

# Designing Physical Spaces for Digital Objects:

Creating a Display for Augmented Reality, Centered Around the Interpretation of Paleolithic Art



Thomas Kolvenbag  
Digital Media, Drexel University  
06/06/2019

## Initial Goals:

- Interactive & Paleolithic
- Diorama with shifting narrative
- Guiding Analogies
  - Shifting epochs
  - Analogy of the torch
- A space optimized for Augmented Reality and exploration of construction technique



Image courtesy of: nautil.us

Background Research:

## The Diorama Dilemma

- Dioramas seem outdated, partially because of difficulty in their maintenance [17], prevent exhibit rearrangement [12]
- Museums need to stay relevant and appear modern while maintaining These ageing exhibits.



Image courtesy of: [why.org](http://why.org)

## Background Research: AR in Museums

- *Terracotta Warriors of the First Emperor* [10]
  - The Franklin Institute
  - Photogrammetry
- *Skin and Bones* [13]
  - Smithsonian National Museum of Natural History
  - Specific skeletons throughout the hall are augmented, helping guide users through the exhibit.
- Exhibits such as these play to the expectations of contemporary visitors [10]

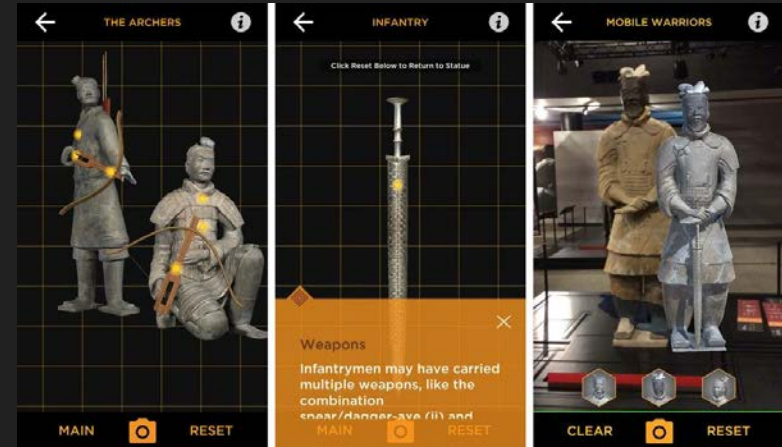


Image courtesy of: nytimes.com

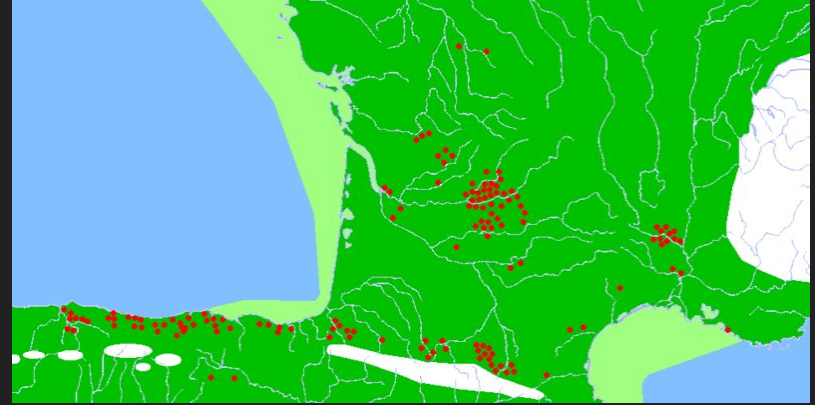
Background Research:

# Prehistoric Artwork

Background Research:

## Prehistoric Artwork

- 3 Sites influenced the project
- Franco-Cantabrian Region



## Background Research:

# Chauvet

- Discovered 1994, Southern France
- Artwork dates between 37,500-27,000 years old [7]
- *Aurignacian Culture*
- *Pont d'Arc*
- *Skull Chamber*
  - Over 190 Bear Skulls in the cave[23]
  - The Altar



Image courtesy of: ancient.eu



Image courtesy of: bradshawfoundation.com



Image courtesy of: Pizzatravel.Com.Ua

Background Research:  
**Altamira [1]**

- Discovered 1868, Northern Spain
- Between 35,000-15,000 years old
- *Magdalenian/Multicultural Collaboration*
- *Continuously Inhabited*
- *Polychrome Bison*



Image courtesy of Dario Lorenzetti



Image courtesy of Wikimedia Common



Background Research:

## Lascaux [14]

- Southern France, Discovered 1940
- Artwork dates between 17,000-15,000 years old
- *Magdalenian Culture*
- *Sistine Chapel of Prehistory [25]*
- *Closed to public in 1963*



Image courtesy of: [bradshawfoundation.com](http://bradshawfoundation.com)



Image courtesy of: [archeologie.culture.fr](http://archeologie.culture.fr)

Background Research:

## Lascaux

### The Shaft Scene [25]:

- *Interaction between bird headed figure & bison*
- *Ambiguous Narrative [14]*
  - *Hunting Accident*
  - *Shamanistic Ritual*
  - *The Flight*



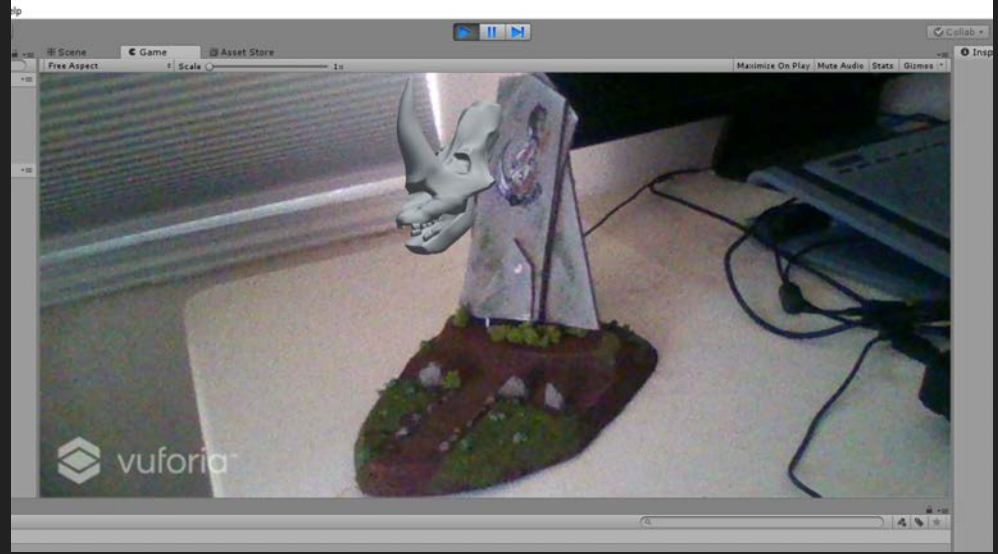
Image courtesy of: [archeologie.culture.fr](http://archeologie.culture.fr)

# Production

- Prototypes
- Final Build design
- Construction of Final Build
  - Physical Elements
  - Target Images
  - Digital Assets
  - Building the App
- Feedback
- Future Work

## Prototypes/Proof of Concept: The Rhino Build

- Familiarization with Vuforia and Unity
- Using handmade objects as image target
- Foam core board & Acrylic paint
  - Partially reflective
  - Volume of paint
- Unsuitable Scale/Dimensions



Prototypes/Proof of Concept:

## The Pink Build

- Paper proved to be reliable.
- Manipulating objects to dictate projection placement
- expanded polystyrene
- Size of target image



Final Production:

## Overall Design:

- Visually reference megalithic structures
- Create an intimate space to house The digital figures
- Force viewer to align themselves along certain avenues in order to engage with the build



Image courtesy of Wikimedia Common



Image courtesy of: english-heritage.org.uk



Final Production:  
The Pillar & Stage

**The Pillar:**

- $\frac{3}{4}$ " AC Plywood cut to 4'x6" boards
- Glued together and bound.
- Capped with 16" octagonal cuts.



Final Production:

## The Pillar & Stage

### The Stage:

- Extruded Polystyrene
- Cut to shape, glued in place
- Backed by high density fiberboard.





Final Production:

## The Pillar & Stage

### Painting:

- Primed White
- Prussian Blue & Burnt Umber
- Roller & consecutive layers of different ratios
  - Stone-like texture
- Goldenrod yellow added to interior
- 
- Shaft Scene Reproduction



Final Production:

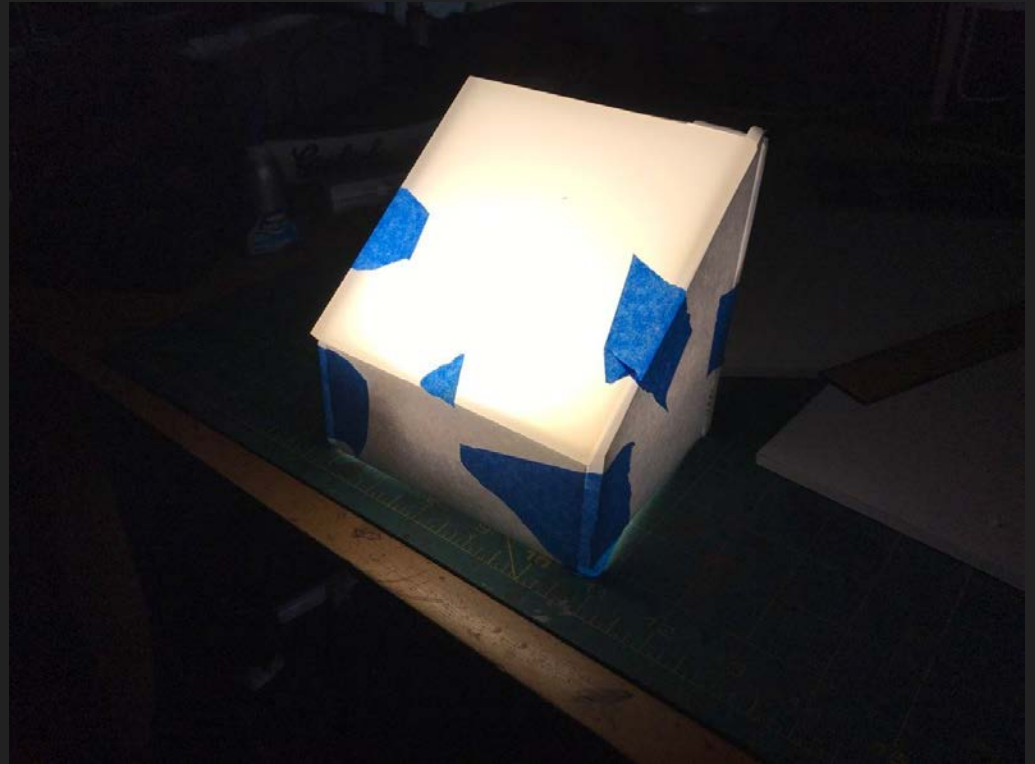
## Image Targets

### The Lightbox:

- Roughly 35 degree angle
- White interior to reflect light

### The Panels:

- $\frac{1}{4}$ " Acrylic sheets, 55% Opacity
- 5" Squares.



Final Production:

## Image Targets

### The Illustration:

- Marker
- Photoshop
- Printed onto sticker paper & placed onto the acrylic tiles
- Uploaded to Vuforia Developer Portal



Final Production:

## Image Targets

### The Illustration:

- Marker
- Photoshop
- Printed onto sticker paper & placed onto the acrylic tiles
- Uploaded to Vuforia Developer Portal



Final Production:

## Narrative Digital Objects

### The Ritual Narrative:

- Goal: Depict the bird headed figure as a Shaman, performing a ritual.
- To be shown as a hand-carved object



Final Production:  
Narrative Digital Objects

**The Ritual Narrative:**

Workflow:

- Photoshop > Houdini



Image courtesy of Wikimedia Common

Image courtesy of Bradshaw Foundation



Final Production:

## Narrative Digital Objects

### The Hunt Narrative:

- Goal: Depict the bison in an Advantageous or victorious position over the bird headed figure.
- A representational depiction



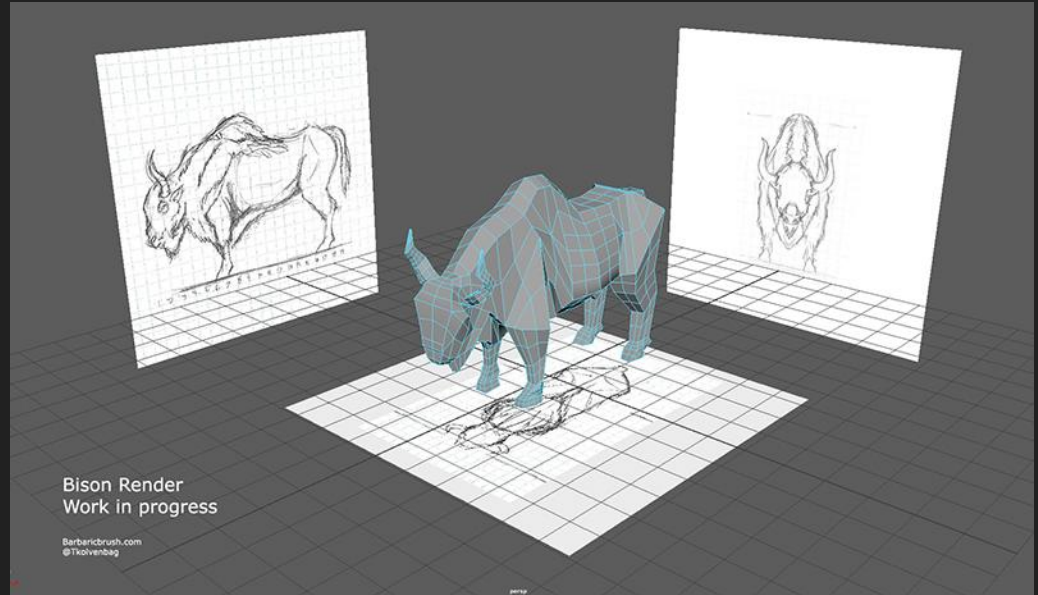
Final Production:

## Narrative Digital Objects

### The Hunt Narrative:

Workflow:

- **Maya** > Zbrush > Houdini
- Plotting basic geometry





Final Production:

## Narrative Digital Objects

### The Hunt Narrative:

Workflow:

- Maya > **Zbrush** > Houdini
- Fine detail sculpting
- Polyweight painting



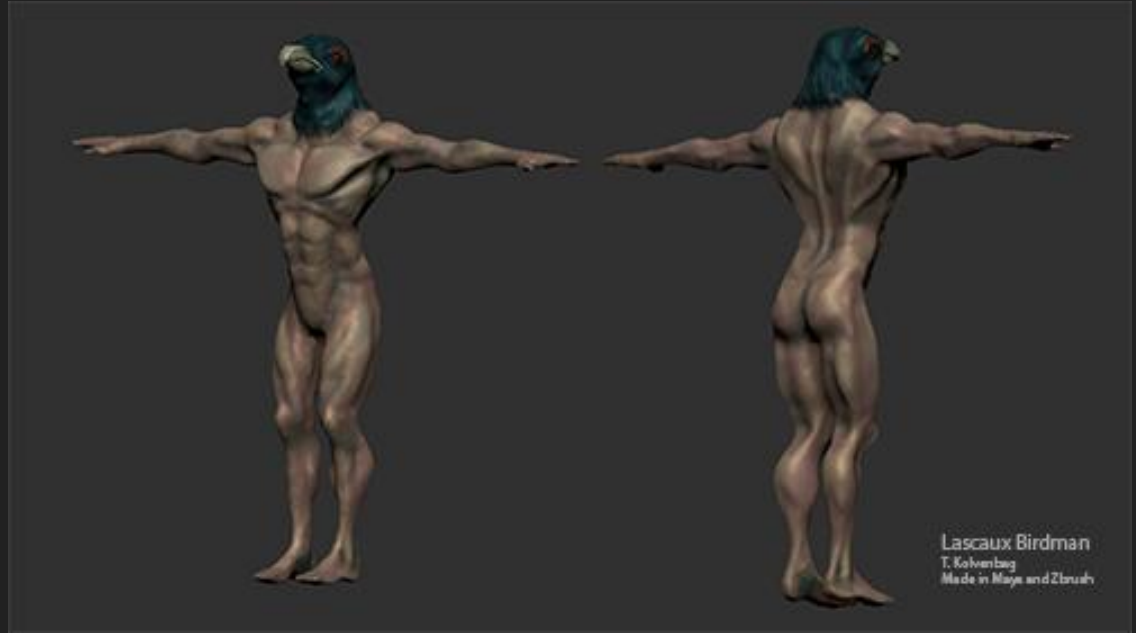
Final Production:

## Narrative Digital Objects

### The Hunt Narrative:

#### Workflow:

- Maya > **Zbrush** > Houdini
- Fine detail sculpting
- Polyweight painting



Final Production:

## Narrative Digital Objects

### The Hunt Narrative:

Workflow:

- Maya > Zbrush > **Houdini**
- Posing and exportation



Final Production:

## Narrative Digital Objects

### The Escape Narrative:

- Goal: Depict a bird in flight, representing quick, unrestrained Movement. Escape.
- Depicted as a cave painting



Final Production:

## Narrative Digital Objects



## The Escape:

- Stone Canvas modeled & UV mapped in Houdini
- UV map grid taken to photoshop,
- 6 Frames drawn
- Unity cycles through these frames via script
  - Invokerepeating

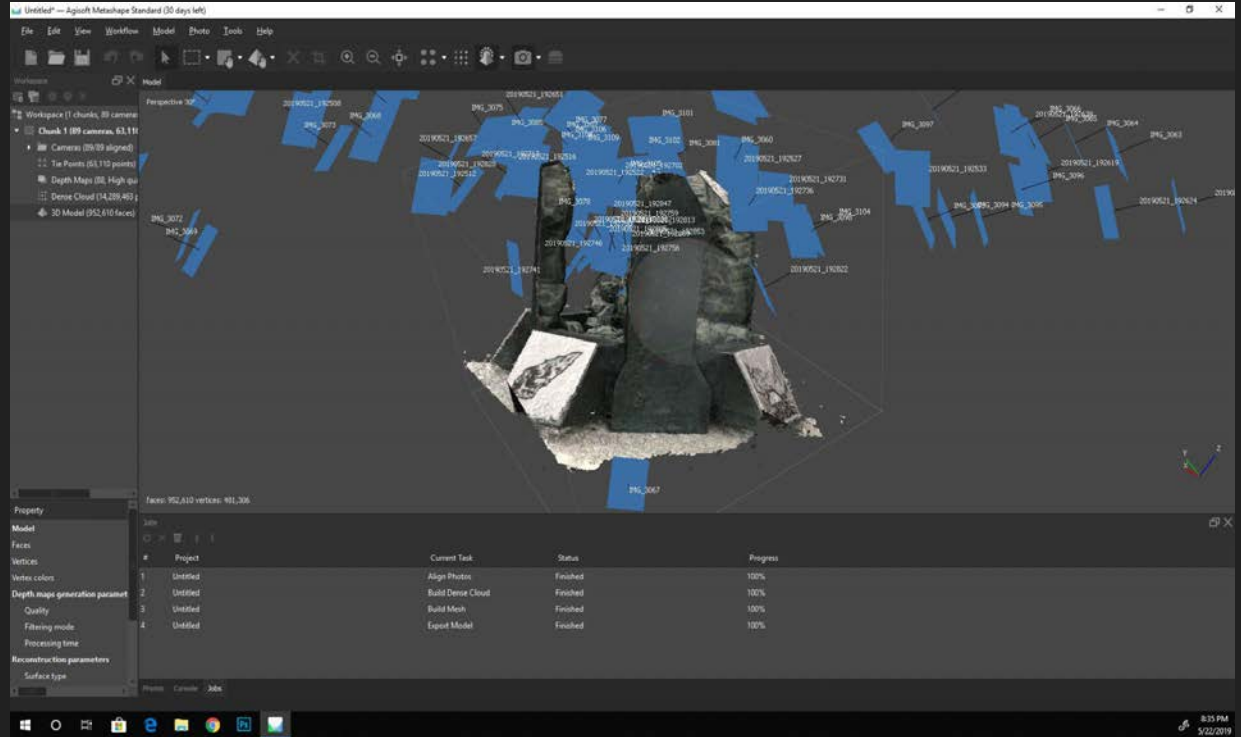


Final Production:

# Unity

## Photogrammetry

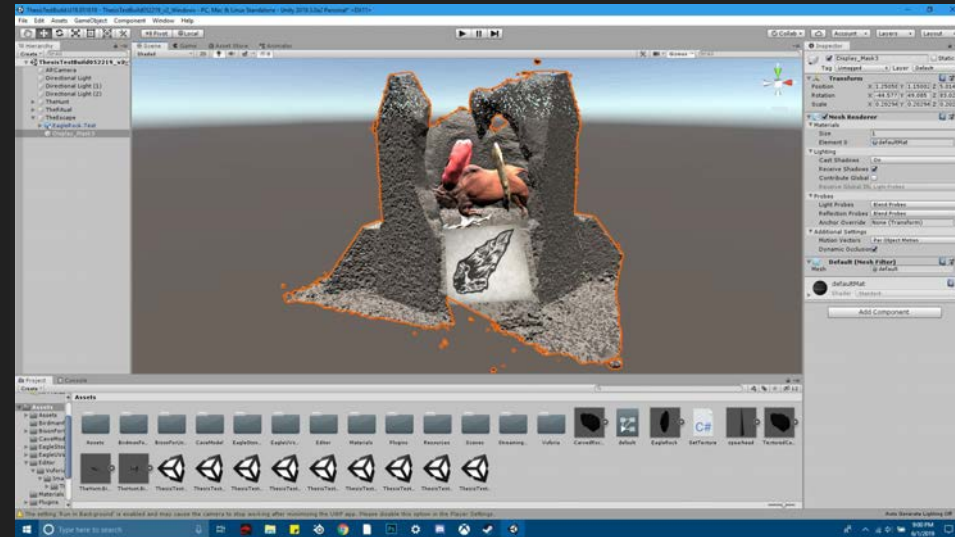
- 89 photographs used to Generate 3D object of the Stage
- Aided by painted texture Imported into Unity



Final Production:

# Unity:

1. Import the Unity package from Vuforia's website
2. Import the narrative assets
3. Pair the appropriate Image targets and objects
4. Apply the Stage scan to each narrative as a depth mask
5. Publish the scene as an APK file for use with Android phones.



Showcase:

## Reactions:

- The Escape animation elicited biggest reaction
- Image Targets were not entirely self evident
- Further Optimization required for The Hunt vignette
- People aligned themselves as designed.





## Future Work:

- Modeling the Stage & Pillar Digitally
  - 3D printing
  - Precision depth masks
  - Target image placement within stage
- Image Target Placement
  - Crowd control
  - Narrative tool
- Software
  - Unity Progressive Lightmapper & Shadergraph.
  - Stabilization of projections & polycount optimization

# Bibliography:

- [12] Kutner, Max. Museum Dioramas Are as Endangered as the Animals They Contain. Newsweek 2015.  
URL <https://www.newsweek.com/2015/08/14/museum-dioramas-endangered-american-museums-358943.htm>
- [17] Pflieger, Paige. Diorama Dilemma: The Art and Science of Museum Displays 2016.  
URL <https://whyy.org/segments/diorama-dilemma-the-art-and-science-of-museum-displays/>
- [7] Groeneveld, Emma. Chauvet Cave. Ancient History Encyclopedia. 2017. URL [https://www.ancient.eu/Chauvet\\_Cave/](https://www.ancient.eu/Chauvet_Cave/)
- [25] Groeneveld, Emma. Lascaux Cave. Ancient History Encyclopedia. 2017. URL [https://www.ancient.eu/Lascaux\\_Cave/](https://www.ancient.eu/Lascaux_Cave/)
- [1] Collins, Neil. Altamira Cave Paintings (c.34,000 - 15,000 BCE). Encyclopedia of Art Education. Visual-arts-cork.com. URL <http://www.visual-arts-cork.com/prehistoric/altamira-cave-paintings.htm>
- [23] Zorich, Zach. A Chauvet Primer. Archaeology Archive. 2011:64:2 URL [https://archive.archaeology.org/1103/features/werner\\_herzog\\_chauvet\\_cave\\_primer.html](https://archive.archaeology.org/1103/features/werner_herzog_chauvet_cave_primer.html)
- [14] Looney, Mary Beth, PhD. Lascaux. Khan Academy. URL <https://www.khanacademy.org/humanities/ap-art-history/global-prehistory-ap/paleolithic-mesolithic-neolithic/a/lascaux>
- [10] Hurdle, Jon. Arming China's Terracotta Warriors - With Your Phone. The New York Times. 2017 URL <https://www.nytimes.com/2017/09/29/science/china-terracotta-warriors-augmented-reality.html>
- [13] Lavery, Ryan. Smithsonian Brings Historic Specimens to Life in Free "Skin and Bones" Mobile App. Smithsonian 2015. URL <https://www.si.edu/newsdesk/releases/smithsonian-brings-historic-specimens-life-free-skin-and-bones-mobile-app>
- [21] Vuforia. Image Target Guide. PTC Inc. 2018. URL <https://library.vuforia.com/articles/Training/Image-Target-Guide>

# Thank You!

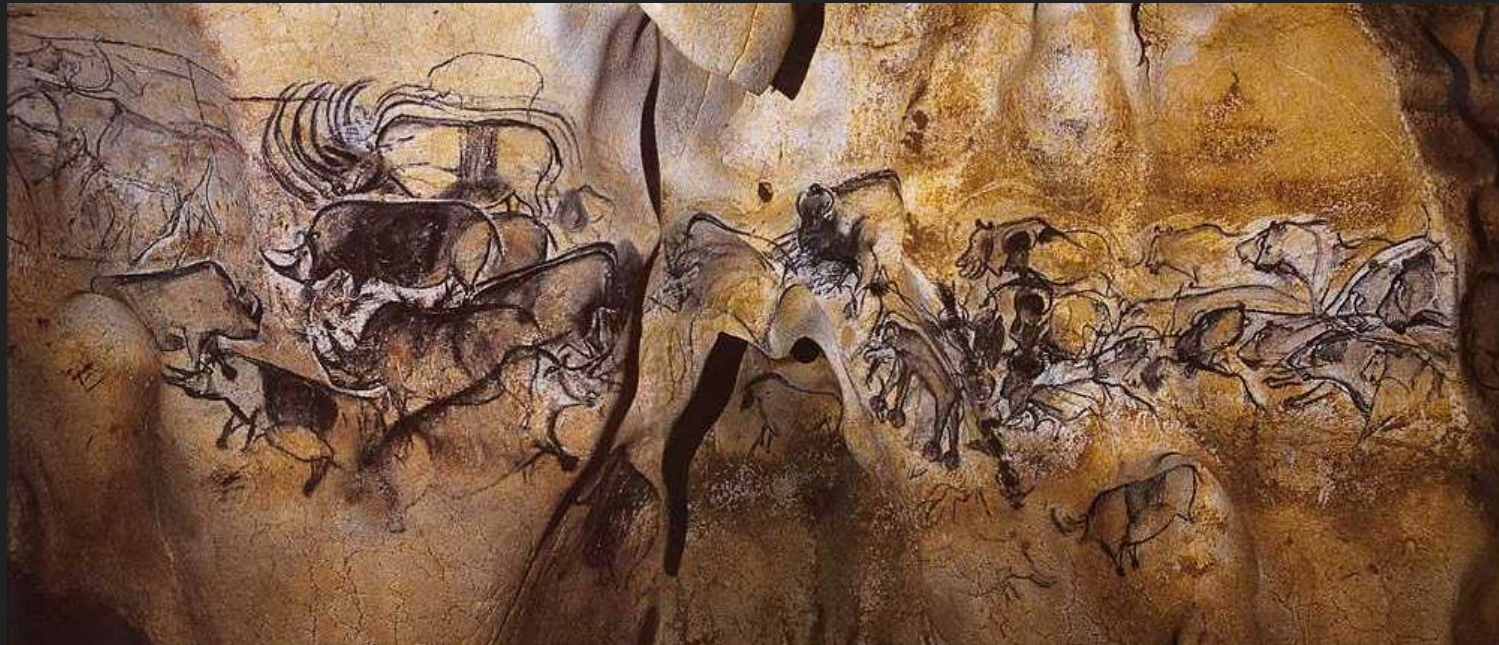


Image courtesy of: [theologicalanthropology.com](http://theologicalanthropology.com)