

Scientific Illustration - Depicting Life in Prehistory

Jennifer Lee

Colorado State University, Department of Anthropology
CURC, April 2019

HISTORY: Scientific illustration has been a prominent part of research for centuries, gaining prominence in the 18th century - it was employed by Charles Darwin, John Audubon, Sarah Drake, and Maria Merian to name a few (Crist, 2017). These portrayals were done in the field and lab to record critical research information in the absence of photographic technology (*Figure 1*).

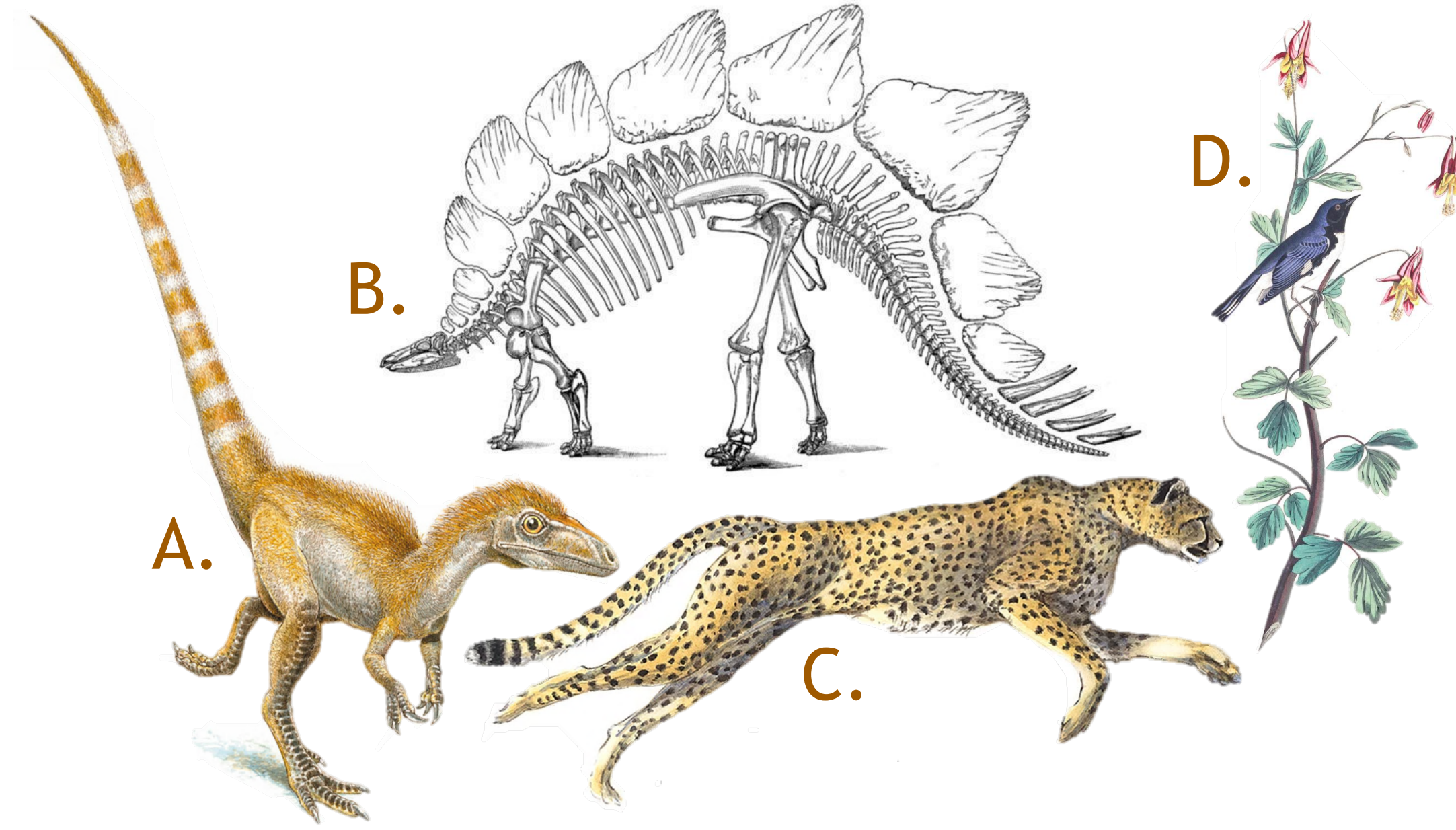


Figure 1: Examples of scientific illustration today & in the past

A. Modern depiction of *Sinosauropteryx* (Sloan, 2016);
B. O.C. Marsh's 1800s illustration of *Stegosaurus* (Switek, 2011);
C. Modern rendition of cheetah (Guth, 1976);
D. John J. Audubon's 1800s documentation of Black-throated Blue Warbler behavior.

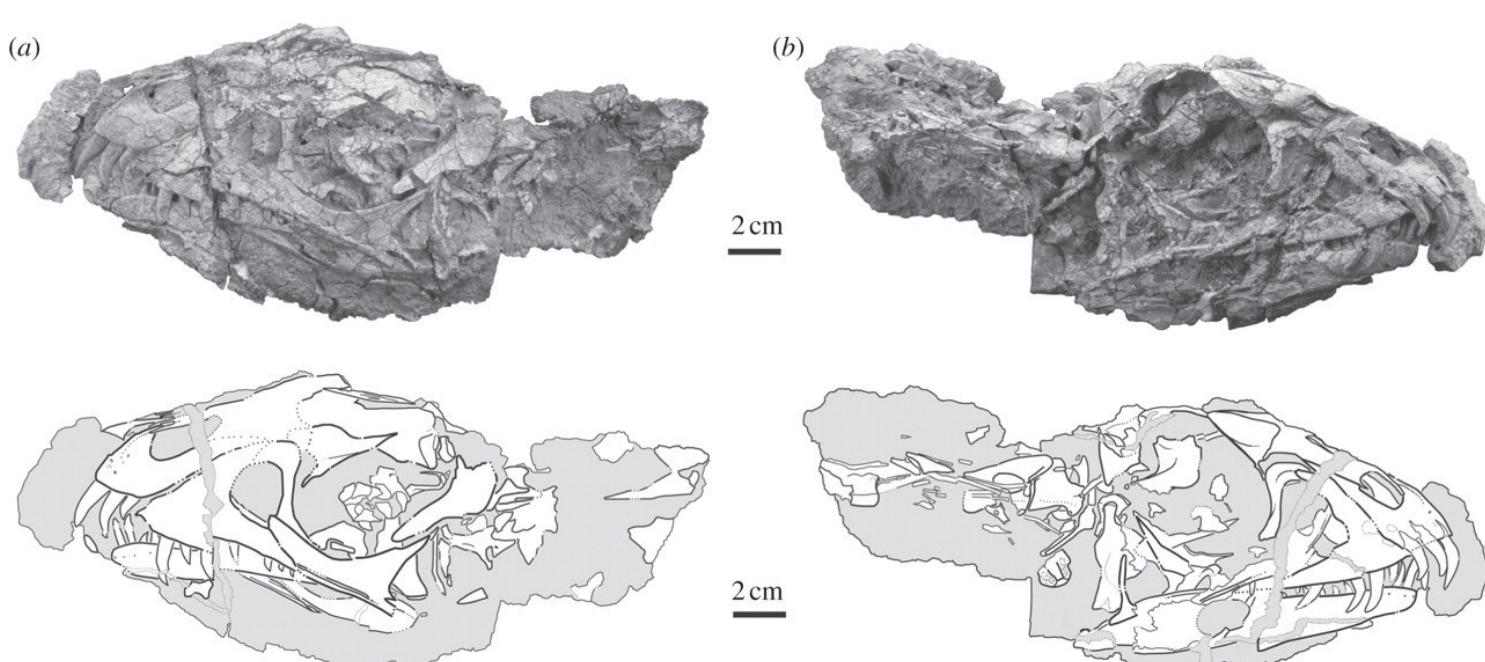
IMPORTANCE: Scientific illustrators “use scientifically informed observation, combined with technical and aesthetic skills to accurately portray a subject” (Scientific Illustration, 2003). This entails attention to detail. However, since there have been significant advances in imaging technology since the 18th century, why are these illustrations still needed and used today?

- **Layers:** Scientific illustration enables layering techniques that highlight key details specific to research questions - it eliminates background noise (Scientific Illustration, 2003). As a result, it provides an accurate representation of an organism's morphology from internal to external in relation to systems throughout the body. This not only provides an intriguing image for viewers, but it gives a correct orientation of deep and external layers for researchers/students to understand the placement of anatomical parts and features in a given region.
- **Fossil colors:** Some fossils are naturally a dark hue (*Fig. 2*), making it difficult to get photographs that show details necessary for taxonomic identification (Monoyios, 2011).
- **Extinct animals:** Many extinct animal reconstructions (*Fig. 1*) are done by scientific illustrators because cameras cannot capture animals that are not alive today. This requires sketches based on fossil skeletons (Monoyios, 2011).
- **Taphonomy factor:** Fossils are subject to millions of years of environmental, geological, & faunal modification (*Fig. 3*). As a result of taphonomic processes, fossil remains may be crushed, cracked, and/or worn away. Scientific illustration can fill-in the gaps & provide an outline of missing remains, or it can smooth over the cracks to allow the full anatomical element to be seen (Monoyios, 2011).

Figure 2: Fossil mandibular ramus & teeth (*Arfia opisthotoma*, DMNS 126360); Note dark coloration.



Figure 3: *Daemonosaurus chauliodus* reptile fossil teeth & cranial elements. Top row, photograph. Bottom row, illustration of fossil element details within rock matrix (Sues *et al.*, 2011).



- **Sometimes fossils are small ... REALLY SMALL:** In the CSU Primate Origins Lab I have observed a multitude of miniscule fossils, some averaging a mere 2 cm in length. Such fossils are difficult to see with the naked eye, let alone a camera lens (Monoyios, 2011). Many of these specimens have to be examined under extreme magnification with a microscope (*Fig. 4*). Scientific illustration can enlarge such tiny fossils while still providing extreme detail and a clear image of the specimen itself.
- **Too much DETAIL:** Photography can capture too much detail sometimes, creating a busy image of the fossil that can overshadow key features necessary to identify a taxon. *Fig. 3* is a great example of how these drawings can make some features purposefully more clear than others; something that can't be done from a photograph (Monoyios, 2011). Not only is this more useful for all researchers, but “often the artist sees an important feature missed by the scientist” (Scientific Illustration, 2003) which can further enhance the research being done.

ACKNOWLEDGMENTS:

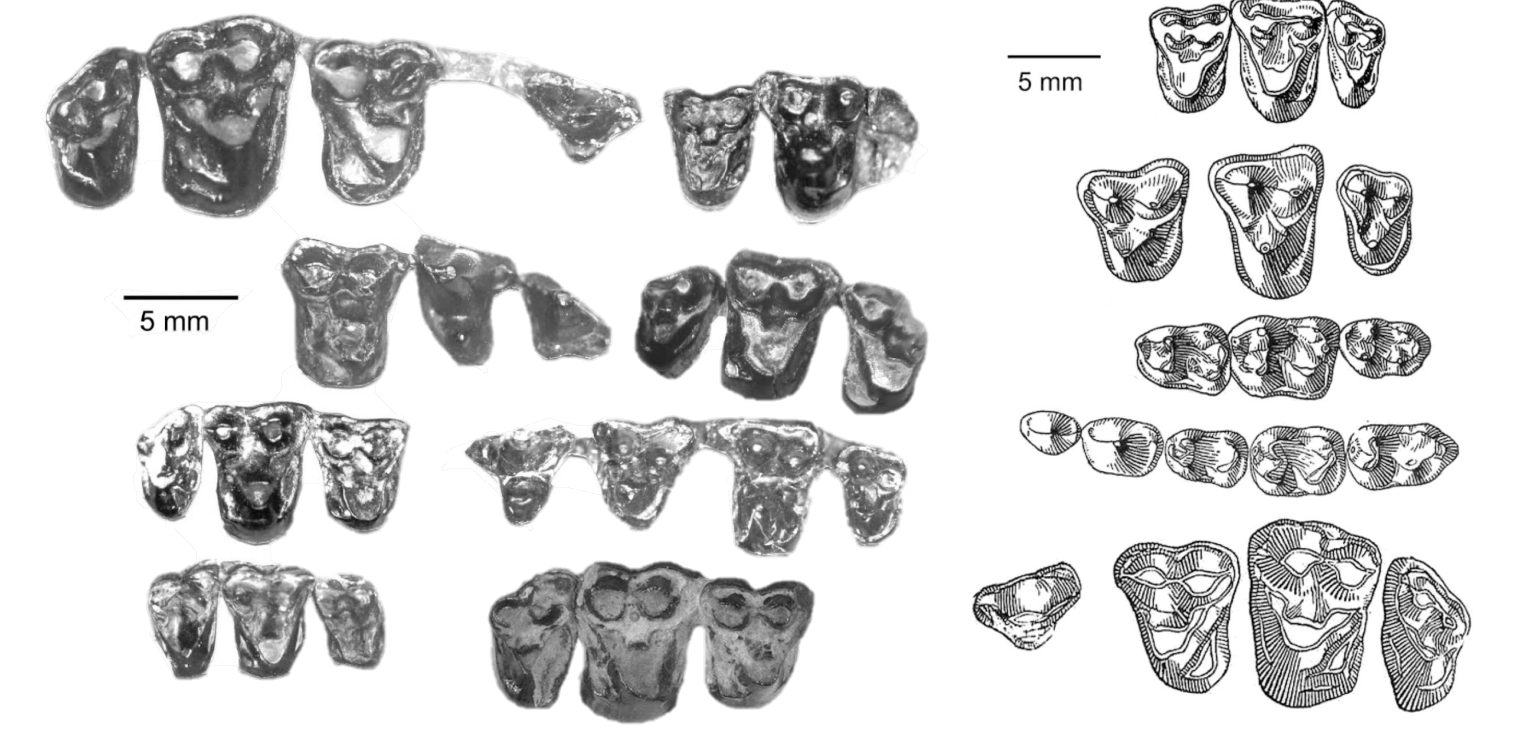
This project was made possible by the Colorado State University Anthropology Department, specifically the Primate Origins Lab where I continue to do my illustrations. I would like to give a warm thank you to Prof. Kim Nichols who recognized my artistic talent and brought me into this study under the advisement of herself and Dr. Tom Bown. I am forever grateful to Dr. Bown as he continues to guide me with all of the details necessary for scientific illustration and for being patient with me while I found the right style for these drawings. Both Prof. Kim Nichols and Dr. Tom Bown have pushed me to academic success while also keeping me motivated by showing great appreciation for my work and talent. I would also like to thank Dr. Connie Fellmann, as she was the professor in my first anthropology class at CSU who truly sparked my interest in the field from the start. Without that class I would not be where I am today. Lastly, I want to thank my good friends and colleagues, Elizabeth Larson and Matt Harrison, for their support in my academic work and for pushing me to not only apply for the Paleontology Summer 2019 Field School, but also to apply my artistic skills to scientific illustration.

REFERENCES:

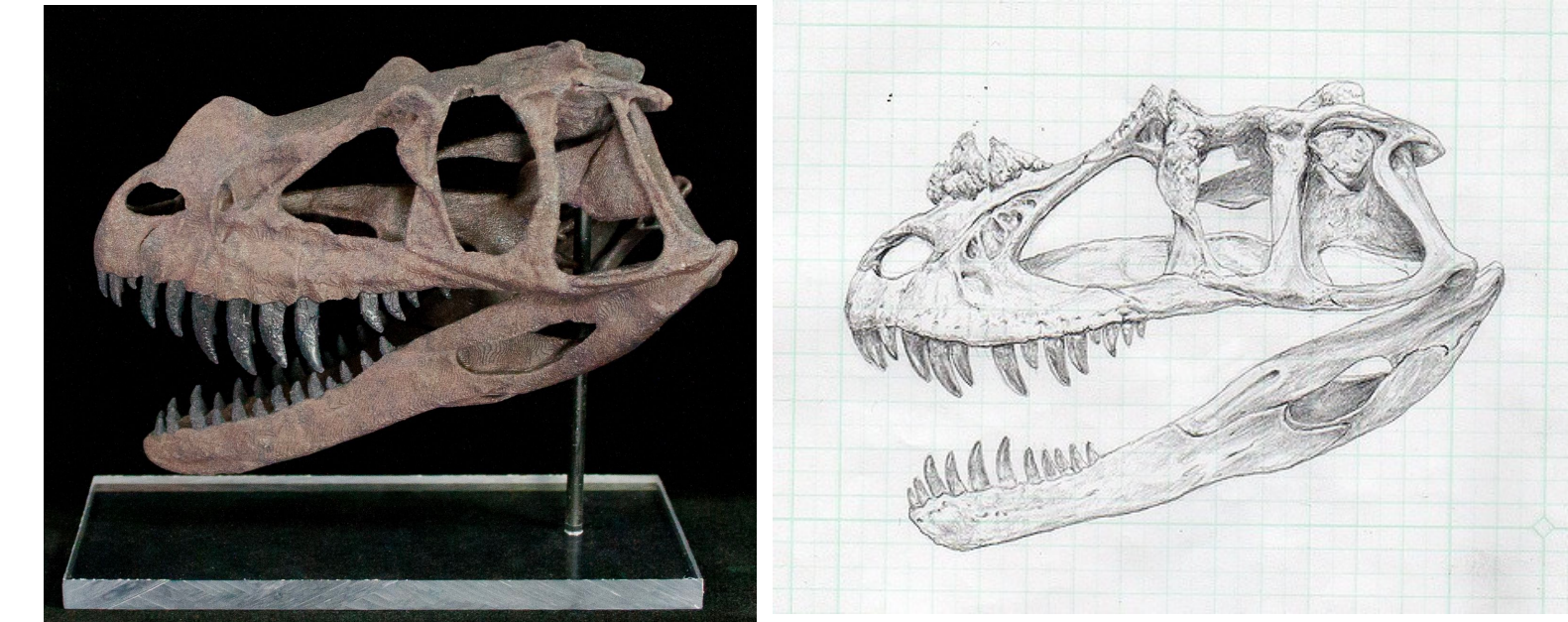
- Audubon, J. J. (2015, March 10). Black-throated Blue Warbler. Retrieved March 31, 2019, from <https://www.audubon.org/birds-of-america/black-throated-blue-warbler>
- Crist, C. (2017, January 13). 9 Gorgeous Historic Scientific Illustrations. Retrieved March 30, 2019, from <https://www.pastemagazine.com/articles/2017/01/9-gorgeous-historic-scientific-illustrations.html>
- Guth, G. (1976). Retrieved March 30, 2019, from <http://guthillustration.com/animal-art.html>
- Lucas, S. G., Zeigler, K. E., & Kondrashov, P. E. (2004). *Paleogene mammals*. Albuquerque, NM: New Mexico Museum of Natural History and Science.
- Miniature 3D Printed Ceratosaurus Skull Replica. (n.d.). Retrieved March 31, 2019, from <https://www.fossillera.com/products/miniature-3d-printed-ceratosaurus-skull-replica>
- Monoyios, K. (2011, July 12). 5 Reasons Your Camera Won't Steal My Job. Retrieved March 31, 2019, from <https://blogs.scientificamerican.com/symbiotic/http://blogs.scientificamerican.com/symbiotic/2011/07/12-5-reasons-your-camera-wont-steal-my-job/>
- Science Illustration. (2003). Retrieved March 31, 2019, from <https://gnsi.org/science-illustration>
- Sloan, C. (2016, June 23). Dinosaur True Colors Revealed for First Time. Retrieved March 30, 2019, from <https://news.nationalgeographic.com/news/2016/06/23-dinosaur-true-colors-revealed/>
- Stucky, R. K., & Covert, H. H. (2014). A new genus and species of early Eocene (Ypresian) Artiodactyla (Mammalia), *Gagadon minimonstrum*, from Bitter Creek, Wyoming, U.S.A. *Journal of Vertebrate Paleontology*, 34(3), 731-736. doi:10.1080/02724634.2013.827580
- Sues, H., Nesbitt, S. J., Berman, D. S., & Henrici, A. C. (2011). A late-surviving basal theropod dinosaur from the latest Triassic of North America. *Proceedings of the Royal Society B: Biological Sciences*, 278(1723), 3459-3464. doi:10.1098/rspb.2011.0410
- Switek, B. (2011, May 09). The Myth of the Eight-Spiked Stegosaurus. Retrieved March 31, 2019, from <https://www.smithsonianmag.com/science-nature/the-myth-of-the-eight-spiked-stegosaurus-165459353/>
- Taburin, (2008, December 08). Ceratosaurus skull lateral view. Retrieved March 31, 2019, from <https://www.flickr.com/photos/taburin/3092496344>

TYPES: As with all art, scientific illustrations consist of many different styles. Below are the names and examples of three of these.

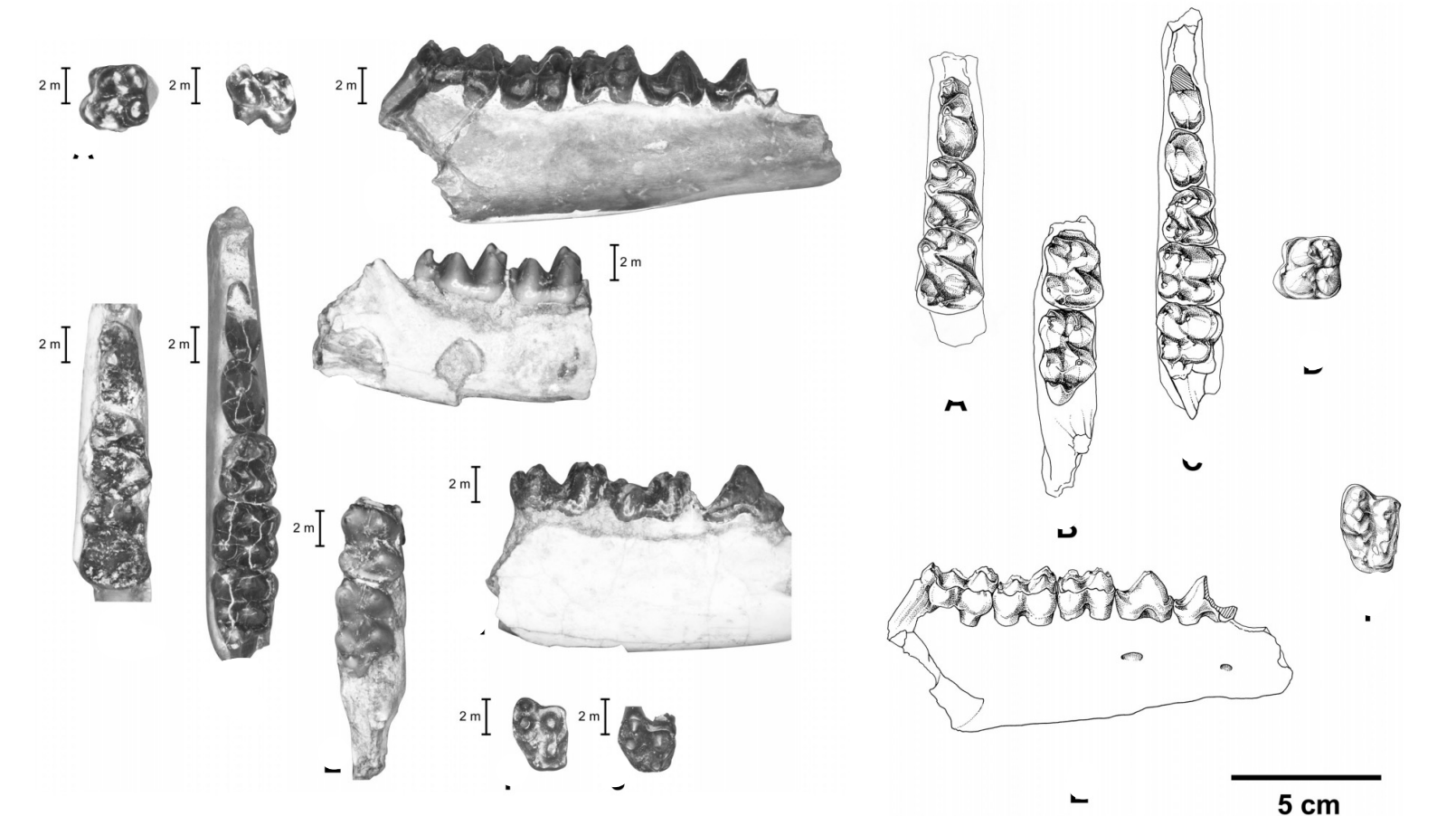
1. **Lines:** This style consists of the artist drawing darker/multiple lines to create depth on the specimen, usually done in pen. The left image is a photo of the fossils of *Oxyclaenus simplex* and the right image shows illustrations of the same fossil teeth (Lucas *et al.*, 2004).



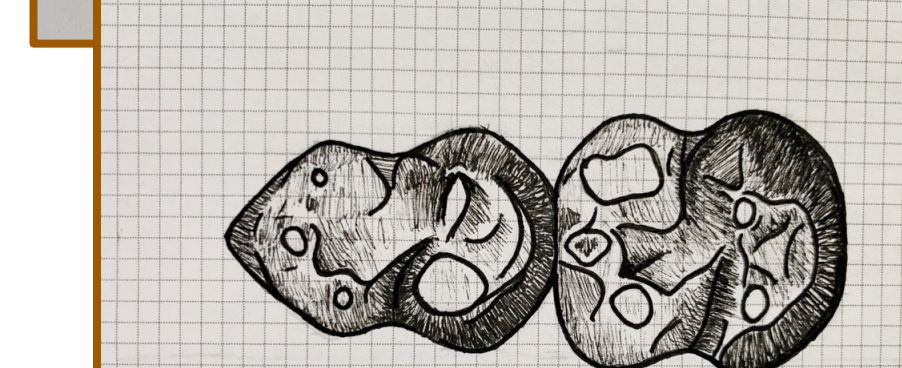
2. **Pencil:** Sometimes pencil drawing is the preferred technique in order to get gradient, smooth shadows. This can be seen in the images to the right. The left is a photo of a *Ceratosaurus* skull in miniature from a 3D Printer replica and the right image shows an illustration of the specimen (Taburin, 2008).



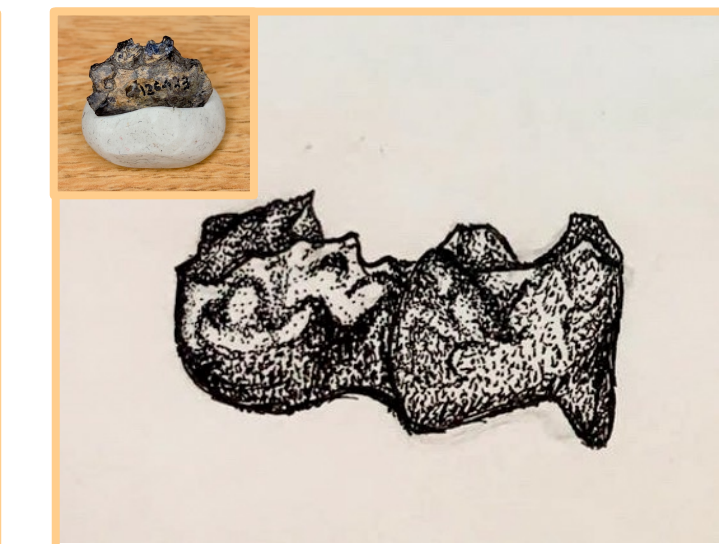
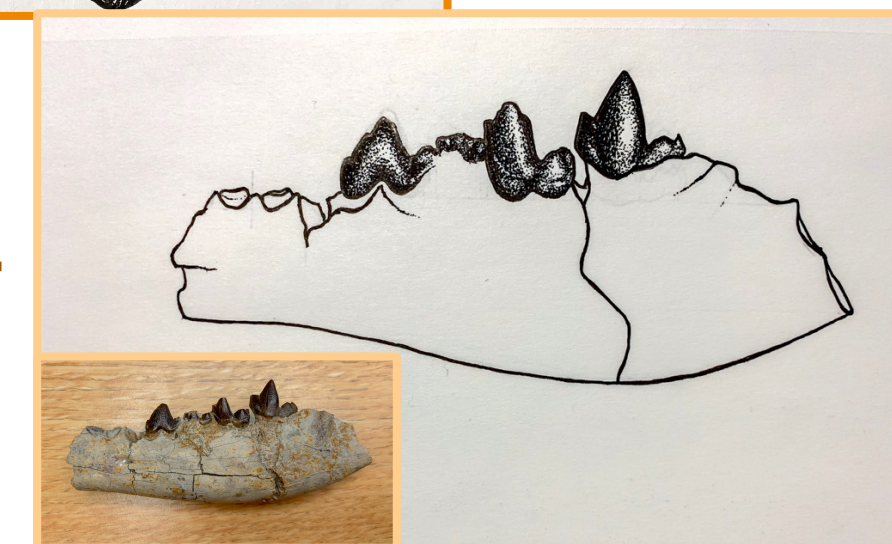
3. **Stippling:** This third technique is the clustering of many small dots to create diverse shading and highlighting. The image on the left is a photo of the fossils of *Gagadon*, *Hexacodus*, and *Antiacodon*, and the right image is a stippling drawing done in ink of these fossils (Stucky & Covert, 2014).



FEB 2019



PRESENT



MY PROCESS: I have now developed a technical process and artistic rhythm to create scientific drawings in the anthropological and paleontological context.

- **Materials:** Micron pens, H pencil, pencil sharpener, eraser, sketchbook.
- **Step 1:** Choose scale (the smaller the specimen, the bigger the scale; this is also dependent on the amount of detail wanted) and measure the specimen, placing corresponding marks on the paper (in pencil).
- **Step 2:** Make an outline in pencil of the whole specimen.
- **Step 3:** Outline in ink.
- **Step 4:** Shade in ink. The goal here is to bring out the diagnostic features for the taxon.
- **Step 5:** Erase left over pencil.

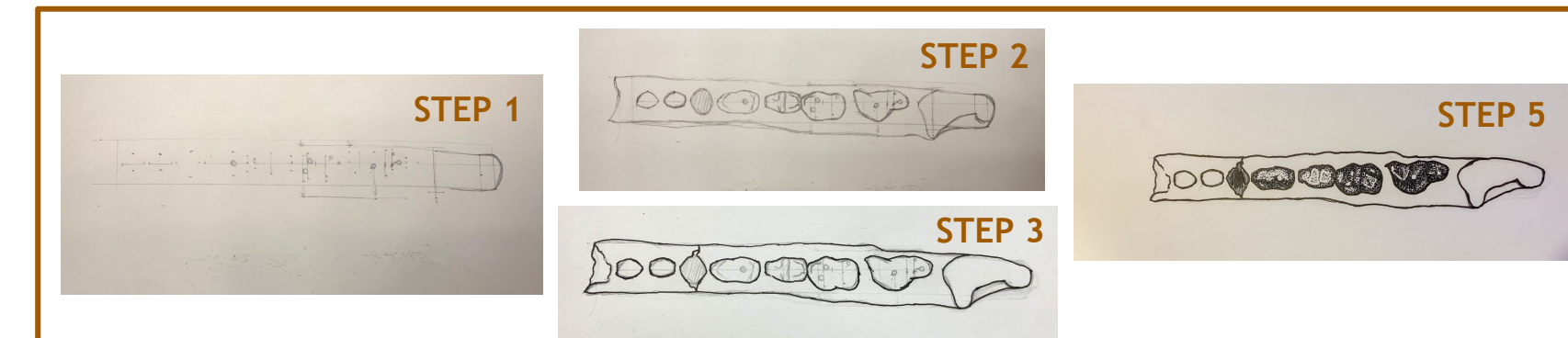
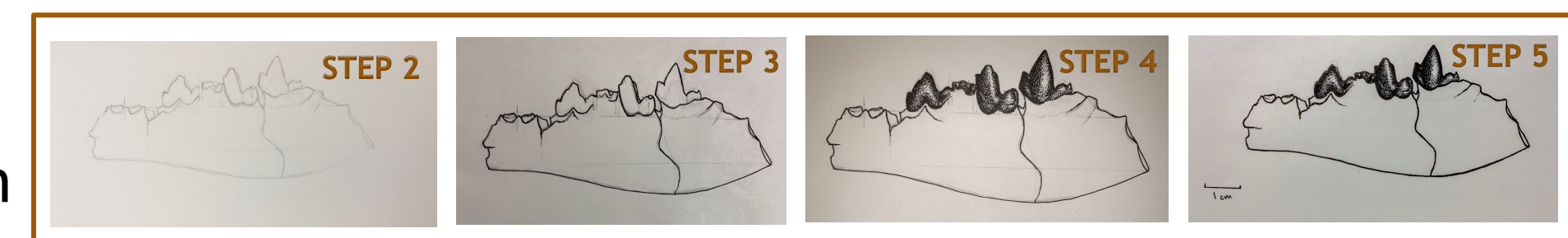


Figure 4: Line Work



Figure 5: Stippling



COMPARISONS: Two sets of drawings are shown that are exactly the same except for the style I used (*Fig. 4*: line and *Fig. 5*: stippling). After reviewing this work, it was obvious to Prof. Nichols, Dr. Bown and I that stippling brought out the most detail and contrast. These details are of the most use in anthropological & paleontological scientific illustration AND research!