

SunoikisisDC Digital Approaches to Cultural Heritage
2022 session 3

3D Imaging & Museum Research

Gabriel Bodard (University of London)
Daniel O'Flynn (British Museum)
Daniel Pett (Fitzwilliam Museum)

3D methods

3D methods

1. 3D imaging (scanning)
2. 3D modelling (visualisation)
3. Virtual Reality
4. Augmented Reality
5. 3D printing

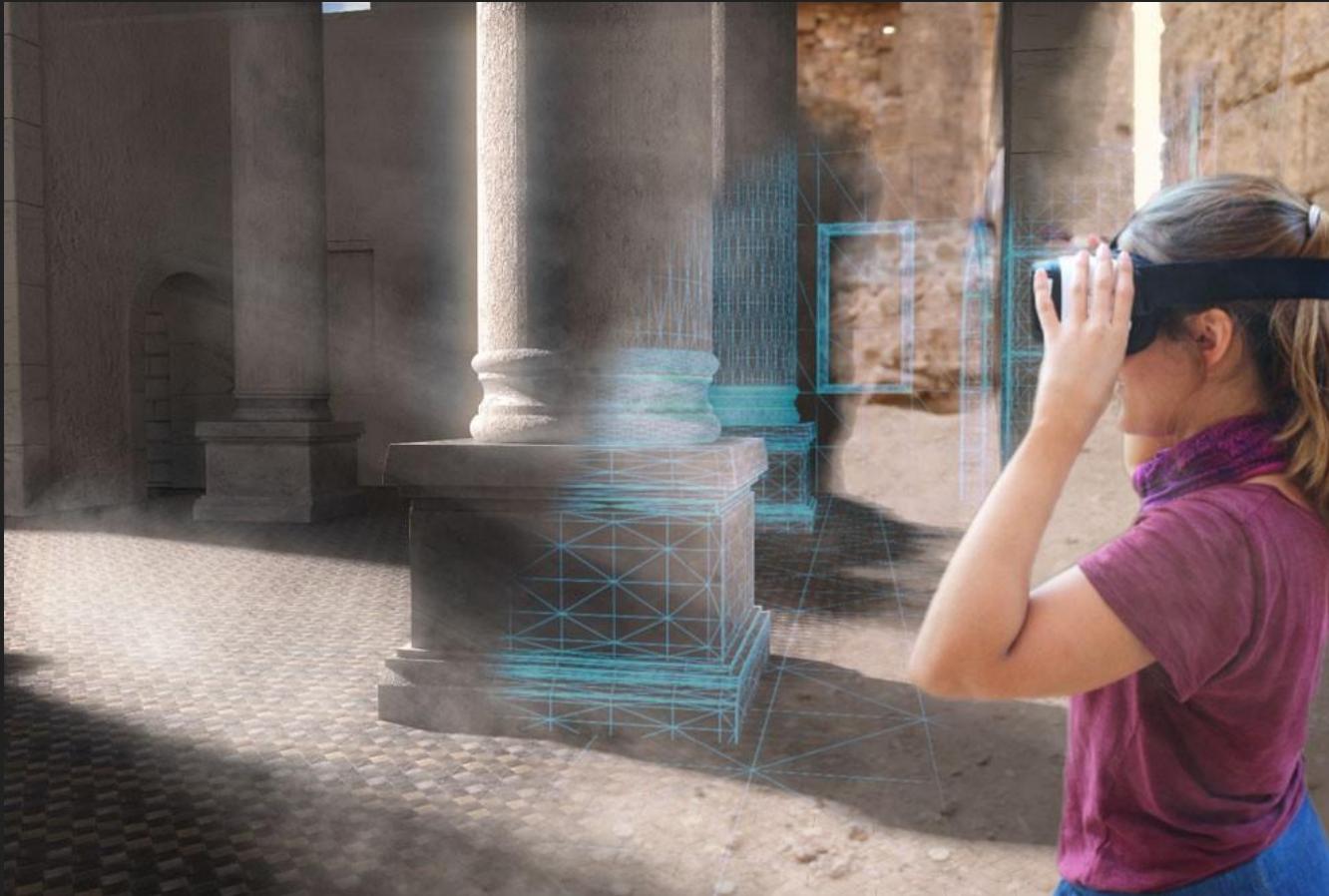
1. 3D imaging or scanning



2. 3D modelling or visualization



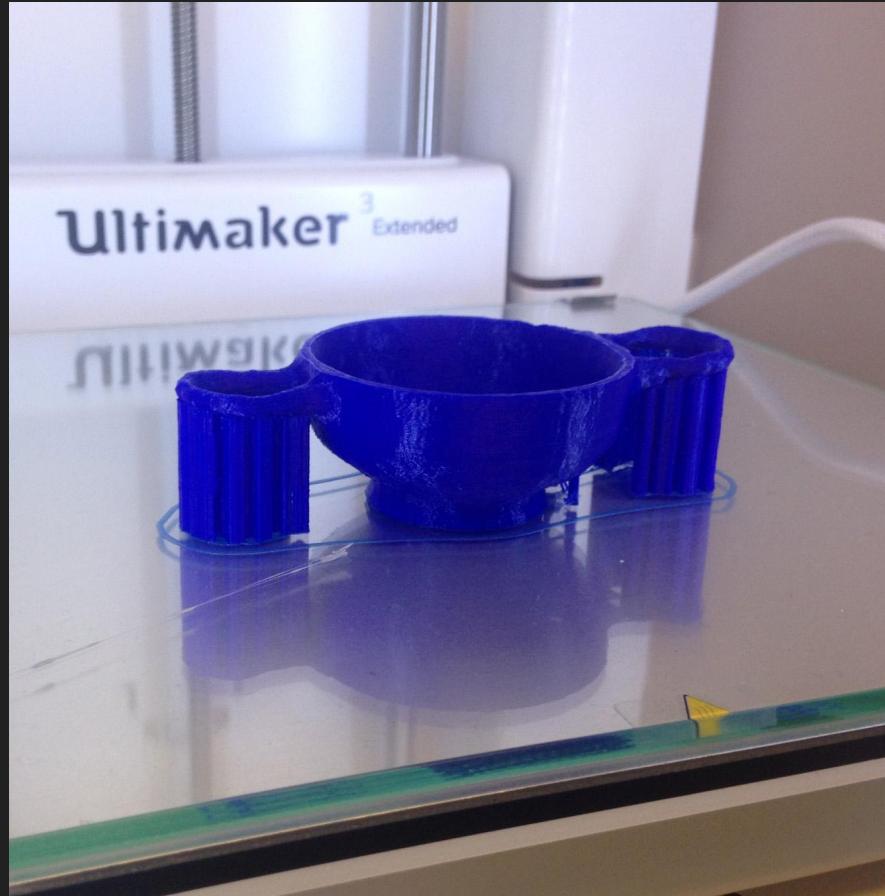
3. Virtual Reality (VR)



4. Augmented Reality (AR)



5. 3D printing





Peirene ... 13.5k 21 367



Ancient gre... 4.7k 4 21



Snake St... 8.5k 11 180



Greek Ba... 2.1k 19 122



The Three ... 6.1k 0 95



Ancient Gr... 3k 14 233



Discobol... 20.5k 1 150



Ancient Gr... 6.4k 1 112



Al Khaz... 26.2k 20 497



Stone Ancie... 2.7k 4 74



Stadium o... 3.3k 1 105



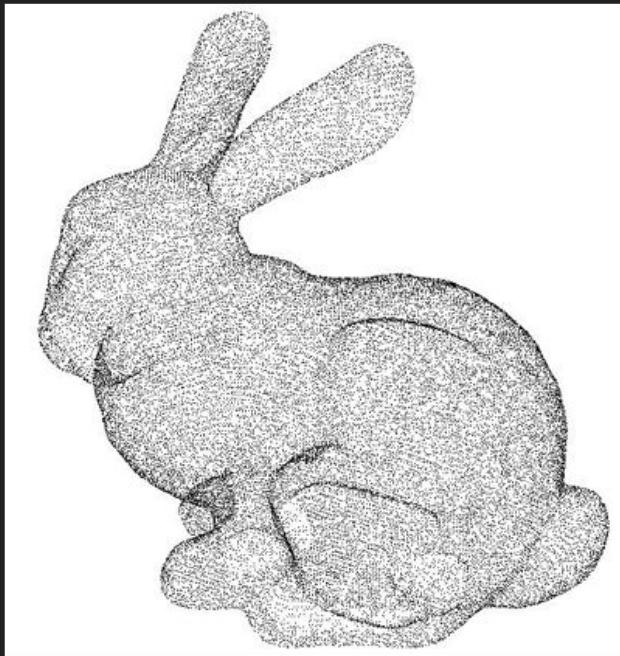
Greek Pott... 1.2k 0 19

3D imaging

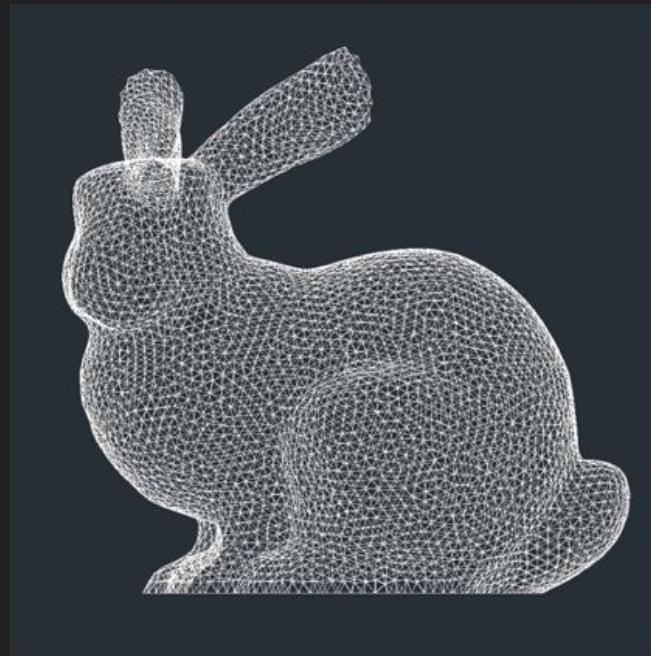
3D technologies and formats

1. Point cloud vs mesh
2. Laser scanning:
 - a. time of flight / triangulation / structured light
3. Computer Tomography / XRay
4. Photogrammetry / Structure from Motion
5. Reflective Transformation Imaging

3D Imaging outputs



Point Cloud



3D Mesh

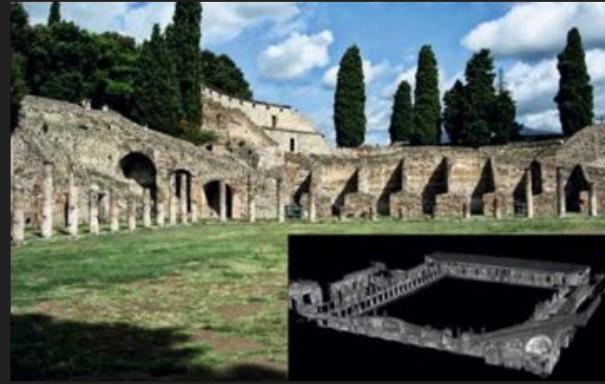
Laser Scanning Time of Flight

PROS

- * Good geometric fidelity
- * Suitable for large areas

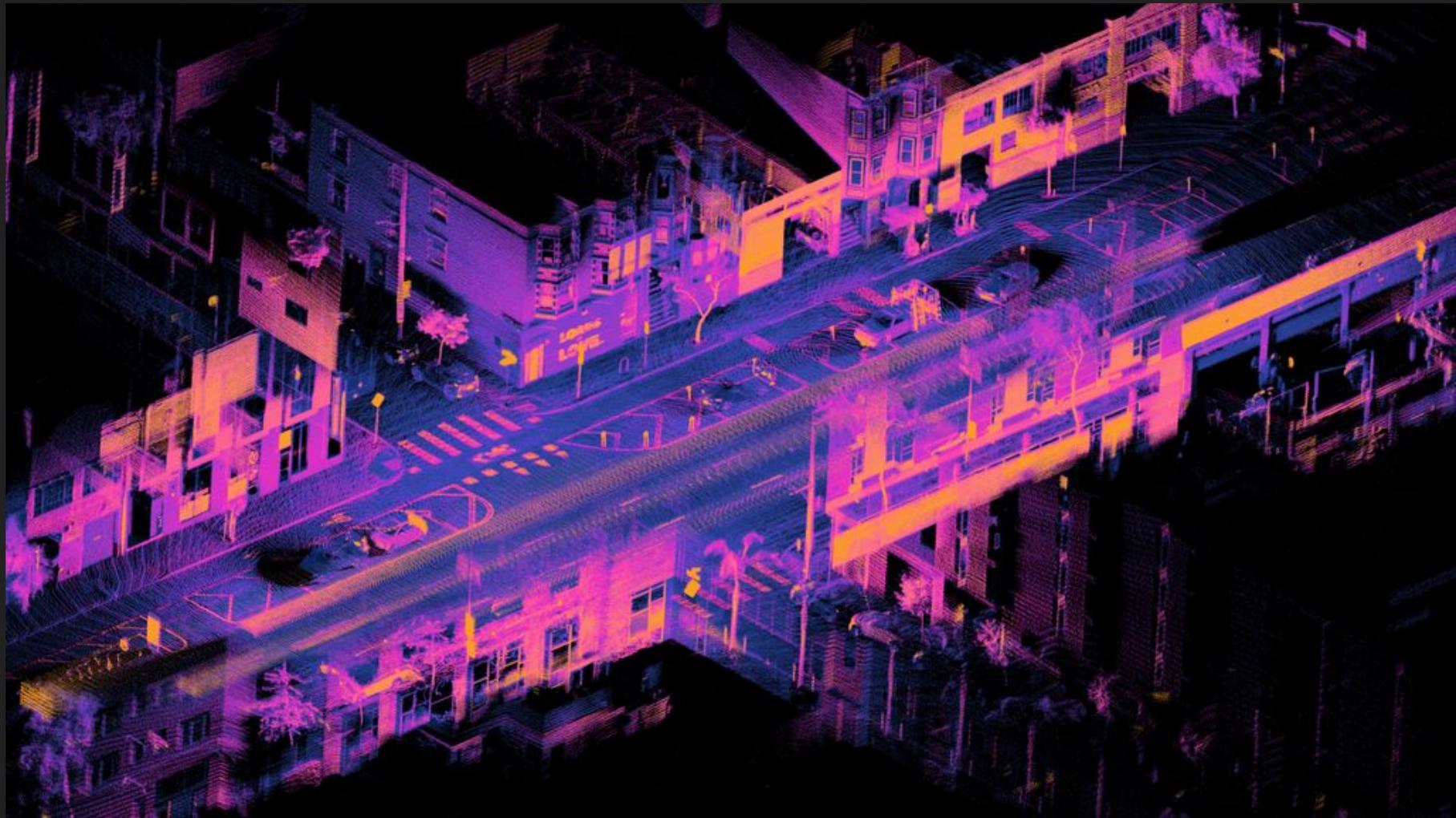
CONS

- * Cost
- * Massive data set
- * Slow process
- * Not accurate on smaller artefacts



The Pompeii Quadriporticus Project





Laser Scanning Triangulation

- * Cheaper
- * Better on smaller surfaces (not adequate for larger ones)
- * Portable
- * Ready to use

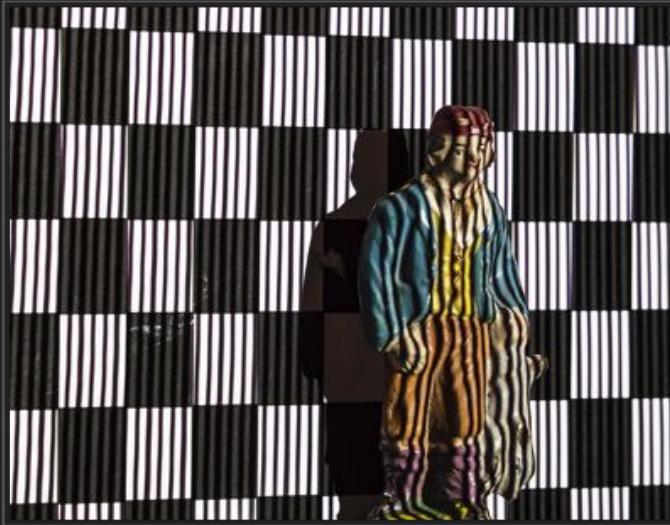


<http://surveyequipment.com/faro-scanner-freestyle-3d/>



<http://www.nextengine.com/>

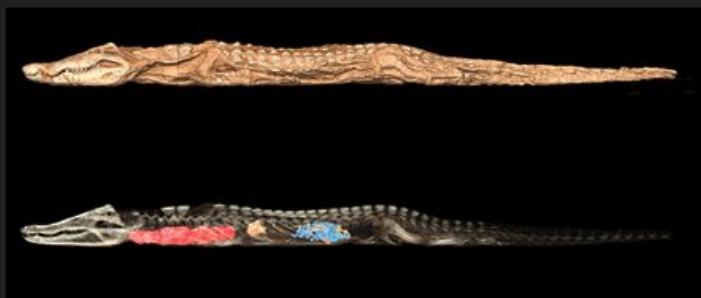
Structured Light



3D scanning by Structured Light using a mini (pico) projector coupled with the “3D scanning software” developed by D. Moreno and G.Taubin at Brown University School of Engineering.

- * Fast
- * Accurate
- * Has to be performed in a studio
- * Requires calibration
- * Is slightly out of date, but still used and researched

CT Scan (Computed Tomography)



- * Expensive
- * Non portable
- * Requires training
- * Non invasive
- * Virtual autopsy

Images of CT scans used by the British Museum for the exhibitions
“Ancient Lives, New Discoveries” and “Scanning Sobekh”.

Photogrammetry

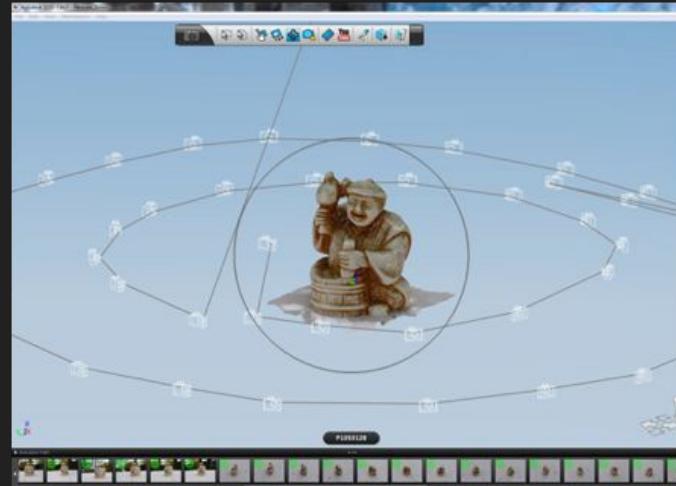
- * Based on triangulation
- * Cheap
- * Easy to learn
- * Portable equipment
- * 3D mesh as an output

Agisoft Photoscan

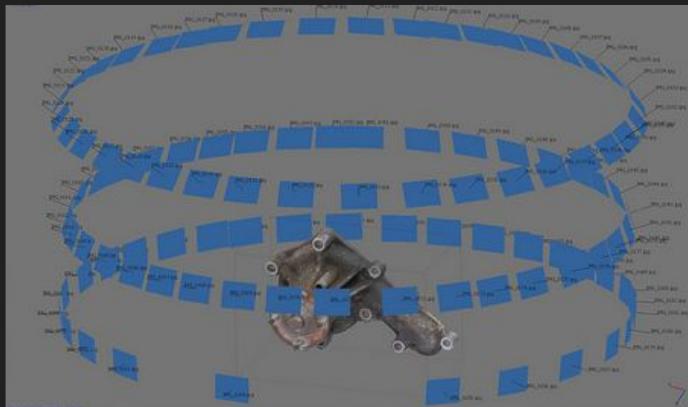
<http://www.agisoft.com/>

3DF Zephyr

<https://www.3dflow.net/3df-zephyr-free/>



Capture with 123D catch <http://www.tcpproject.net>



Capture with Photoscan <https://www.flickr.com/photos/erik-nl/sets/72157628813159493/>

Structure from Motion

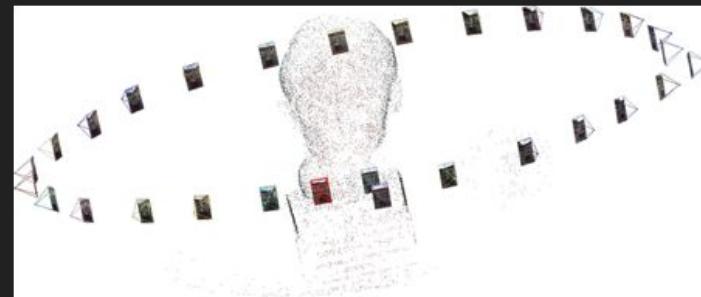
* Similar to Photogrammetry

Visual SfM

* Cheap

<http://ccwu.me/vsfm/>

* Relatively simple to use (but requires more IT skills)



* Accurate colour information

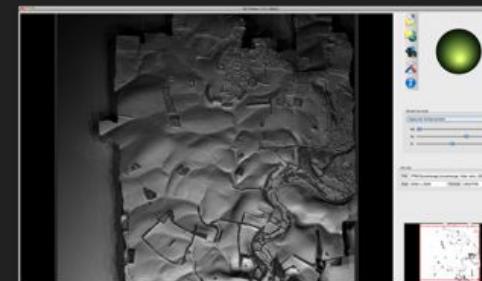


* Long processing time

* Output in point cloud

Reflectance Transformation Imaging (RTI)

- * Virtual relighting
- * Cheap (when not performed with the dome)
- * Free software
- * Can only be seen (easily) in the viewer

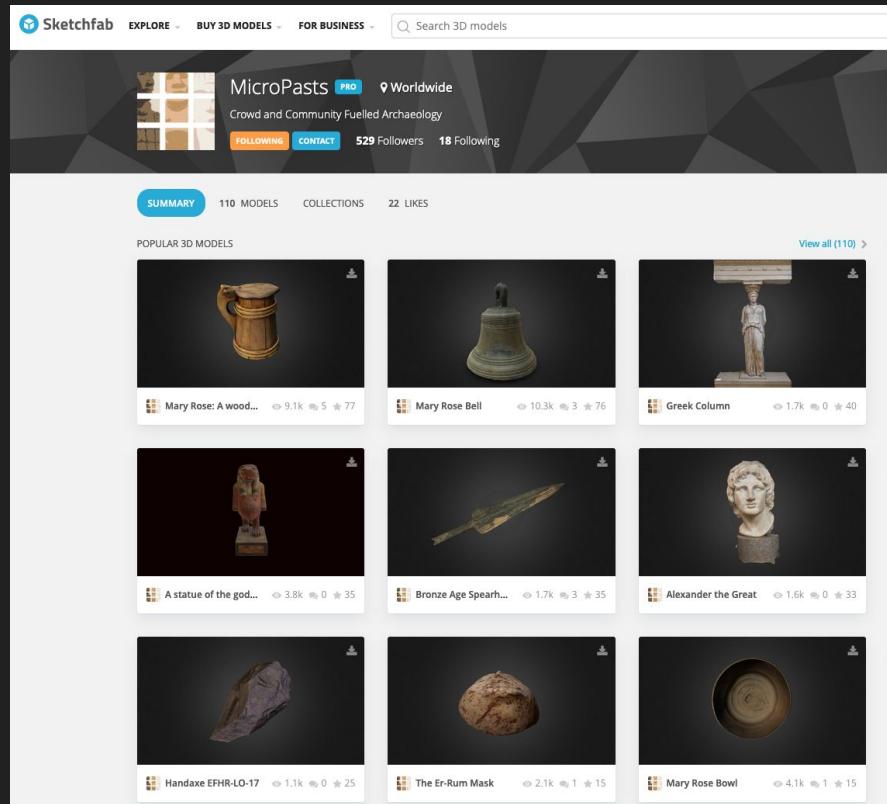


Museological 3D

Bloomsbury - Cambridge - beyond

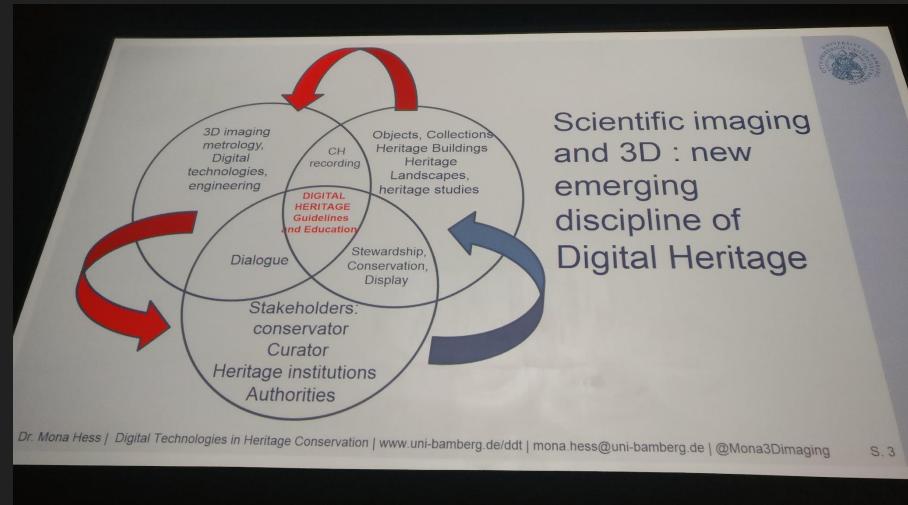
Adventures in 3D started in 2014

- Began with MicroPasts
- Construction of crowd powered 3D models of Bronze Age objects
- 100 3D models were made collaboratively with our contributors
- MicroPasts paid for:
 - Software
 - 3D printer
 - Processing hardware



What opportunities did we see?

- Public engagement
 - Narrative tools
 - Beyond the spinning object
 - Journey towards total object biography
- Applied use in the museum
 - Exhibition design
 - Interactive installations (eg Museum in a Box, touch screens)
 - 3D surrogate tactile handling
 - Applied Scientific imaging
- Research project generation
- Cheap and effective imaging technique
- Push the boundaries of museum's view on copyright and photography



Structure from Motion (SFM)

Photo Masking: Contribute

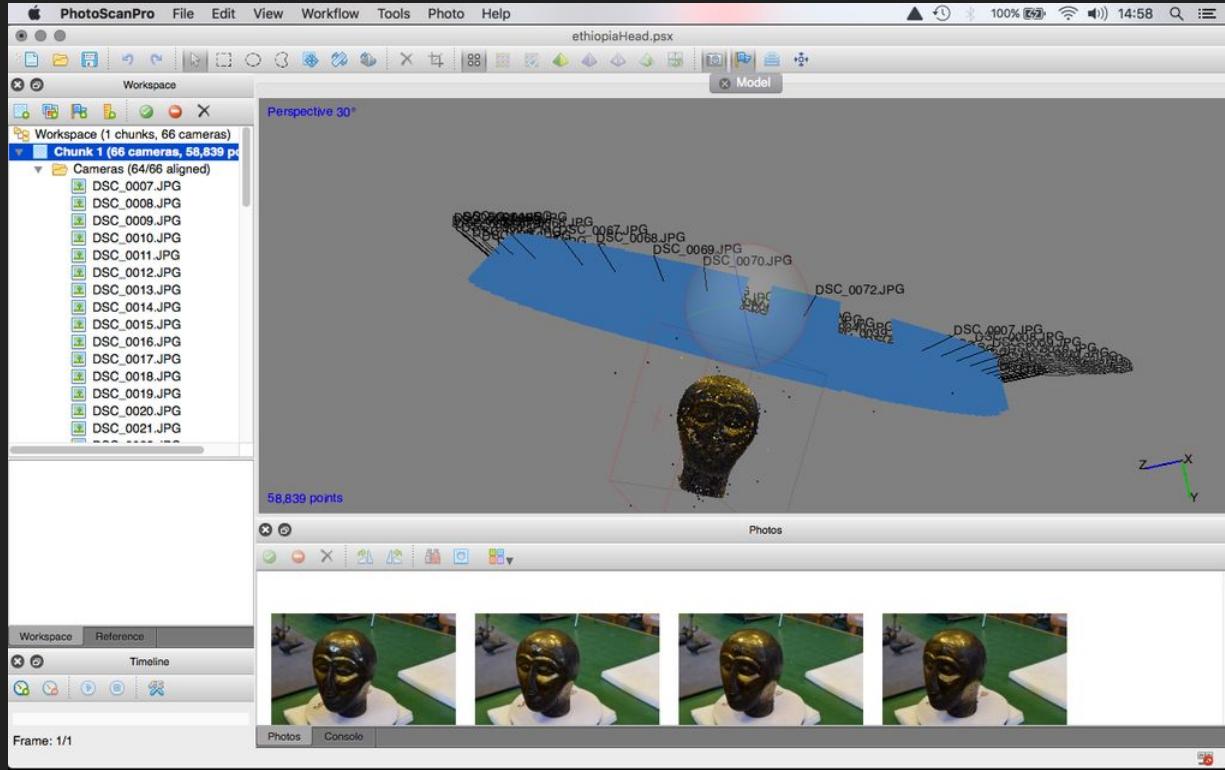
Draw the outline and/or holes of the main object shown in the picture

Photo loaded Outline Holes Draw Edit Remove all polygons Save the drawings

You are working now on task: 6220

You have completed: 5 tasks from 27

Models created in PhotoScan





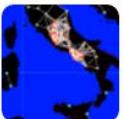
Daniel Pett
@DEJPett

We now have 30 downloadable models of mainly @britishmuseum content generated by @MicroPasts crowd on @Sketchfab



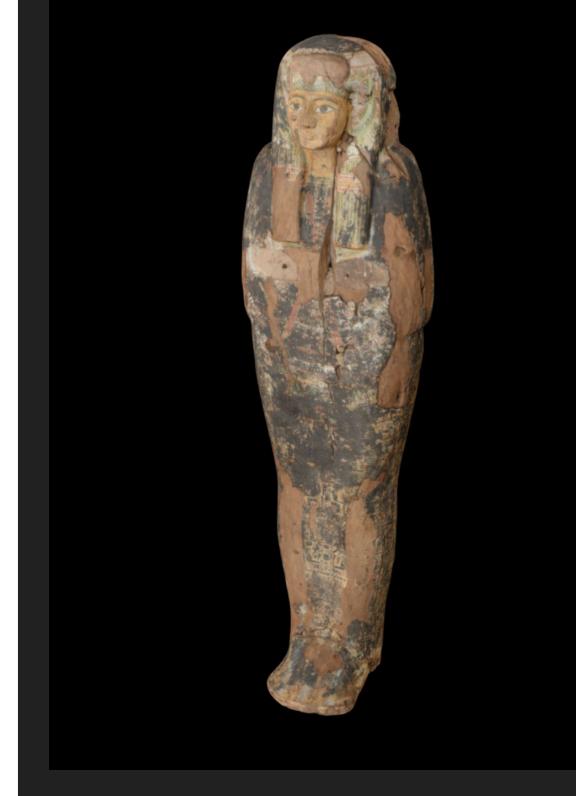
MicroPasts's 3D models

MicroPasts - See MicroPasts 3D models on Sketchfab
sketchfab.com



Sebastian Heath @sebhth · 14 Jan 2015

@portableant I'm loving the CC-By license! Set the bar, my friend, set the bar.



Annotated 3D

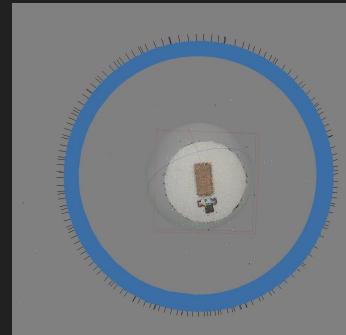
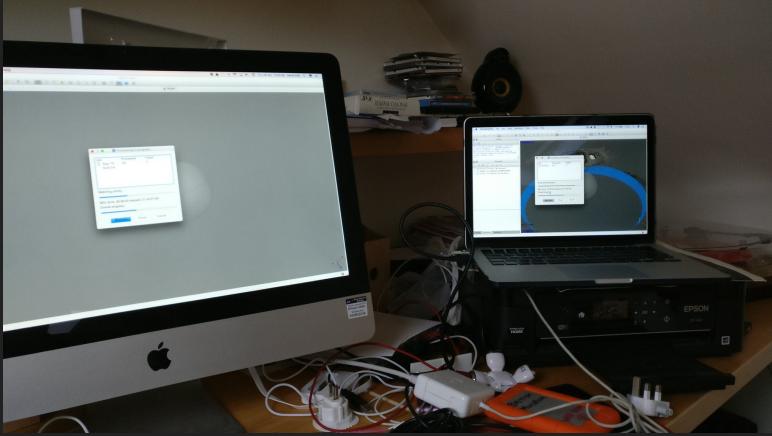




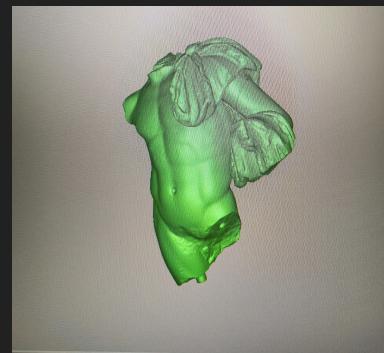
Australian
National
University



<https://twitter.com/DEJPett/status/823904546577649664/video/1>

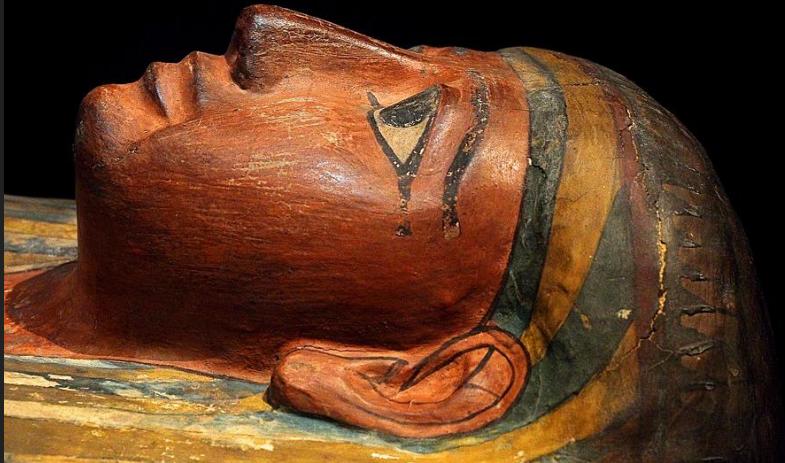


I took my toys to Cambridge - what next?



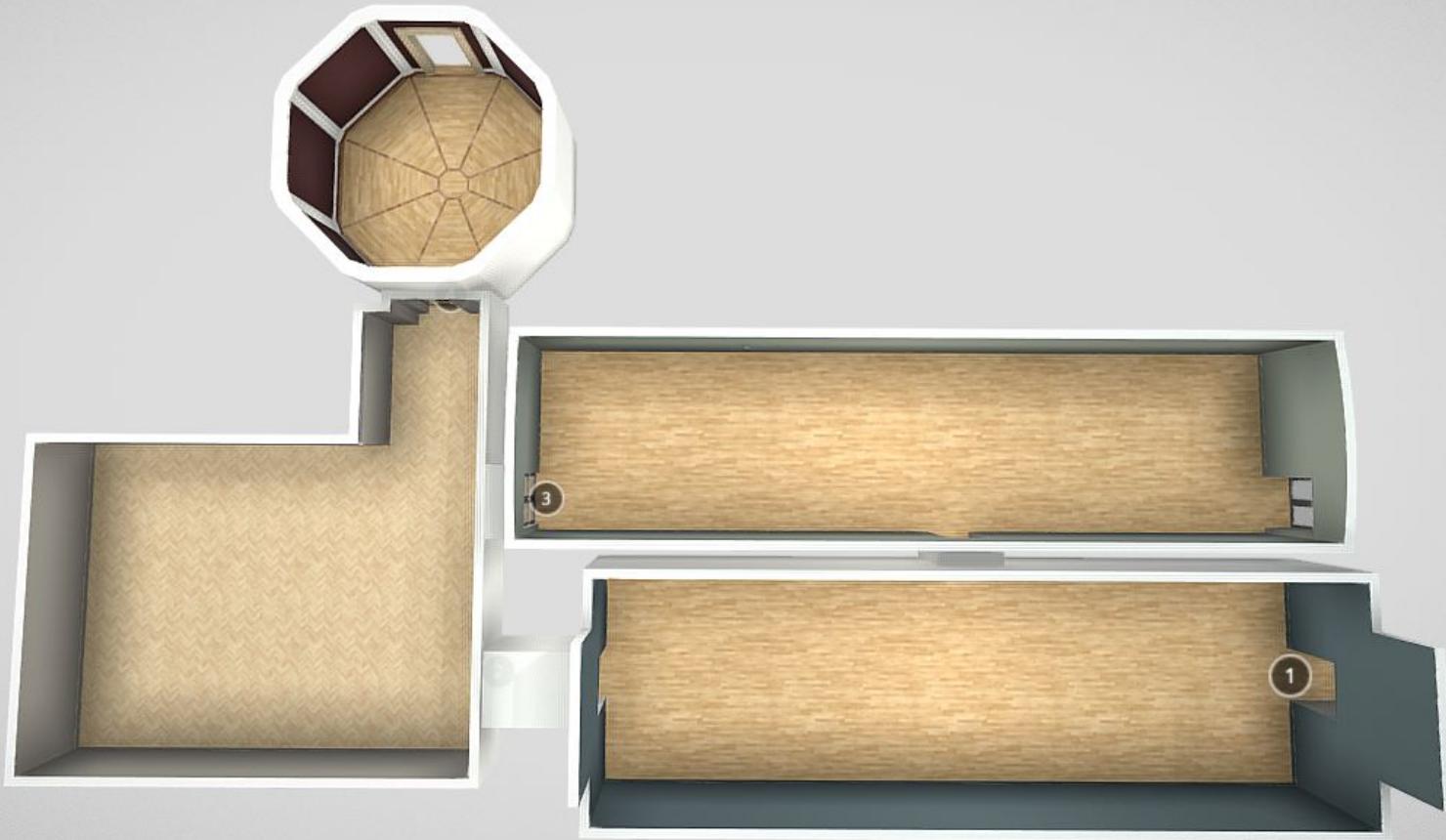
Digital / Research

The Egyptian Coffins Project has seen the curatorial team learn to create a website, commission 3D reconstructions, train colleagues in Egypt and the UK and build an award winning pop up museum with funding from the GCRF, Isaac Newton Trust and more.



AHRC funding of £200k enabled us to host 4 post doctoral research fellows to work on 3D imaging and its impact with two Creative Industries Partners.

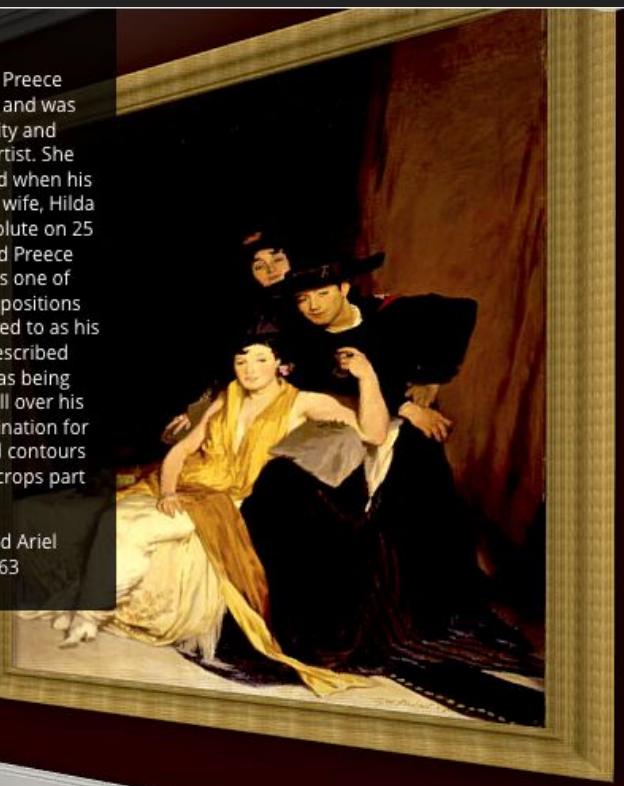
This has been supplemented by AHIF, CHRG and Marlay Group funding enabling a high tech 3D scanner to be bought, photogrammetry licenses to be purchased and over 100 objects modelled.



Oil on canvas

Spencer met Patricia Preece (1894- 1966) in 1929 and was captured by her vitality and commitment as an artist. She became his lover, and when his divorce from his first wife, Hilda Carline, became absolute on 25 May 1937, he married Preece four days later. This is one of two self-portrait compositions which Spencer referred to as his 'double nudes'. He described painting this picture as being like an ant crawling all over his lover's body; his fascination for its crevices, folds and contours is such that he even crops part of Preece's head.

Bequeathed by Wilfrid Ariel Evill, 1963 PD.966-1963



1

2





Animation of a CT scan of the box coffin of Nespawershefyt

from The Egyptian Coffins Project

The MIN box is complete but in the reconstruction from this data set there is some loss on the proper left side due to technical constraints.





Egyptian Museum, Cairo 3D Models

13 models - 6 subscribers

[SUBSCRIBE](#) [EMBED](#) [SHARE](#) [REPORT COLLECTION](#)

Relief Fragment, Cairo museum

Coloured fragment, Cairo Museum

Stele of Akhenaten, Egyptian Museum Cairo

Stele, Egyptian Museum Cairo

Stele, Egyptian Museum Cairo

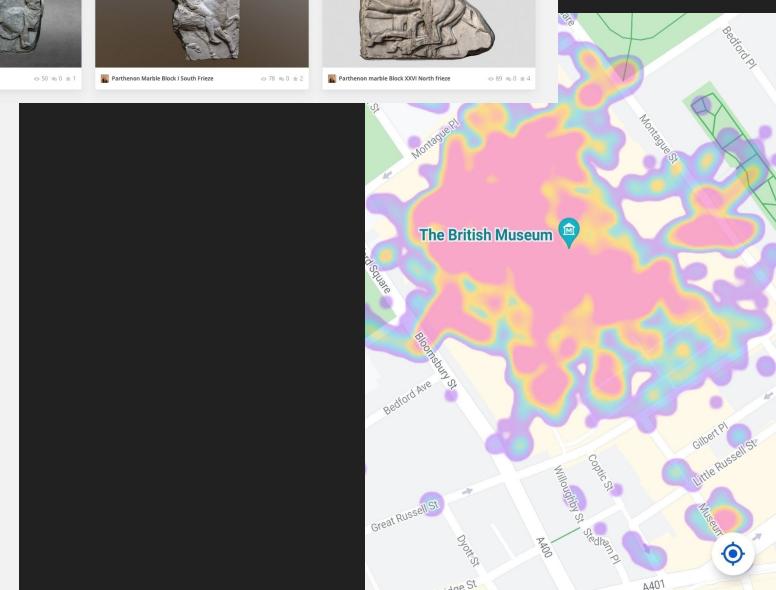
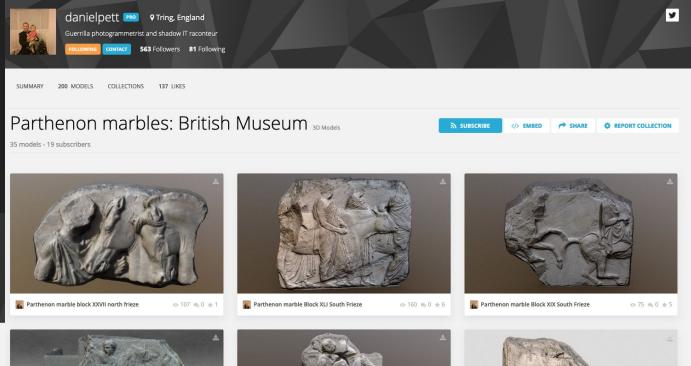
Benben Stone

Panel from wall relief, maybe from Saqqara

Garlanded cartonnage with coffin base

4 Sarcophagus lids, Egyptian Museum Cairo

Guerrilla Photogrammetry



13,267 photos

September 2011 – September 2021

The British
Museum



X-ray CT Imaging in Museum Research

Dan O'Flynn

Department of Scientific Research
The British Museum



@danoflynn

X-ray imaging in the Museum

How was it made?

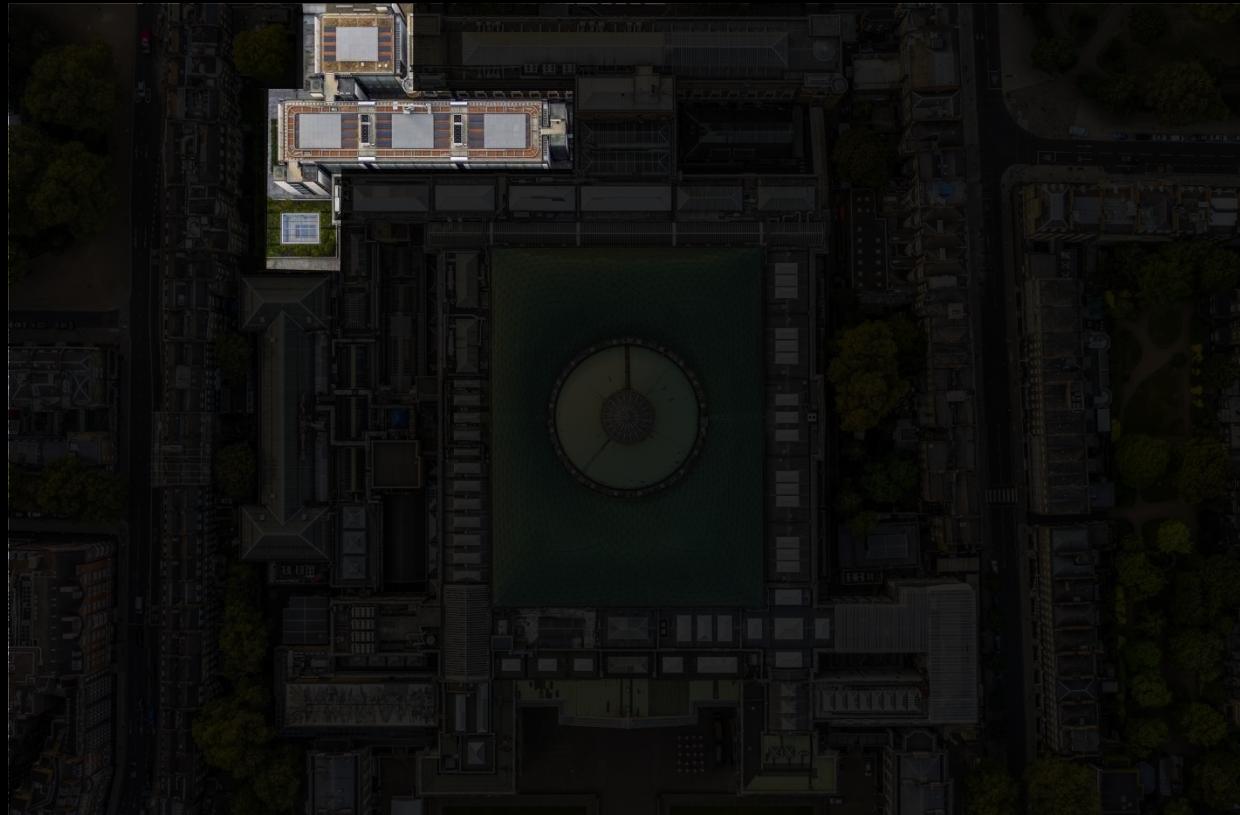
- Materials, techniques

What condition is it in?

- Damage, repairs

Is there anything hidden inside?

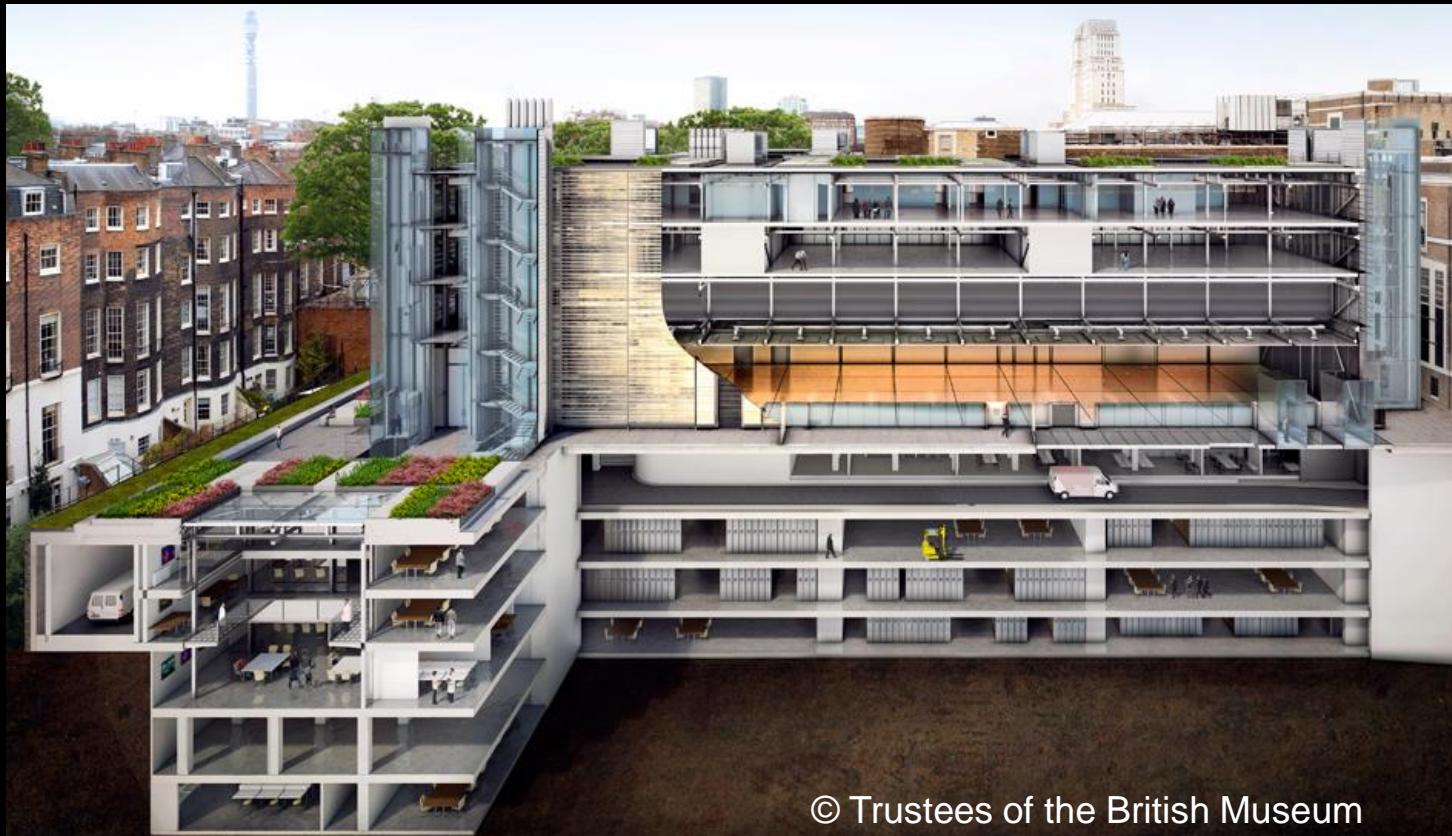
The British Museum



Credit: Jeffrey Milstein/Rex/Shutterstock

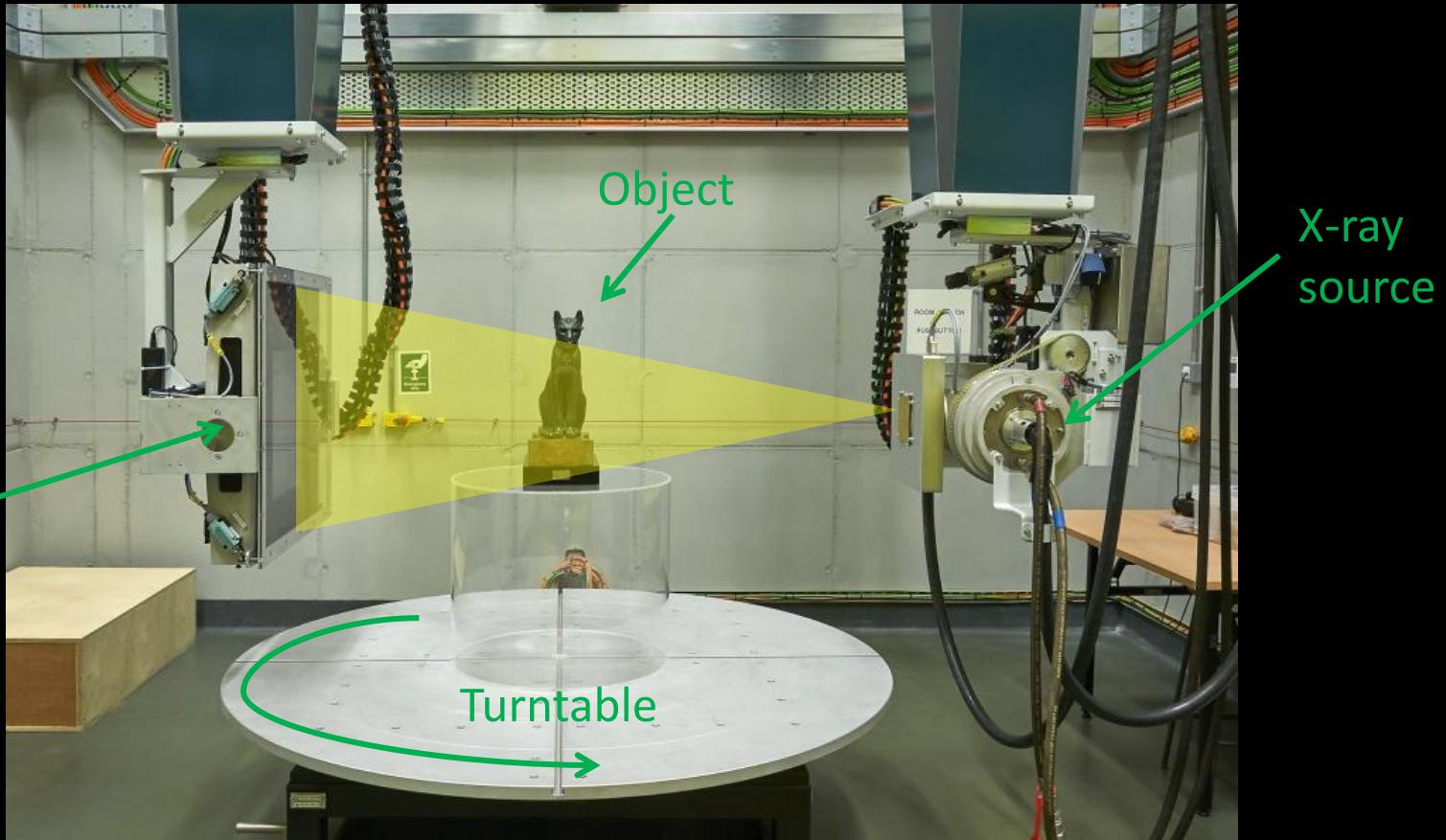
The British
Museum

World Conservation and Exhibitions Centre



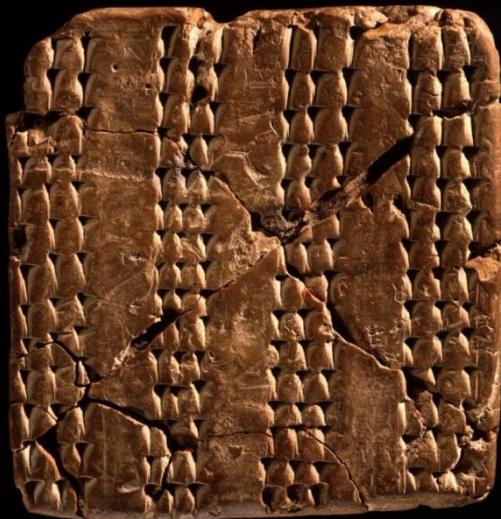
© Trustees of the British Museum

X-ray Imaging Lab



The British
Museum

Cuneiform tablets



UPM CBS 6043
© Penn Museum



Plimpton 322
© Christine Proust and Columbia University

Cuneiform Tablet

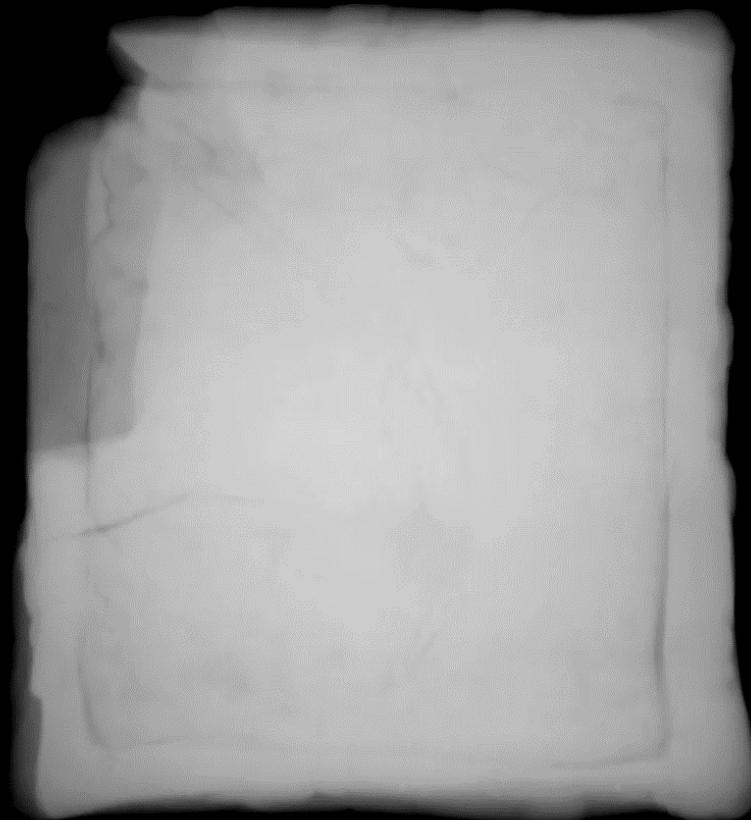
Girsu, present-day Iraq
3rd Millennium BC

1896,0612.112 (ME15892)

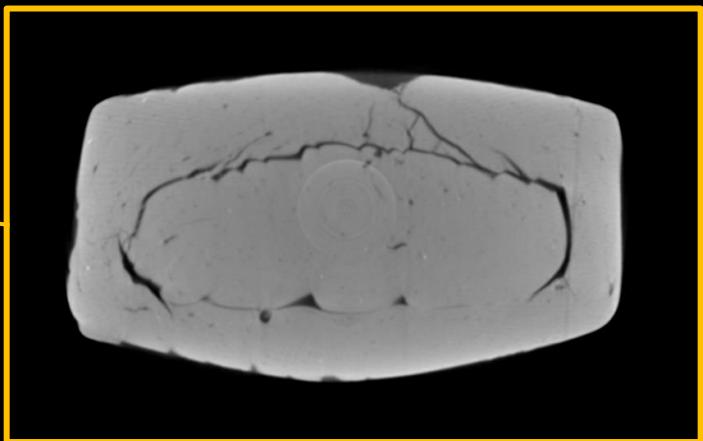
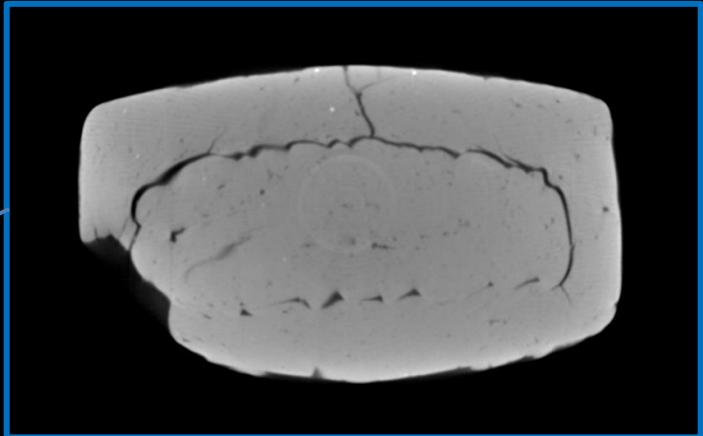


← 4.5 cm →

Radiographs - “Projections”



X-ray CT slices



X-ray CT volume render



The British Museum

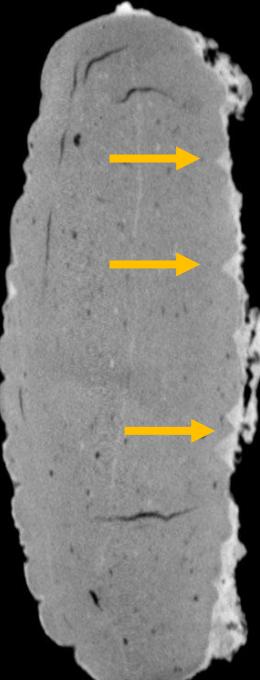
Translated by Jonathan Taylor
(Curator, BM Middle East Department):

*2427kg wool, as rations for the men of
(the village) Gaka, under the
supervision of the chief minister, via
(Mr) Shesh-Utumu, from (Mr) Aradmu,
governor of (the city) Girsu, have been
withdrawn.*

(Sealed with) the seal of (Mr) Babati.

Year Shu-Sin became king





“.....the Cuneiform tablets are heavily encrusted with finely crystallized selenite which covers and completely blocks up the inscriptions.....”
Alexander Scott, October 1919

The British
Museum

Mummy Mask

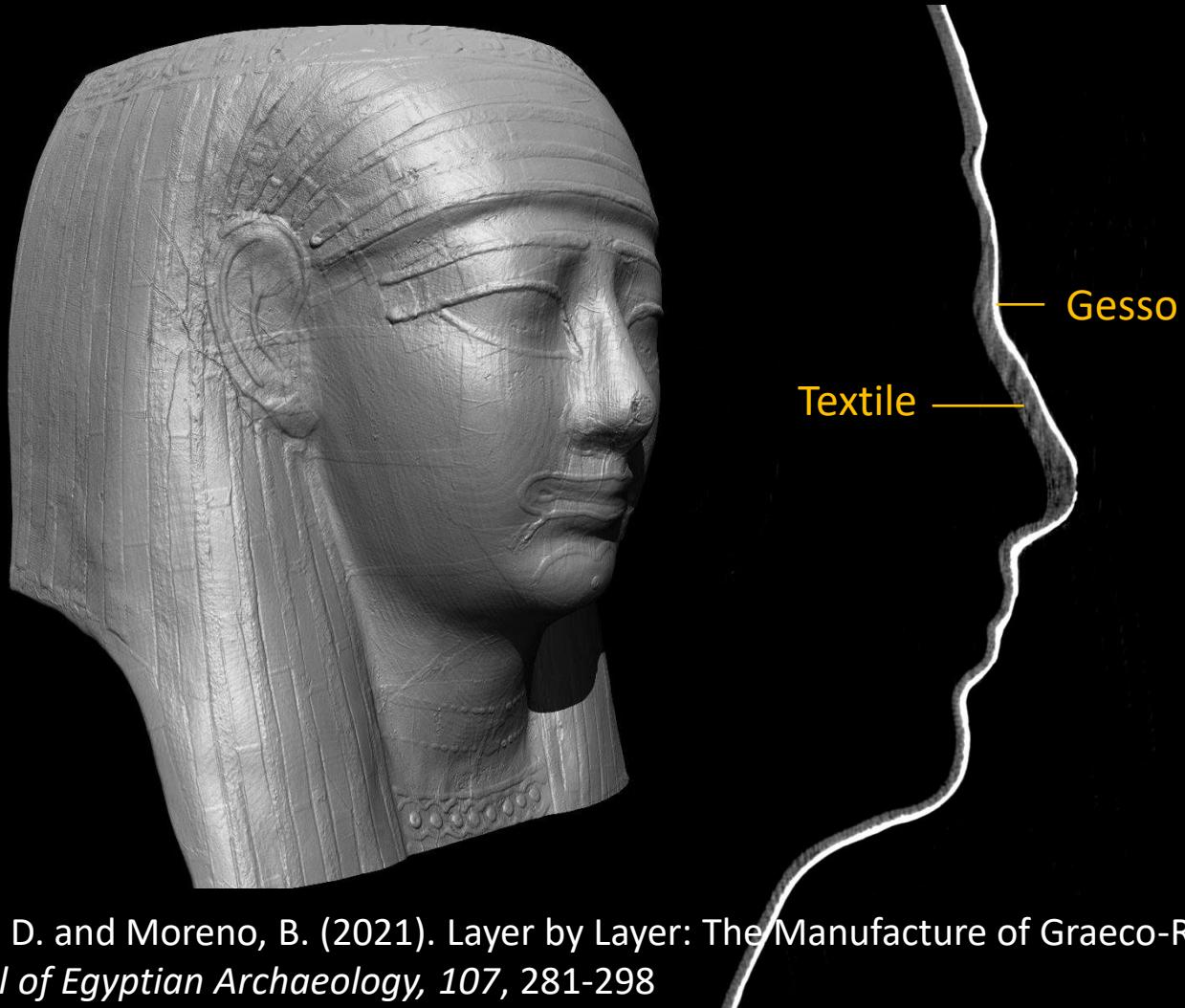
Egypt

Late Period (1st C BC – 1st C)
EA29472



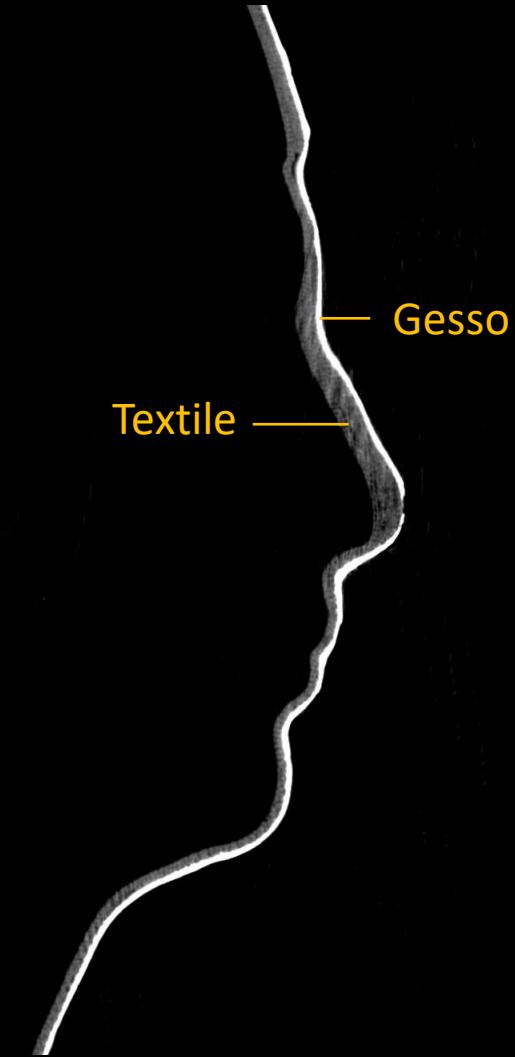
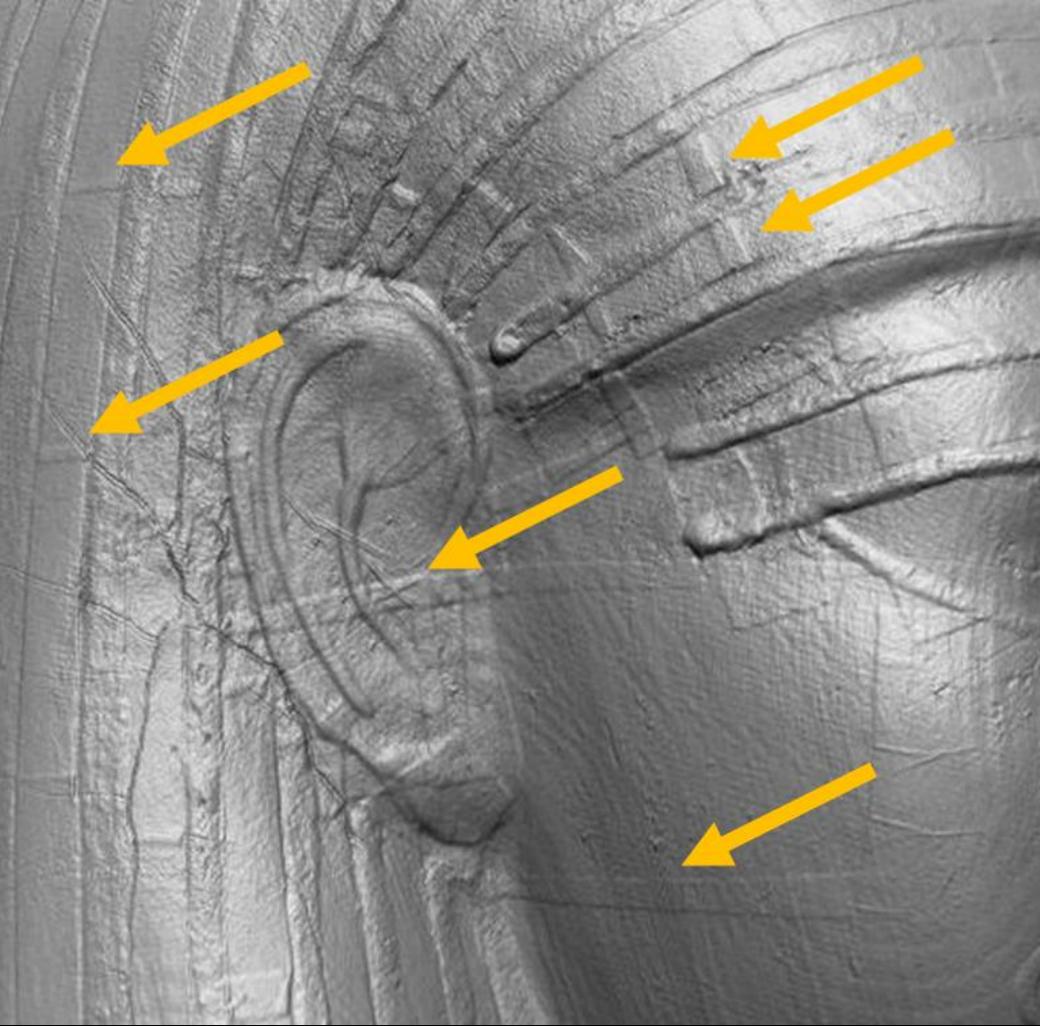
Vandenbeusch, M., O'Flynn, D. and Moreno, B. (2021). Layer by Layer: The Manufacture of Graeco-Roman Funerary Masks. *The Journal of Egyptian Archaeology*, 107, 281-298

The British Museum



Vandenbeusch, M., O'Flynn, D. and Moreno, B. (2021). Layer by Layer: The Manufacture of Graeco-Roman Funerary Masks. *The Journal of Egyptian Archaeology*, 107, 281-298

The





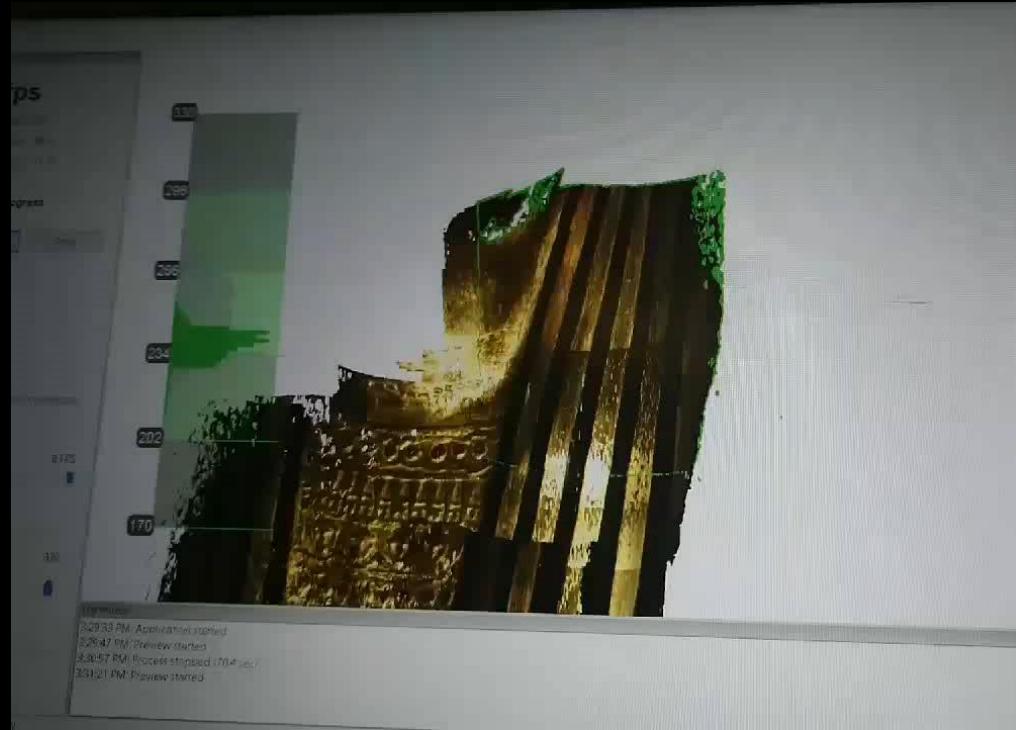
EA 29472
1st C BC – 1st C



EA 69020
c. 50 - 70

Vandenbeusch, M., O'Flynn, D. and Moreno, B. (2021). Layer by Layer: The Manufacture of Graeco-Roman Funerary Masks. *The Journal of Egyptian Archaeology*, 107, 281-298

Structured Light Scanning







ROOM SEARCH
PUSHBUTTON

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- Jonathan Taylor (The British Museum)
- Marie Vandenbeusch (The British Museum)
- Benjamin Moreno (IMA Solutions)
- Daniel Pett (The Fitzwilliam Museum)
- Amelia Knowlson (University of Leeds)

Software used

- VG Studio Max (Volume Graphics)
- ImageJ/Fiji -
<https://imagej.net/software/fiji/>



@danoflynn

Photogrammetry

Metashape walkthrough:
youtu.be/G-il2Neh928
(by Alicia Walsh)