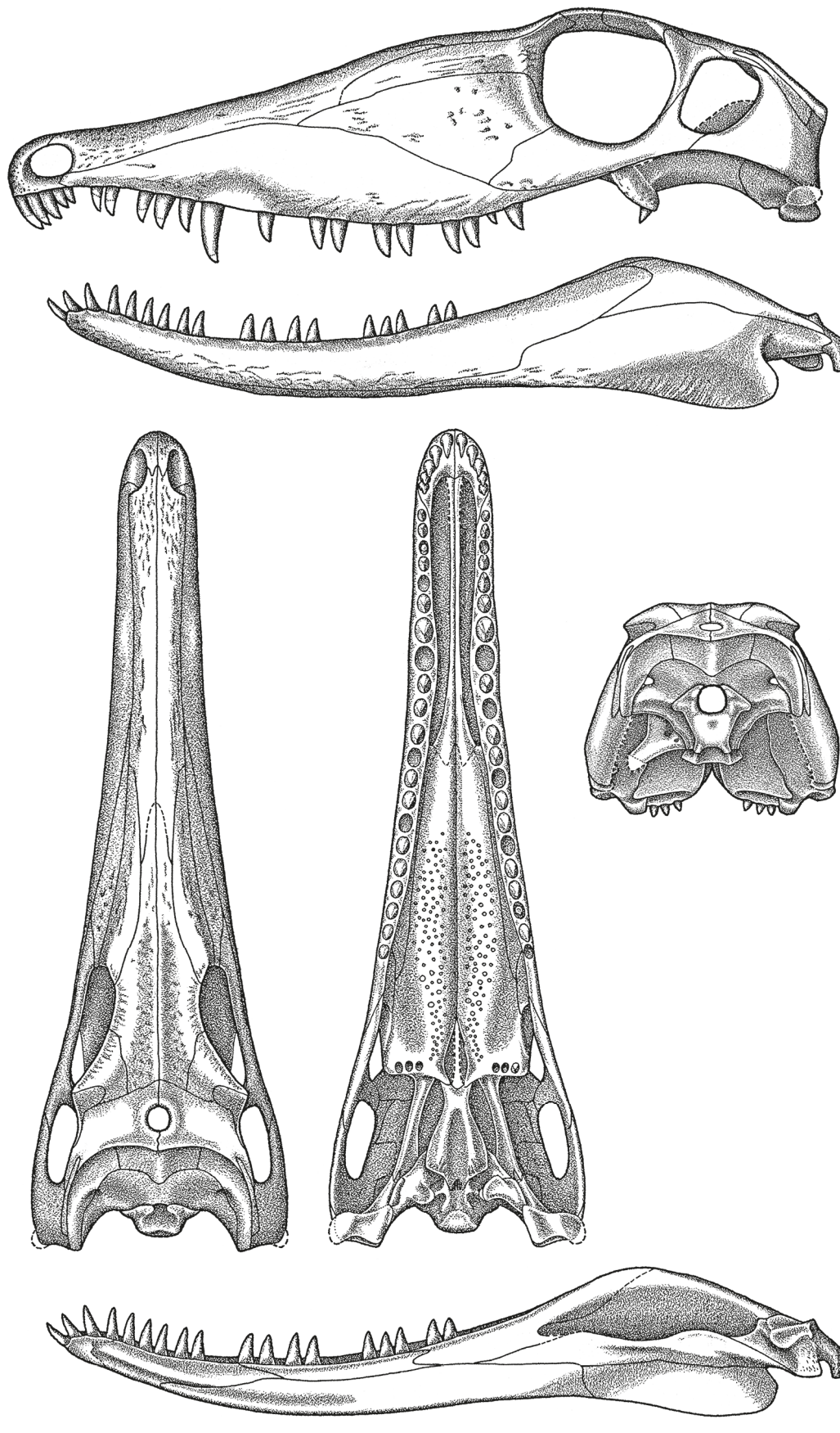


FIG. 2. — Skull reconstructions of the early Permian synapsid *Secodontosarus* Romer, 1936 in several views. Modified from Reisz *et al.* 1992. Scale bar: 5 cm.



FIG. 3. — Photograph and scientific illustration of the small temnospondyl *Gerobatrachus* Anderson, Reisz, Scott, Frobisch & Sumida, 2008 from the early Permian of Texas. Scale bars: 1 cm. Credits: photo and image by D. Scott.

Since this program aimed to engage children during their summer break, the paleo-lab was a logical choice to captivate these young minds. Diane, alongside a few Reisz graduate students, joined forces to create an interactive exploration of paleontological techniques. This proved to be immensely popular, underscoring Diane's tireless commitment to advancing science by offering young minds the opportunity to experience the wonders of paleontology—a journey that undoubtedly mirrored her own remarkable path.

Diane also contributed to articles aimed at kids, like those in *Dig* magazine founded in 1999 by the Archaeological Institute of America. This magazine provided a venue for inquisitive children to explore both archaeological and paleontological discoveries. Diane contributed twice to this children's magazine. Sadly, the magazine went out of print in 2019. In addition to these magazine contributions, Diane also contributed her expertise to children's books, like that authored by Laura J. Steele and titled *Mommy do Dinosaurs have Belly Buttons* published in 2014. Her contribution to this children's book, which is available on Amazon, was just another example of how Diane could translate complex scientific concepts by non-scientists.

SCIENTIFIC CONTRIBUTIONS

Scott and Reisz have forged a partnership lasting over 40 years (refer to publication list for comprehensive overview). Diane's invaluable contributions have left an indelible mark on various projects, encompassing most of the theses and postdoctoral research of students in the Reisz lab (e.g. Laurin 1991, 1993; Reisz & Laurin 1991; deBraga & Reisz 1996; Anderson & Reisz 2004; Sullivan & Reisz 2005; Evans & Reisz 2007; Campione & Reisz 2010; Polley & Reisz 2011; publication list 27; 28; 31; 32; 42), as well as numerous research publications by Reisz and his collaborators (e.g. Reisz *et al.* 2012; Fröbisch

et al. 2015; LeBlanc *et al.* 2015; publication list 16-26; 29; 30; 33-41; and 43). Whether assuming the role of mentor, guide, assistant, or co-author, Diane consistently enhanced these endeavors.

Diane's expertise was in high demand from other researchers, particularly Dr Hans-Dieter Sues. Her preparatory work and scientific illustrations have graced several publications beyond the confines of the Reisz lab (publication list 7; 11; and 12). She has had the privilege of working on fossil vertebrates from around the world, coupling the preparation of materials with meticulous scientific illustrations. Furthermore, she actively engaged in research projects, earnestly dissecting the anatomy of the creatures in her purview and delving into their biology. Her profound enthusiasm for pathology and dental anatomy has significantly influenced the trajectory of research within the Reisz lab (publication list 22) and continues to inspire budding students in the field (publication list 42).

Her genuine commitment and unwavering dedication to unraveling mysteries in vertebrate evolution are exemplified by several remarkable projects. Notably, her studies encompass the enigmatic sailed sphenacodontid *Secodontosaurus* Romer, 1936 (publication list 2; and 3) the diminutive temnospondyl *Gerobatrachus* Anderson, Reisz, Scott, Frobisch & Sumida, 2008 (publication list 16) and the tiny embryonic remains of the Early Jurassic dinosaur *Massospondylus* Owen, 1854 (publication list 13; and 21). Throughout these endeavors, her patience and commitment shine prominently.

For instance, Diane prepared the skull and atlas axis complex of the early Permian synapsid *Secodontosaurus*, rectifying damage from a previous acid preparation attempt and skillfully exposing the skull, lower jaw, braincase, and anterior vertebrae while preserving their integrity. She subsequently rendered illustrations of the specimens, produced detailed

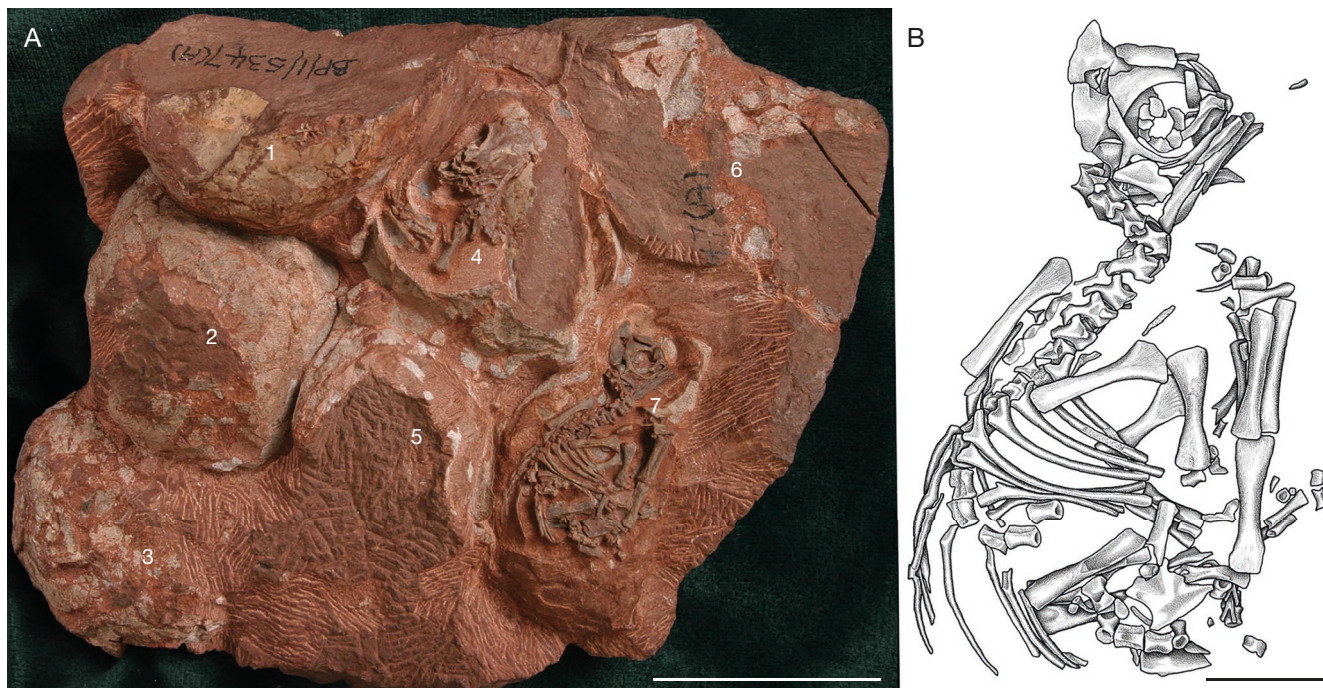


FIG. 4. — **A, B**, Clutch of eggs with embryos of *Massospondylus* Owen, 1854 (**A**), with drawing of the embryonic skeleton (**B**). Numbers 1-7 refer to individual *Massospondylus* eggs. Modified from Reisz *et al.* 2012. Scale bars: A, 5 cm; B, 1 cm.

drawings of the skull and mandible from various perspectives, and pioneered the use of CT data to create an exceptional skull reconstruction (Fig. 2).

Similarly, she invested countless hours in preparing the diminutive early Permian temnospondyl *Gerobatrachus*, unraveling its anatomy and producing detailed illustrations. This project posed a particular challenge, necessitating a delicate balance between exposing maximal anatomical details while safeguarding the unique specimen for future studies (Fig. 3).

As a further validation of her extraordinary expertise in fossil preparation, illustration, and research, she devoted six months to painstakingly uncovering a clutch of small *Massospondylus* eggs and the embryos concealed within (Fig. 4). This undertaking was monumental, and Diane's exceptional skills were indispensable. In a discussion with one of the authors, she recalled the fragility of the eggs, which were as thin as two sheets of paper, and the delicate nature of the embryonic bone, which would vanish upon contact with moisture. The entire process of preparation, illustration, and anatomical interpretation spanned more than a year, and this ambitious project would not have been achievable without her unparalleled expertise and exceptional patience.

Over the years, Diane has cultivated a sixth sense for discerning what lies beneath layers of sediment. She often remarked, "You almost get a sense of where the bones are", explaining the need to know when to stop and to differentiate between adjacent bones while seeking clues to identify the creature. Her customary approach to any project involves achieving near-complete preparation of the fossil, exposing as much of its anatomy as safely possible, before embarking on illustrations. Invariably, additional preparation was

needed to elucidate the fossil's anatomy, always with a focus on maintaining its structural integrity for future researchers once the project concludes and the materials return to the research collections where they belong.

Diane's exceptional accomplishments in the study of fossils are a testament to her mastery of preparatory techniques and the creation of precise, informative scientific illustrations. In her fossil preparation, she employed various tools, including drills and miniature pneumatic tools, but ultimately found that the best and most meticulous method involved a pin vise with either blue steel needles or carbide rods. For visual representation, Diane often relied on the camera lucida attachment of a dissecting microscope, allowing her to simultaneously view the object and the drawing surface. While initially using a stippling technique for clarity, akin to drafting, she later transitioned to using the Coquille board, a textured paper that captures soft wax and graphite Conté pencil, creating the stippled effect necessary for print reproduction. Despite its unforgiving nature, with more than three decades of practice, Diane rarely made mistakes. Her method and technique for illustrating specimens have evolved over the years, evident in the sequence of publications. Nevertheless, both the artistic quality of her illustrations and the precision of the informational content have remained consistently high.

Perhaps the most impressive facet of her research involves the creation of skeletal reconstructions. After preparing and illustrating a specimen, Scott employed micro-measurements and combined with her extensive knowledge, honed over her many years exposing the fossil bone hidden in the matrix and working out the complex and often novel anatomies that are the hallmark for the many specimens she has been

able to study, she was able to reconstruct a skull's appearance (publication list 2; and 41). These painstakingly drafted reconstructions significantly contributed to the scientific understanding of these ancient, extinct creatures' anatomy.

While these roles are not uncommon, even if Diane's skills represent the epitome of the profession, she was always eager and excited to learn and explore new techniques. One of these novel techniques involved the use of scanning electron microscopy (SEM). In this role, she not only mastered the skills required to be an effective SEM technician but also opened up numerous opportunities for the Reisz lab to study the fine microstructure of fossil teeth and provided others working in the lab to learn from Diane's own SEM mastery. In a recent paper (deBraga *et al.* 2019), Diane's willingness to share her knowledge helped with the analysis of a new species of captorhinid resulting in a wealth of additional information on the dentition of captorhinids.

PUBLICATIONS

As can be discerned from the scientific contributions section of this paper, Diane Scott has produced a massive body of work that is partly reflected in the dozens of publications by Reisz, his students, and his collaborators. More significantly, Diane has also been a coauthor on more than three dozen research publications spanning more than three decades. The list below points to the papers to which she contributed to as an author and is organized in chronological order so as to paint a detailed picture of her immense talent. As an author, Diane contributed significantly to all of these works, but there are three (publication list 13; 20; and 43) in particular where Diane's contribution is of particular relevance. In these three instances, Diane's specific contribution to the research is briefly described following the article title.

1. REISZ R. R., BERMAN D. S. & *SCOTT D. 1984. — Anatomy and phylogenetic relationships of the Permian reptile *Araeoscelis*. *Journal of Vertebrate Palaeontology* 4: 7-23.
2. REISZ R. R., *SCOTT D. & VON BENDEGEM J. 1992. — Atlas-axis complex of *Secodontosaurus*, a sphenacodontid mammal-like reptile (Eupelycosauria; Synapsida) from the Early Permian of Texas. *Canadian Journal of Earth Sciences* 29: 112-119. <https://doi.org/10.1139/e92-051>
3. REISZ R. R., BERMAN D. & *SCOTT D. 1992. — The cranial anatomy of *Secodontosaurus obtusidens*, an unusual mammal-like reptile (Synapsida: Sphenacodontidae) from the Lower Permian of Texas. *Zoological Journal of the Linnean Society* 104 (2): 127-184. <https://doi.org/10.1111/j.1096-3642.1992.tb00920.x>
4. BERMAN D. S., REISZ R. R., BOLT J. R. & *SCOTT D. 1995. — The cranial anatomy and relationships of the synapsid *Varanosaurus* (Eupelycosauria: Ophiacodontidae) from the Early Permian of Texas and Oklahoma. *Annals of the Carnegie Museum* 58 (2): 99-138. <https://www.biodiversitylibrary.org/page/52458736>
5. REISZ R. R., *SCOTT D. & WILSON H. 1997. — Varanopseid (Synapsida) skeletal elements from the Lower Permian fissure fills of Fort Sill, Oklahoma. *Oklahoma Geology Notes* 56 (3): 160-170.
6. REISZ R. R., MODESTO S. P. & *SCOTT D. 2000. — *Acanthotoposaurus bremneri* and the origin of the Triassic archosauromorph

reptile fauna of South Africa. *South African Journal of Science* 96 (8): 443-445. https://hdl.handle.net/10520/AJA00382353_8965

7. SUES H.-D., OLSEN P. E., *SCOTT D. M. & SPENCER P. S. 2000. — Cranial osteology of *Hypsognathus fenneri*, a latest Triassic procolophonid reptile from the Newark Supergroup of eastern North America. *Journal of Vertebrate Paleontology* 20 (2): 275-284. <https://doi.org/bdvtzt>
8. KRUPINA N. I., REISZ R. R. & *SCOTT D. 2001. — The skull and tooth system of *Orlovichthys limnatis*, a Late Devonian dipnoan from Russia. *Canadian Journal of Earth Sciences* 38 (9): 1301-1311. <https://doi.org/10.1139/e01-028>
9. REISZ R. R., BARKAS V. & *SCOTT D. 2002. — A new species of bolosaurid from the Early Permian of Richards Spur, Oklahoma. *Journal of Vertebrate Palaeontology* 22: 92-101.
10. REISZ R. R. & *SCOTT D. 2002. — Skeletal anatomy of *Owenetta, kitchingi*, a new procolophonid from South Africa. *Journal of Vertebrate Palaeontology* 22: 244-256.
11. SUES H. D., FREY E., MARTILL D. M. & *SCOTT D. M. 2002. — *Irritator challengerii*, a spinosaurid (Dinosauria: Theropoda) from the Lower Cretaceous of Brazil. *Journal of Vertebrate Paleontology* 22 (3): 535-547. <https://www.jstor.org/stable/4524248>
12. SUES H. D., OLSEN P. E., CARTER J. G. & *SCOTT D. M. 2003. — A new crocodylomorph archosaur from the Upper Triassic of North Carolina. *Journal of Vertebrate Paleontology* 23 (2): 329-343. <https://www.jstor.org/stable/4524321>
13. REISZ R. R., *SCOTT D., SUES H.-D., EVANS D. C. & RAATH M. A. 2005. — Embryos of an Early Jurassic prosauropod dinosaur and their evolutionary significance. *Science* 309 (5735): 761-764. <https://doi.org/10.1126/science.1114942> (companion article in science, very extensive media coverage)
Arguably her most significant work, or at the very least, the work that has been witnessed by the widest audience, was her contribution to the study of the embryonic remains of *Massospondylus*. The meticulous effort necessary to excavate these exceedingly delicate embryos stands as one of the most remarkable professional achievements of the Reisz lab.
14. MODESTO S. P., *SCOTT D. M., BERMAN D. S., MÜLLER J. & REISZ R. R. 2007. — The skull and palaeoecological significances of *Labidosaurus hamatus* a captorhinid reptile from the Lower Permian of Texas. *Zoological Journal of the Linnean Society* 149 (2): 237-262. <https://doi.org/10.1111/j.1096-3642.2007.00242.x>
15. REISZ R. R., MÜLLER J., TSUJI L. A. & *SCOTT D. 2007. — The cranial osteology of *Belebey vegrandis* (Parareptilia: Bolosauridae) from the Middle Permian of Russia, and its bearing on Reptilian evolution. *Zoological Journal of the Linnean Society* 151 (1): 191-214. <https://doi.org/10.1111/j.1096-3642.2007.00312.x>
16. ANDERSON J., REISZ R. R., *SCOTT D., FRÖBISCH N. & SUMIDA S. S. 2008. — A stem batrachian from the Early Permian of Texas and the origin of frogs and salamanders. *Nature* 453: 515-518. <https://doi.org/10.1038/nature06865> (extensive media coverage)
17. REISZ R. R., GODFREY S. & *SCOTT D. 2009. — *Eothyris* and *Oedaleops*: do these early Permian synapsids form a clade? *Journal of Vertebrate Paleontology* 29 (1): 39-47. <https://www.jstor.org/stable/20491067>
18. MODESTO S. P., *SCOTT D. & REISZ R. R. 2009. — Arthropod remains in the oral cavities of fossil reptiles support inference of early insectivory. *Biology Letters* 5 (6): 838-840. <https://doi.org/10.1098/rsbl.2009.0326> (good media coverage).

19. MODESTO S. P., *SCOTT D., BOTHA J. & REISZ R. R. 2010. — A new and unusual procolophonid parareptile from the Lower Triassic Katberg Formation of South Africa. *Journal of Vertebrate Paleontology* 30 (3): 467-479. <https://doi.org/10.1080/02724631003758003>
20. BERMAN D. S., REISZ R. R. & *SCOTT D. 2010. — Redescription of the skull of *Limnoscelis paludis* Williston (Diadectomorpha: Limnoscelidae) from the Pennsylvanian of Canon del Cobre, Northern New Mexico. *New Mexico Museum of Natural History and Science Bulletin* 49: 185-210.
- Reconstructing the skull of *Limnoscelis* holds significance for several reasons. Firstly, it represents a crucial stem amniote, the anatomy of which is essential for advancing our understanding of Amniota's evolution. Secondly, and particularly pertinent to this paper, it serves as the foundation for an exploration of cranial reconstructions. The methodology is fundamental to Diane's approach and is included in the Festschrift as a methodological paper, showcasing Diane's process (deBraga *et al.* this volume).
21. REISZ R. R., SUES H.-D., EVANS D. C. & *SCOTT D. 2010. — Embryonic skeletal anatomy of the Early Jurassic prosauropod dinosaur *Massospondylus*. *Journal of Vertebrate Paleontology* 30: 1653-1665.
22. REISZ R. R., *SCOTT D., PYNB B. R. & MODESTO S. P. 2011. — Osteomyelitis in a Palaeozoic reptile: evidence for bacterial infection and its evolutionary significance. *Naturwissenschaften* 98 (6): 551-555. <https://doi.org/10.1007/s00114-011-0792-1> (good media coverage)
23. REISZ R. R., *SCOTT D. & MODESTO S. P. 2011. — A new Early Permian reptile and its significance in early diapsid evolution. *Proceedings of the Royal Society of London, Series B* 278: 3731-3737. <https://doi.org/10.1098/rspb.2011.0439>
24. SPINDLER F., *SCOTT D. & REISZ R. R. 2015. — New information on the cranial and postcranial anatomy of the early synapsid *Ianthodon schultzei* (Sphenacomorpha: Sphenacodontia), and its evolutionary significance. *Fossil Record* 18: 17-30. <https://doi.org/10.5194/fr-18-17-2015>
25. MODESTO S. P., *SCOTT D. M., MACDOUGALL M. J., SUES H.-D., EVANS D. C. & REISZ R. R. 2015. — The oldest parareptiles and the early diversification of reptiles. *Proceedings of the Royal Society of London, Series B* 282: 20141912. <https://doi.org/10.1098/rspb.2014.1912> (very good media coverage)
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In perhaps one of the most influential recent papers showcasing the ability to envision extinct life as it truly was, this work on the facial reconstruction of dinosaurs stands out. If, as is becoming increasingly common, both scientific and popular dinosaur reconstructions start to acknowledge the importance of maintaining anatomical consistency with what we know about function, then the days of fully exposed dinosaur teeth may be behind us. Diane has had a significant impact on how we will perceive dinosaurs in the future, exemplifying her dedication to accuracy and her skill in “reading” fossils.

CONCLUSION

Diane has left an indelible mark on the field of vertebrate paleontology. Her contributions, in the form of drawings, reconstructions, and photographs, have been featured in research publications, textbooks, magazines, and even children’s books (refer to section on “Educational Outreach” above). While her research has spanned a wide spectrum, from lungfish to primates, her most enduring impact lies predominantly in the study of Paleozoic tetrapods. She has set a standard of excellence in fossil preparation and scientific illustration that will prove challenging to match. Even though she has retired, her work continues to serve as the cornerstone of research in the Reisz lab, and her painstaking attention to detail and passion for fossils continue to inspire students.

In retrospect, it is fair to say that Diane has always been and continues to be a force to be reckoned with, balanced by her empathetic and caring nature. Her boundless energy can be exhausting to most people. Diane seldom sits still, and even in her post-retirement phase as of 2022, she is still learning to relax. Her adventures with her beautiful black standard poodle, Shiloh, and her daily crossword puzzle sessions with a cafe latte continue to keep her engaged.

There is no better way to acknowledge her immense contributions to the field of Paleontology than by highlighting her achievements in a volume dedicated to honoring her legacy as a mentor to generations of students. This volume stands as proof that it is possible to unlock the potential in a child who once did not have a penchant for reading.

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