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ANTH 258/CIS 106

Visualizing the Past/Peopling the Past

Final Project: Text

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**Roots of Knowledge:**

**Modeling Manioc in the Bolivian Amazon**

*Setting the Scene*

Media Theorist Marshall Mcluhan famously said, “The medium is the message” (1967). Content is often inseparable from the very forms that carry its meaning. This idea has many far-reaching implications, especially in the context of education. Disciplines must constantly examine the tropes and familiar representations used *within* the subject, as well as *of* the subject, but beyond this, they must examine *how* those tropes are communicated (Russell 2002:53). Within the specific fields of archeology and anthropology, digital resources present a tremendous new frontier. New methods of communicating, representing, and interacting with educational content can provide rich experiences, bringing subjects to life in entirely novel ways.

With this in mind, University of Pennsylvania’s Fall 2016 schedule included a class titled, “Visualizing the Past/Peopling the Past” (ANTH 258/CIS 106). Co-taught by Professor Norm Badler and Professor Clark Erickson, ANTH 258/CIS 106 addressed topics of historical representation and synthesized lessons in archeology and computer graphics. For the final project, teams and individuals worked to generate assets for a three-dimensional model of daily life in the Bolivian Amazon. My specific project centered on the agricultural production of manioc as one important aspect of life in Pre-Columbian South America. This report presents my work and summarizes my process. As an outline, I initially address context and background to frame my research and decisions. Next I offer an overview of my processes and progress, including an analysis of the methods and tools I used for the project. Finally I address the future direction and broader implications of my project, which highlight my personal interests and ambitions, as well as more general context.

*Background*

Initial research and meetings with Professor Clark Erickson helped me narrow the focus of my project to agricultural methods in Pre-Columbian South America. Agriculture has been a central part of life in the Bolivian Amazon for many centuries, as the climate is prone to cycles of flooding and rain that dominate the region. In response to the seasonal wetlands, Bolivian farmers developed a form of landscape engineering that involved raising fields for crop production (Figure 1). The raised field method was effective in Pre-Columbian years, as well as contemporary times (Erickson 2006:251). Systems of causeways and canals surrounding raised fields directly affect other aspects of Bolivian life as well. For example, transportation and communication become subject to the constructed routes in the domesticated landscapes (ibid.). That agricultural solutions often have impacts that spill into other areas of life is an important lesson that emerges from the raised field strategy.

In addition to raised fields for the flooding seasons, other forms of farming play a central role in Bolivian life. As one example, slash and burn farming describes a process by which sections of wooded areas are cleared and burned for farming (Figures 2-3). Though the method enriches the soil with many beneficial nutrients, the high cost and labor-intensive demands of slash and burn farming disqualify it as an efficient means to cultivate produce (Erickson, personal communication 2016). Another important source of source of food production for people living in South America are house gardens (Doolittle 2004:391). With vegetation situated close to the houses, food becomes more easily accessible for the people leaving there (Figures 4-5). In addition, house gardens can become grounds for hunting any game or wildlife that are attracted to the crops (Erickson, personal communication 2016). Even in contemporary times, gardens remain an important part of landscape engineering:

 …early people were gatherers who harvested the bounty of the land and over time became so familiar with certain plants that they domesticated them, most probably in protected areas near their homes—in protogardens…Gardens remain of fundamental importance to people in the twenty-first century” (Doolittle 2004: 391).

Within an even broader agricultural context, relationships between humans and plant-life are deeply rooted (Hastorf 1997:773).

My initial investigations led to an interest in modeling agriculture and produce from Pre-Columbian South America. Popular crops of the Bolivian region include vegetation like maize, beans, squash, manioc, sweet potatoes, and tree cotton, among other plants (Erickson, personal communication 2016). I had originally intended to focus the bulk of my modeling on maize, or corn products, a significant crop of the region. After researching the available resources of modeling libraries however, I decided that modeling manioc would instead provide an opportunity to work on a novel model and contribute something unique to the final simulation (Figures 6-7). At the same time, this strategy would leave room for me to import and integrate pre-made models of maize for a final garden. Thus I focused my research on manioc.

Manioc (cassava or yuca), is planted from stem cuttings. Without the threat of frost, manioc can be planted in nearly every season (O’Hair 1995). Manioc must develop for roughly eight months of before it is ready for harvest. Manioc harvest is usually performed by hand, at which point both the stems and the roots are prepared for future use. Stems are readied for cutting and planting, while roots are collected for processing--depending on the manioc variant (O’Hair 1995). Sweet manioc requires little processing before consumption, while bitter manioc contains hydro cyanide and must be processed before used. Although bitter manioc requires more labor and processing before consumption, the bitter variant is more impervious to pest, embodying both pros and cons (Erickson, personal communication 2016). Many byproducts can be made from the various techniques that process manioc (both bitter and sweet), including *chicha*, *almidon* flour, and *chive* (Denevan 1966:99-100). Despite being relatively low in nutrients, manioc is valued for its versatility. Of all cultivated crops in the Bolivian Amazon, sweet manioc was likely the staple for many regions (Métraux 1948:384).

*Project Process and Progress*

In this section, I examine the tools and methods used in my project, as well as my current progress to date.

As preliminary research, I turned to sources from articles that explore the cultural significance of gardens and domestic plants. Multiple meetings with Professor Clark Erickson were formative in helping me develop an understanding of manioc-related processes, and I had the opportunity to explore a vast library of images from Professor Clark Erickson and his colleagues. In addition to these resources, I found material online, from Google images searches and YouTube videos, as well as a useful website detailing many aspects of the manioc cultivation process (O’Hair 1995).

With an understanding of manioc crops newly acquired, I turned to the modeling process with guidance from Professor Norm Badler and help from teaching assistants Sally Kong, Chloe Snyder, and Robert Zhou. My general strategy has been to begin with generic objects and individual models of crops. My next goal has been to cover larger areas within the unity game engine to simulate realistic fields and populations of crops. Finally, by reassigning components of crop models to a variety of tasks, I could model many aspects of the crop lifecycle and process. With the MAYA 2016 software, I started by modeling roots, leaves, and then finally the full plant (Figures 8-11). In addition, with the Motion Capture technology in the Sig Lab, I pantomimed several actions involved in the planting and harvesting process related to manioc (Figures 12-18). What follows is an in depth summary of those two processes.

My introduction to Maya software began in the CIS lab component of ANTH 258/CIS 106. TAs led the class through modeling basic shapes and objects like cubes and canoes. With these experiences forming the foundations of my modeling skills, I turned to the specific subject of my project. TA Sally Kong guided me through the construction of roots and a stem for manioc plants (Figures 8-9). Next, I turned to the leaves, using Google images of manioc as references (Figure 10). Finally I stitched together the root and leaf components of my model, representing a full manioc plant (Figure 11).

The next step in my final project was to record motion capture sequences to use with my model (Figure 12). I studied several videos on YouTube that detailed various parts of the manioc harvest process (lifeinthailand 2013; Agribusiness How It Works 2013; tar 160 2009), and from these clips I composed a list of activities:

* Chopping the manioc stalk
* Removing the leafy top
* Chopping roots on branch
* Dropping handful of roots for planting (Figures 14-15)
* Pulling roots with hands for smaller plants
* Breaking off roots and throwing them into baskets
* Picking up basket
* Using pitchfork to unearth roots (Figures 16-17)
* Pulling out heavy roots

As props, I used a broom, dustbin, and armchair component to stand in for various objects throughout the session (Figure 13). My actions with these objects were recorded and sent for rigging in MotionBuilder (Figure 18).

Due to a number of technical limitations, this final step of integrating my motion capture and models into a scene has not yet been completed. In addition, I have attempted to texture my models, but have recently met little success working independently. In the meantime, constituent elements of the scene are aggregated in my Dropbox folder as a fruitful direction for future modeling progress.

TAs Chloe Snyder and Sacha Best constructed a digital simulation of the Bolivian Amazon for the final projects (Best and Students of ANTH 258/CIS 106, 2016). The three-dimensional environment was set up to host the assets of ANTH 258/CIS 106 students, integrated into final a scene on the Unreal engine. With this aspirational resource as context, I would hope to develop models of three farming methods I discussed earlier. The slash and burn method of farming would require a charred and cleared landscape for the crops I’ve prepared. Raised fields for the wetlands would be another rewarding location to set up a manioc scene given the abundant water resources in the rendered scene (Figure 19). Finally, I would be most excited to curate a house garden on the prepared Unreal landscape. To successfully model a house garden, I would coordinate with fellow ANTH 258/CIS 106 students modeling Amazonian houses. I would place my manioc crop models alongside other prefabricated crops, like maize and tree cotton. Whole plants would be placed partially submerged in the earth, and individual roots could be gathered in piles or baskets. The harvest-related activities I prepared through motion capture are well suited for land gardens, and I would present various stages of the harvest process as well. Through incorporating the Maya and MotionBuilder models into a single scene, I could represent a comprehensive simulation of agricultural processes as an important aspect of Pre-Columbian life. Situated alongside the collective work of my peers and advisors, my “Roots of Knowledge” project would be part of a multi-faceted educational model of life in the Bolivian Amazon.

*Future Direction and Conclusion*

Beyond my immediate desires to add texture, construct fields, and rig characters with motion, I hope to see my work in a larger educational context. As archeology embraces new mediums of representation, three-dimensional models grow increasingly relevant. The benefits of turning toward computer modeling for simulations of structures and space have proven to be just the beginning; simulations with human actions and projected models are becoming more familiar and more powerful learning tools. Digital representation is an important step for archeology, as well as the broader realm of humanities and education. Advances in representations and interactions with those representations are opening the doors for new learning experiences. Learning is no longer simply defined by listening to lectures passively—the definition has been broadened to include engaging with a history that unfolds before our very eyes. As we continue to emphasize interactivity and agency in learning contexts, we create more opportunities to truly enliven the educational experience.

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