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CENTER FOR ANCIENT MIDDLE EASTERN LANDSCAPES (CAMEL)

Emily Hammer

This was a year of change and growth for the Center for Ancient Middle Eastern Landscapes (CAMEL). In August 2014, Emily Hammer joined the Oriental Institute as CAMEL's new director, and the student staff saw a complete turnover except for graduate student Associate Director Elise MacArthur. CAMEL seized this opportunity to dedicate its efforts in new directions that emphasize regional and local landscape scale research, similar to the original vision of CAMEL's founder, the late Professor Tony Wilkinson. The goal of these new research directions is to re-establish the lab as one of the pre-eminent groups conducting landscape archaeology in the Near East and as a source of innovative methods and approaches within this field. Concrete steps taken toward this goal in 2014–2015 included 1) research projects with concrete archaeological questions resulting in publications and presentations, 2) collaboration with programs at other universities that have technical expertise that CAMEL would like to build, 3) engagement with historians and philologists, and 4) expansion of involvement in cultural heritage projects.

We began the year with an open house event in November, which was an opportunity for CAMEL to connect with the Oriental Institute and University of Chicago communities about possibilities for collaborative geospatial work. Several new CAMEL projects resulted from conversations with faculty during the open house, including a study of the landscapes around Persepolis using historical aerial photos, and an atlas of Bronze and Iron Age Anatolia. Thanks to Matthew Stolper and the Persepolis Gift Fund, we were able to hire a graduate student, Jennifer Altman-Lupu, to georeference aerial photographs of Persepolis captured by Erich F. Schmidt in the mid-1930s. A set of photographs taken in 1936 was selected and used to create a historical 3D model of the site, before modern development obscured many traces of historical and ancient features in the landscape (fig. 1). A video of this 3D model will be on display in the upcoming exhibit Persepolis: Images of an Empire, in the Oriental Institute Museum, and CAMEL is in the process of making the spatial data generated from this project accessible to the public through a website, "Persepolis from the Air" (http://worldmap.harvard.edu/maps/6719/). Conversations with Petra Goedegebuure about recent archaeological and text-based research concerning the historical geography of Bronze and Iron Age Anatolia resulted in preliminary efforts by undergraduate student Rolland Long and graduate student Joshua Cannon to create an online atlas that will spatially explore political and material landscapes of Bronze and Iron Age central and southeastern Anatolia, focusing on the Old Assyrian trading network, the Hittite empire, the Neo-Hittite states, and Urartu.

In the winter and spring quarters, CAMEL kicked off two methodology projects using historical satellite imagery. In March, Emily Hammer traveled to the University of Arkansas' Center for Advanced Spatial Technologies (CAST) to work with Jesse Casana and others on developing a methodology for building historical digital elevation models using CORONA "spy satellite" images from the 1960s and 1970s. Topography is important for the detection of mounded sites in the Middle East, as well as for the study of ancient landscape features

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Figure 1. (top) Historical 3D model of Persepolis, Iran. Generated by Jennifer Altman-Lupu using aerial photographs taken by Erich F. Schmidt in 1936. (bottom) One of Schmidt's 1936 photographs from a vertical perspective

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such as irrigation canals. Historical topographic models are essential for areas where mounds and other archaeological features have been destroyed by development, agriculture, flooding, or other processes. The methodology developed during the course of ongoing collaboration with CAST will soon result in academic publications and inspire new projects. The Oriental Institute holds digital copies of aerial photographs taken in 1961 of the area along the Euphrates River in Syria that has since been flooded by the Tabqa Dam and Lake Assad; in the future CAMEL plans to put our historical topography methodology to use through a remote-sensing based re-study of this area, which was partly published by Tony Wilkinson in 2004.

The declassification of CORONA imagery (images 1960–1972, declassified in 1996) transformed the field of Middle Eastern archaeology by providing a high-resolution window into the past, before the destructive effects of development and intensive agriculture took hold in many rural areas (fig. 2). Bronze Age tracks, Iron Age canals, and medieval city walls that have since disappeared from modern view appear clearly in the highest-resolution CORONA images. These discoveries via satellite imagery have greatly enhanced archaeologists' ability to analyze settlement patterns, map ancient peoples' patterns of movement, and clarify the magnitude of ancient communities' effect on the environment. In 2011, imagery from the spy satellite program that succeeded CORONA (named Keyhole-9 HEXAGON, images 1971–1984) was declassified. HEXAGON imagery is much higher-resolution than CORONA and thus provides an even more detailed window into the past (fig. 3). However, archaeologists have not yet used HEXAGON imagery because it has not been scanned and is not available for purchase or download, unlike CORONA imagery. In May, Emily traveled to Greenbelt, Mary-

Figure 2. (left) CORONA "spy satellite" picture of Ebla, Syria, in November 1968. (right) Historical topographical model of the site derived from several 1968 images taken around the same time

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Figure 3. Comparison of the resolution of CORONA imagery (December 1967, left) and newly declassified HEXAGON imagery (December 1975, right) for the multi-period site of Nerwan Höyük in the Silopi Plain of southeastern Turkey

Figure 4. Newly declassified "spy satellite" imagery (HEXAGON) of a possible canal bringing water toward the Iron Age fortress of Sədərəkqala in Naxçıvan, Azerbaijan. Emily Hammer's survey team surveyed this fortress in June 2015

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land, to re-photograph original HEXAGON negatives at the National Archives' Aerial Film Section. Student workers then used these photographs to georeference and reconstruct the filmstrips using Geographical Information Systems (GIS) software. HEXAGON imagery has already proved extremely useful over the last month in guiding Emily's landscape archaeology fieldwork in Naxçıvan, Azerbaijan, helping her survey team to locate previously unknown ancient walls and canals (fig. 4). In the future, CAMEL hopes to assist various Oriental Institute projects in obtaining HEXAGON imagery that may further their research programs.

Afghanistan formed the focus of several of our other research and methodological projects. In addition to the country's huge potential for remote sensing-based landscape archaeology research, these projects were initiated to help support the creation of a new Archaeological Heritage Preservation Center at the university and to extend the Oriental Institute's partnership with the National Museum in Kabul. This work culminated in a successful Oriental Institute application for a three-year archaeological heritage mapping project. The awarded 2.2 million dollars will fund the construction of a GIS database of archaeological sites, which will be used to train Afghan scholars in the use of GIS technology for cultural heritage management and the remote monitoring of archaeological sites using satellite imagery. CAMEL and other scholars will also use the amassed data to carry out research on the archaeological landscapes and settlement patterns of Afghanistan.

During the past academic year, CAMEL student workers and staff constructed a preliminary version of a digital archaeological heritage database for Afghanistan by digitizing information on 1,286 sites across the whole country that were included in Ball and Gardin's 1982 *Archaeological Gazetteer of Afghanistan* (fig. 5). Some of the old information is known to be inaccurate, so we began working on correcting the record of site locations by locating

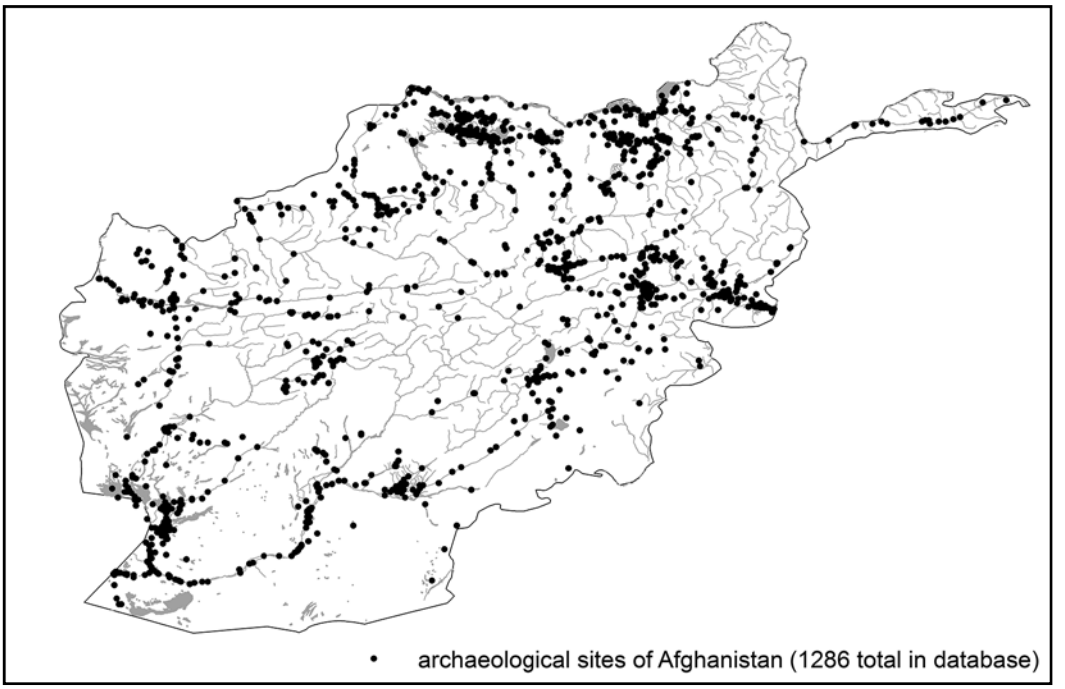

Figure 5. Spatial distribution of known archaeological sites across Afghanistan that have been included in CAMEL's preliminary archaeological heritage GIS database

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them on imagery, mapping them, and performing a brief preservation assessment of the sites visible on the imagery.

Parallel to this digitization and preliminary assessment project, CAMEL had three active graduate student-led Afghanistan research projects. All three research projects will be presented by the involved graduate students at the American Schools of Oriental Research Annual Meeting in November 2015. These research and database building projects will expand under the new Chicago Center for Archaeological Heritage Preservation in 2015–2016.

The first project used the digitized site locations and geological data available from the United States Geological Survey (USGS) to identify which known archaeological sites are in most danger of destruction by future mining activities. A masters in social sciences candidate, Danielle Brown, wrote her thesis on theoretical and methodological issues surrounding the conflict between archaeological heritage preservation and large-scale mining in Afghanistan, in part based on her role in CAMEL's GIS assessment of which sites might possibly be at risk.

The second project has endeavored to develop and refine a way to remotely monitor archaeological sites' preservation through the automated detection of looter's pits (fig. 6). The results of this methodological project, carried out by graduate students Anthony Lauricella and Joshua Cannon, are extremely important for our future archaeological heritage pres-

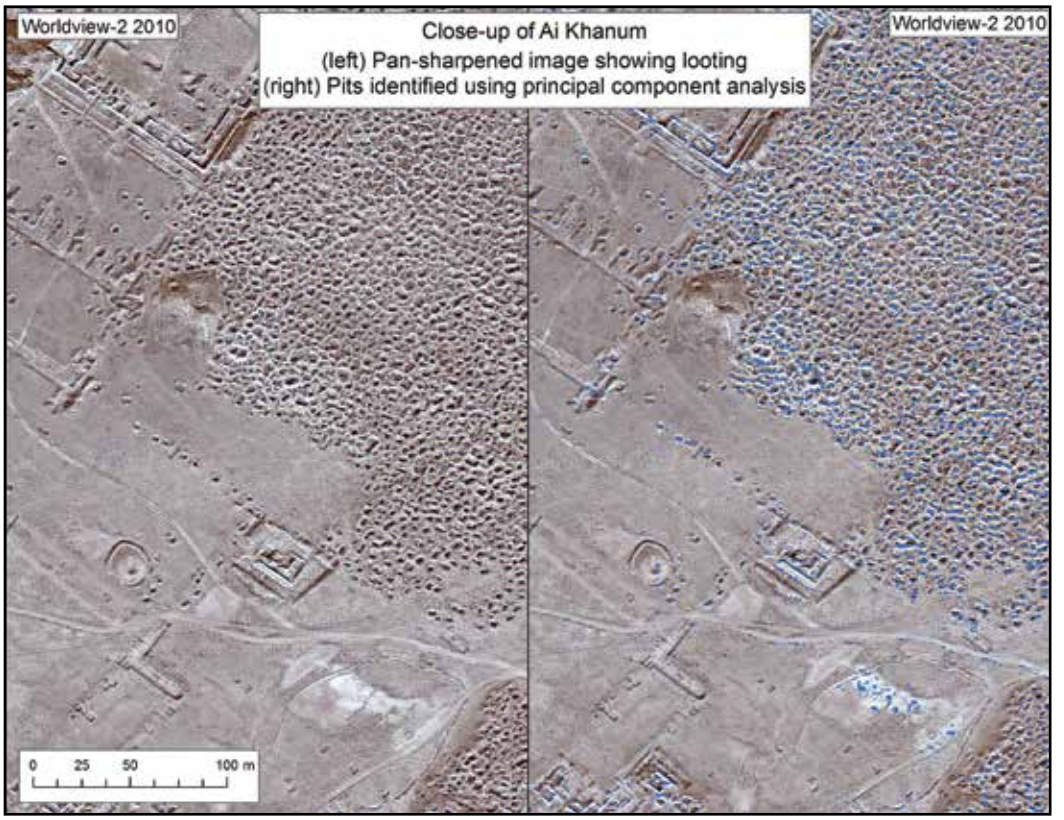

Figure 6. Preliminary results of CAMEL's newly developed method for the automated detection of looter's pits, applied to a section of the major Hellenistic site of Ai Khanoum in northeastern Afghanistan by Anthony Lauricella and Joshua Cannon

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ervation work in Afghanistan since most sites cannot be visited. One of the sites analyzed, Ai Khanoum (Alexandria on the Oxus) in northeastern Afghanistan, showed approximately 17,000 individual looter's pits in a November 2010 image.

Our third project, "Mineralogical Hinterlands in Northeastern Afghanistan," used USGS and Soviet-era geological data to analyze the relationship between Bronze and Iron Age sites and the mineral resources surrounding them. Elise MacArthur and Emily Hammer have been working to identify statistical patterns in the location of archaeological sites in relationship to surface mineral data gathered from spatial analysis of hyperspectral maps. Another component of the project has focused on modeling mineral trading networks using the locations of known mines, known sites, and environmental factors such as topography.

In addition to new research directions, CAMEL has continued to build its research capacities by reshaping its physical spaces and engaging in a number of important archival and database projects. In September 2014, we re-configured our computer laboratory on the second floor to allow for detailed work on large monitors and to accommodate new software and scanners. A new open-door policy in the lab meant that these facilities were in almost constant use: log sheets tally over 100 visitors throughout the academic year. Robert McCormick Adams donated personal notes and maps to the Oriental Institute in summer 2014. Student workers were able to completely scan and inventory this material as well as to georeference the maps for inclusion in our spatial database. This donation and inventory will make original data from Adams' groundbreaking settlement patterns of southern and central Iraq available to interested researchers.

One of CAMEL's greatest assets has been its database, which contains around 20,000 georeferenced maps, satellite images, and other spatial datasets relevant to the archaeology and history of the Middle East. For the past nine years, CAMEL has managed this database itself through custom-built tools. We are now making great strides in transitioning toward use of the Oriental Institute's Integrated Database (IDB). With the dedicated assistance of IDB project managers Foy Scalf and Anne Flannery and the financial support of a two-year Institute of Museum and Library Services grant written last year by Scott Branting, CAMEL devoted considerable time this year toward mapping its existing database to the IDB and testing and refining the blank database template after it was programmed. We are currently in the process of testing preliminary migrations of our data to the new software and expect to transition to full-time use of the IDB over the next year. The major impact of the CAMEL IDB migration lies in the ways it will facilitate making CAMEL's data available for public search and download on the Oriental Institute website. We expect to also complete a preliminary version of this web development in the coming year.

Student training has been essential to the process of building CAMEL's research capacity. Twenty graduate student in Near Eastern Languages and Cultures, Anthropology, and the MAPSS social sciences program were trained in GIS through the Ancient Landscapes I and II courses, and an additional eight students were trained for research and work opportunities in the CAMEL laboratory. The course endeavored to make archaeological and anthropological GIS research more visible at the University through student projects and presentation in a well-attended poster session in March 2015 (figs. 7–9). Without committed students, our accomplishments this year would not have been possible. Our student staff included Elise MacArthur (associate director), Jennifer Altman-Lupu, Danielle Brown, Matthew Cuda, Natasha Murtaza, Jamie Shapiro, Elizabeth Schuda, and Austin Terry. Rolland Long and Larry

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Figure 7. Ancient Landscapes II Class in March 2015 at the student GIS project poster session

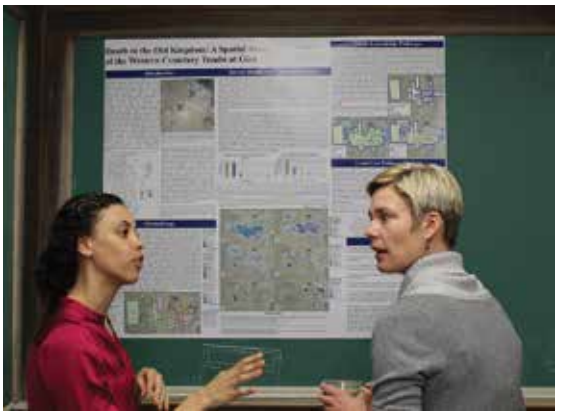

Figure 8. Graduate student Sasha Rohret (left) and Associate Professor Nadine Moeller discuss Sasha's GIS project at the student poster session

Figure 9. Students and visitors congregate around graduate student Akiva Sanders' GIS poster as teaching assistant Anthony Lauricella asks a question

Lissak volunteered for specific projects. Anthony Lauricella and Joshua Cannon served as GIS teaching assistants and worked on independent research in the lab.