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PUTTING TOGETHER THE PUZZLE OF TYRANNOSAURUS REX FOSSILS WITH 3D SCANNING

Valentin Vanhecke scanning the skeleton of T.Rex with an Artec Eva

The discovery of the skeleton of Tyrannosaurus rex, dubbed Trix, in 2013 in Montana, U.S., was staggering news for the paleontological community: more than 80% of the bone volume was preserved, which placed Trix in the top 3 most complete Tyrannosaurus rex skeletons ever found. All essential, larger bones were present, and the quality of the fossil was unmatched by any other T.Rex skeletons in the world.

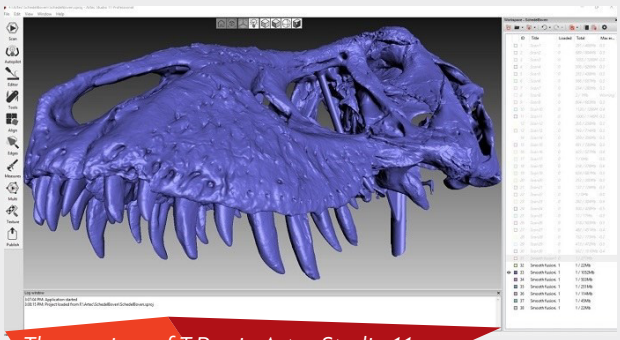
The bones were uncovered by the staff of Naturalis Biodiversity Center based in Leiden, the Netherlands, which is where the skeleton has gone on display. In order to prepare it for exhibiting, the center contracted Valentin Vanhecke, the founder and owner of 3D scanning service provider 4Visualization. Valentin's job was to scan the overall fossil and separate bones on site. The 3D models were later used to mount the entire skeleton: the missing bones were modeled, 3D printed and placed where they belonged.

Valentin made two trips to the Black Hills Institute in South Dakota, U.S. where the bones of Trix were

prepared for scanning. The scanning was performed with an Artec Eva, which was supplied by Artec's Gold Partner 4C Creative CAD CAM Consultants.

"This was great," says Valentin. "Everything was done with the Eva, even the very last two of the tail vertebrae, which are only a few cm long. I managed to do them but they were really on the limit of the smallest size possible. On the other end is the skull, which is nearly 2 m long and has a lot of detail, pathology and hollow spaces, like the eye sockets and all of the nasal passages."

In the skull, a never-seen-before small bone was found that leads from the outer ear toward the inner ear. The bone is a 3—4 mm high ridge that is nearly 1 mm thick and 5 cm long. Despite the small size, the bone was effectively captured by the scanner.



The cranium of T.Rex in Artec Studio 11

The smaller bones took two weeks to scan and the overall fossil took one day. The bones were scanned with the resolution of around 0.3mm.

"Then came the post-processing for all those bones which I did in my office, which was done mostly in the off-time in my company," says Valentin. "This left me with a box of about 200 puzzle pieces without the picture on the front of the box."

Valentin performed smooth fusion of all the bones in Artec Studio 11 software with the resolution of 0.3 or 0.5 mm depending on the size of the bone or the detail. The size of the files ranged from 200 Mb to 1,000 Mb. Valentin simplified the meshes and loaded them in one project with the overall scans of the complete skeleton.

Where possible the missing bones of the T.Rex were mirrored and printed out. Mirroring was performed in Meshmixer, where some color was added as well, after the printing was done.

All the missing bones were printed using Ultimaker 3D printers. When the whole skeleton was in place, Valentin made several more scans of T.Rex to know exactly how to put all the pieces where they belonged.

The complete skeleton of the T.Rex in 3D

"Putting the puzzle together was a tedious job as the skeleton is about 13 meters long from the tip of the nose to the end of the tail," says Valentin. "At first I hoped to do it with all the bones in the high resolution that I had scanned them in, but that was too much for my computer, so I had to simplify all the bones to keep the total size workable."

The final model was featured on Dutch national television in the "Expeditie T.Rex" film and can be viewed on the 4Visualization page on Sketchfab.