CAMEL

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CAMEL stands for Center for the Archaeology of the Middle Eastern Landscape. This is somewhat of an overstatement because it is by no means a center but rather is a small laboratory in the basement of the Oriental Institute (my own little Bletchley Park) that processes large quantities of data that once were considered to be secret. Nevertheless, despite its modest scale, since its foundation in 1998 the lab has been the home of a number of interesting archaeological developments (fig. 1). Activities conducted under the general umbrella of CAMEL include the study of the landscapes of highland Yemen (see our web page: http://www-oi.uchicago.edu/OI/PROJ/CAMEL/Main.html), the development of Geographical Information Systems (GIS) databases of various archaeological surveys, and, most importantly, building up a large collection of high quality satellite images from the Cold War era. These image collections have provided a remarkable and invaluable source of information on the development of the ancient Near Eastern landscapes.

In our mission statement we declare: "At CAMEL we aim to analyze and understand the ancient Near Eastern landscape by combining both traditional on-the-ground archaeological surveys with remote-sensing methods such as satellite imagery and aerial photograph analysis. In addition our research methods include geoarchaeological studies of buried landscapes and environmental change, and the use of texts to provide information on human use of the land. Although much of our work does entail the reconstruction of demographic histories and economic landscapes, we are also seeking an understanding of the various ways in which people related to their landscapes. An extension of the CAMEL approach to landscape is a modeling program which is attempting to show how a Bronze Age Near Eastern Society provisioned itself with food, and how in the long term such strategies might have varied according to fluctuations in climate. Such modeling techniques, that harness the capabilities of GIS with powerful crop and demographic models, are currently being developed as a CAMEL-related project in conjunction with the Division of Information Sciences at the Argonne National Laboratory, Argonne, Illinois."

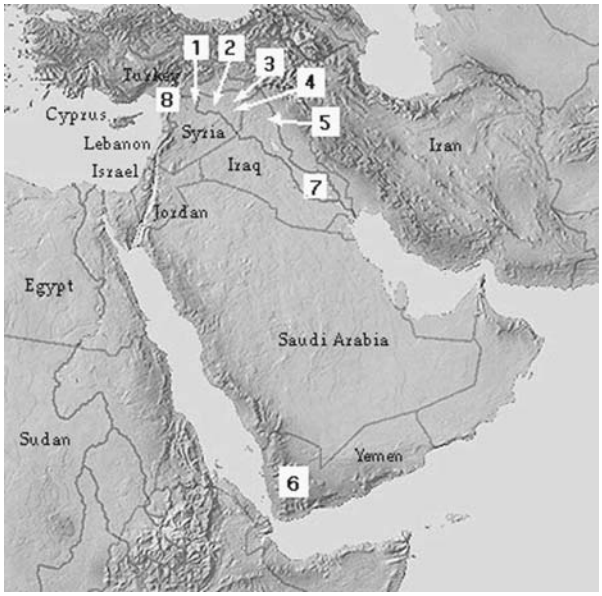

Figure 1. Projects involving CAMEL: (1) Tell es-Sweyhat, (2) Balikh Valley, (3) Tell Beydar, (4) Hamoukar, (5) Ashur Area, (6) Dhamar Project, Yemen, (7) Southern Mesopotamia

The lab itself is housed within the archaeology laboratory in the basement of the Oriental Institute within my own laboratory. We must thank Annette Klein who contributed the funding for the creation of this space, as well as grants from the University of Chicago which contributed to the initial purchase of the computers and software. Thanks must also go to William Sumner whose vision enabled these laboratories to be established in the basement of the Oriental Institute. A huge vote of thanks must also go to John Sanders who, at the outset, supplied

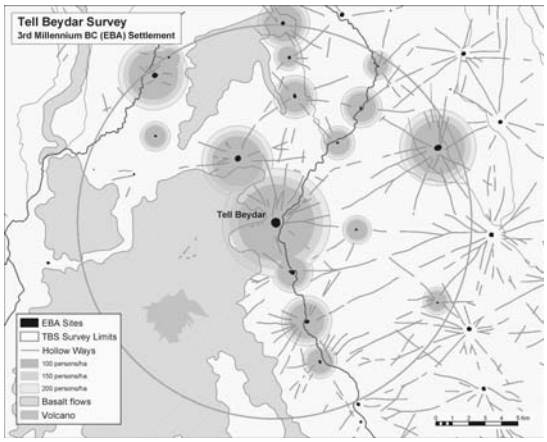

Figure 2. GIS reconstruction of the Bronze Age landscape around Tell Beydar, Syria. Processed by Jason Ur

the expertise and advice on the development of this lab and whose skills continue to enable it to function.

Regular readers of the *Annual Report* will by now be familiar with the significance of landscape archaeology, but it is useful to be able to show just how the techniques of satellite remote sensing and Geographical Information Systems (GIS) are proving to be such powerful analytical tools. GIS enable different types of mapped information to be stored as a series of "layers" that can then be analyzed and manipulated together so as to display them in new ways or to provide new data combinations. It is therefore possible to superimpose distributions of archaeological sites on, for example, soil maps to determine favored locations for settlement development; to calculate the areas of archaeological sites; estimate the amount of cultivated land around sites of a given period; as well as to ask questions such as the distance to nearest water sources or nearest neighbors. When employed in conjunction with information on the physical environment and the landscape derived from satellite images, GIS can provide an excellent means of manipulating the large spatial data sets gathered during survey.

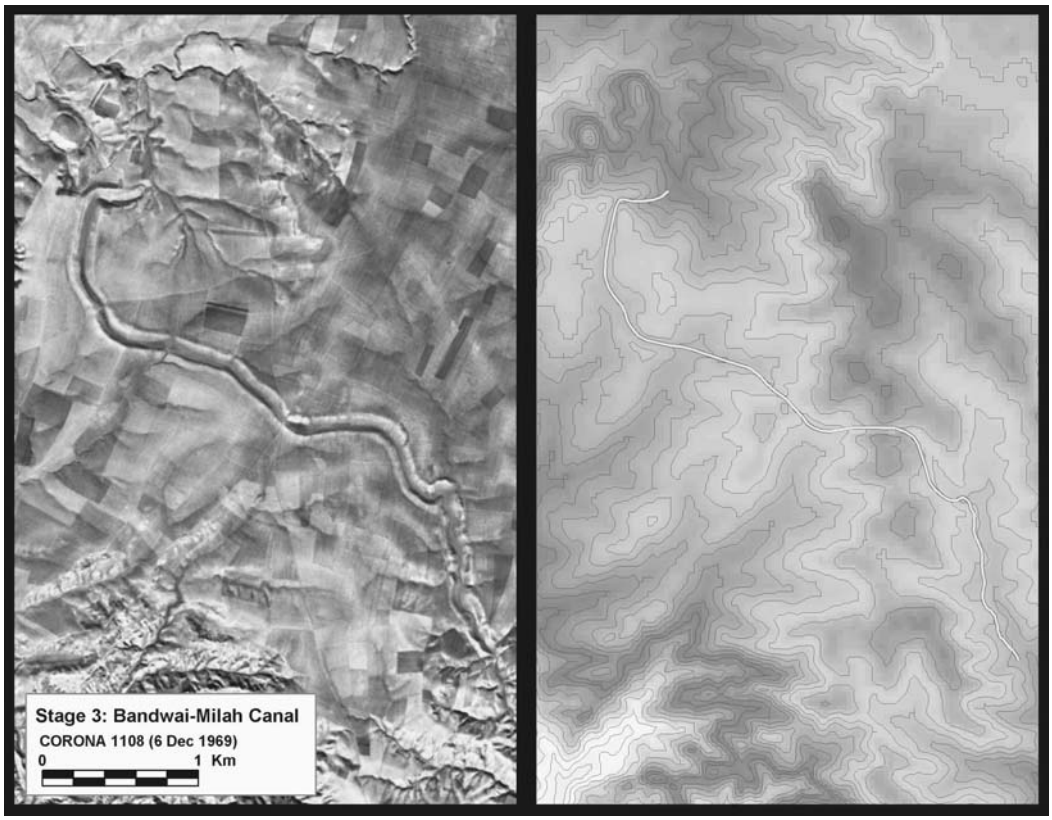

Figure 3. Detail of Assyrian canal north of Nineveh showing its course projected on a topographic map generated via a GIS. Processed by Jason Ur (courtesy of U.S. Geological Survey, used with permission)

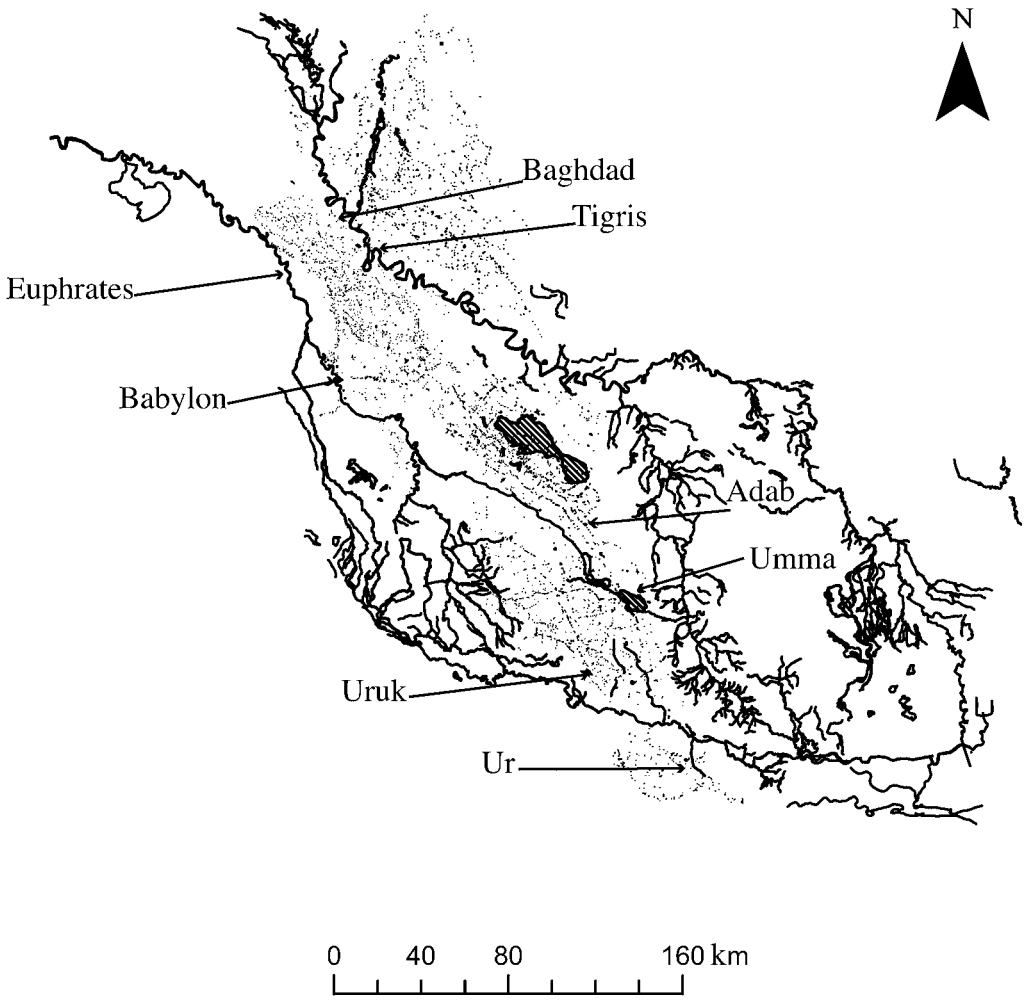

Figure 4. The pattern of archaeological sites in southern Mesopotamia, Based on data from the original surveys of Robert McC. Adams, McGuire Gibson, Henry Wright, Hans Nissen, and others and replotted by Carrie Hritz by means of a Geographical Information System

For this reason alone, Geographical Information Systems will prove to be indispensable in landscape analysis in the future, and, because the Oriental Institute has long been a center for archaeological survey, these techniques will become indispensable for the future of the Institute.

An example of the application of GIS to northern Syria should demonstrate some of the potential of these new methodologies. Archaeologists frequently employ the term "city-states" rather loosely to the scatter of settlements and polities that appeared in Mesopotamia during the Bronze Age. However, it is sometimes difficult to understand precisely what type of settlement systems that are being refereed to. In the rain-fed north of Upper Mesopotamia, the classic tells form a relatively even scatter across a landscape. In the last two or three years, Jason Ur has been working assiduously to understand more about these systems of settlement. Jason's analyses provide reconstructions of the landscapes around tells, as well as estimates of the economic infrastructure that enabled them to grow and survive. The recently released CORONA satellite images (Cold War satellite images declassified in 2001) enable him to recognize the routes of ancient tracks or pathways that radiated out from the Bronze Age tells. Most importantly, they

Figure 5. Detail of the landscape around Babylon as captured by a CORONA satellite image during the early 1970s. Note the distinctive soil pattern of gilgae features to the top and the ancient and recent canal traces at the base of the image and a little above respectively. Processed by Carrie Hritz (courtesy U.S. Geological Survey, used with permission)

allow him to demonstrate how these routes enable the reconstruction of the pattern of cultivated lands around each of these sites. Because archaeological surveys have demonstrated that the tells in this part of northern Syria and Iraq are dated to the third millennium B.C., we are able to estimate the size of Bronze Age cultivated areas. This can be undertaken using three different approaches. First we can estimate the area of cultivation from the point where the tracks from the village settlements disappear or fade out (fig. 2). Next we can calculate the population of the settlements from their surface area on the satellite images or by means of field survey. From this figure, we can then estimate the amount of staple foods required to feed the population, and from this demand we can estimate the area of cultivated land required to produce those crops. The figures show these various estimates combined with a third factor, namely the area of land that could be cultivated by the plow teams referred to in cuneiform texts from the nearby site of Tell Beydar. Magnus Widell's analysis of the textual sources provides this additional estimate. These estimates suggest that these tells were surrounded with just enough cultivated land to support the community housed within the settlement. Although such analyses were not impossible using traditional techniques, they become much more efficient using GIS. Moreover, without the crucial information supplied by the satellite images (namely the points where the local tracks fade out), we would be without one of the fundamental data sources for reconstructing these 5,000 year old landscapes. Even more important, I feel, is that GIS enable us to bring together and analyze evidence from archaeological field survey, excavations, satellite image analysis, and cuneiform texts within the same framework.

During the 1950s, 1960s, and 1970s, Robert McC. Adams and a number of colleagues here at the Oriental Institute undertook a grand sweep of archaeological surveys throughout the Mesopotamian plains and adjacent regions of Iran. With the advent of GIS, we are now able to take data from these surveys and re-analyze it against a backdrop of information derived from soil surveys, satellite images, and the changing pattern of past land use as provided by various forms of mapping over the last century or so. Carrie Hritz is currently analyzing an impressive data-

base derived from the earlier surveys and is demonstrating just how densely the ancient Mesopotamian plains were populated (fig. 4). Not only was the density of settlements remarkably high, but also (as has long been known by the original surveyors of this landscape) these settlements are arranged in distinctive alignments that follow the patterns of former channels. Evidence of the actual channels is also forthcoming from the spoil banks that line some of the channels, as illustrated on an additional image from the neighborhood of Babylon (fig. 5).

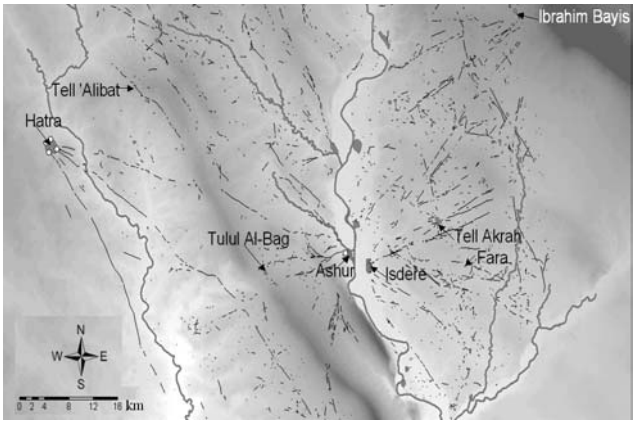

Figure 6. The road system radiating from the Assyrian capital of Ashur, superimposed on a topographic map. Processed by Mark Altaweel

Although the field of Assyriology has a long and illustrious history, it is unfortunate that until recently our understanding of the archaeology of everyday life of Assyrian communities has been rather meager. Now, Mark Altaweel (Department of Near Eastern Languages and Civilizations (NELC) student, CAMEL member) is contributing to our knowledge of the infrastructure of the Assyrian Empire. Specifically, around the early capital of Ashur, Mark has been able to recognize a remarkable pattern of roads that radiate from the capital city (fig. 6). Some of these are almost certainly of Assyrian date. Others, for example, the feature leading to the major Parthian city of Hatra, were clearly in use during or until Parthian times, that is into the early first millennium A.D. Such research adds considerably to our knowledge of how the Assyrian empire actually functioned.

Other types of imaging provide new ways of looking at the landscape. For example, this dramatic three-dimensional view of the site of Nimrud demonstrates rather convincingly how the canal associated with the Nagub tunnel winds around the contours of the Tigris valley to bring water into the Assyrian capital of Nimrud (fig. 7).

In the west of the Fertile Crescent, Jesse Casana has been using CORONA images to study the archaeological resources of the Amuq Plain on behalf of the Amuq Valley Regional Project (fig. 8). Today, especially in summer when much of the valley floor is blanketed by a thick carpet of irrigated cotton, it is very difficult to recognize archaeological sites. Fortunately, the CORONA images were taken during the peak of the Cold War during the late 1960s and the early 1970s when agricultural systems were much less intensive. As a result, Jesse has been able to discern the faint soil or vegetation marks of numerous small archaeological sites. Significantly, many of these have eluded archaeological survey, both the original surveys of the late Robert Braidwood and our own more detailed studies.

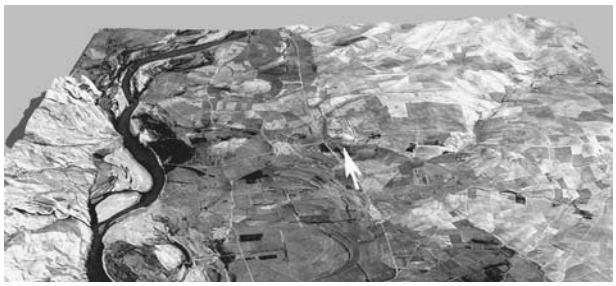

Figure 7. Three-dimensional image of the Assyrian capital of Nimrud with detail of Assyrian canal (right foreground). Produced by draping a Corona satellite image over a digital terrain model of the Tigris Valley. Processed by Mark Altaweel (Corona image courtesy of U.S. Geological Survey, used with permission)

One by-product of our work might be termed "applied archaeology." We have all witnessed the disastrous consequences of

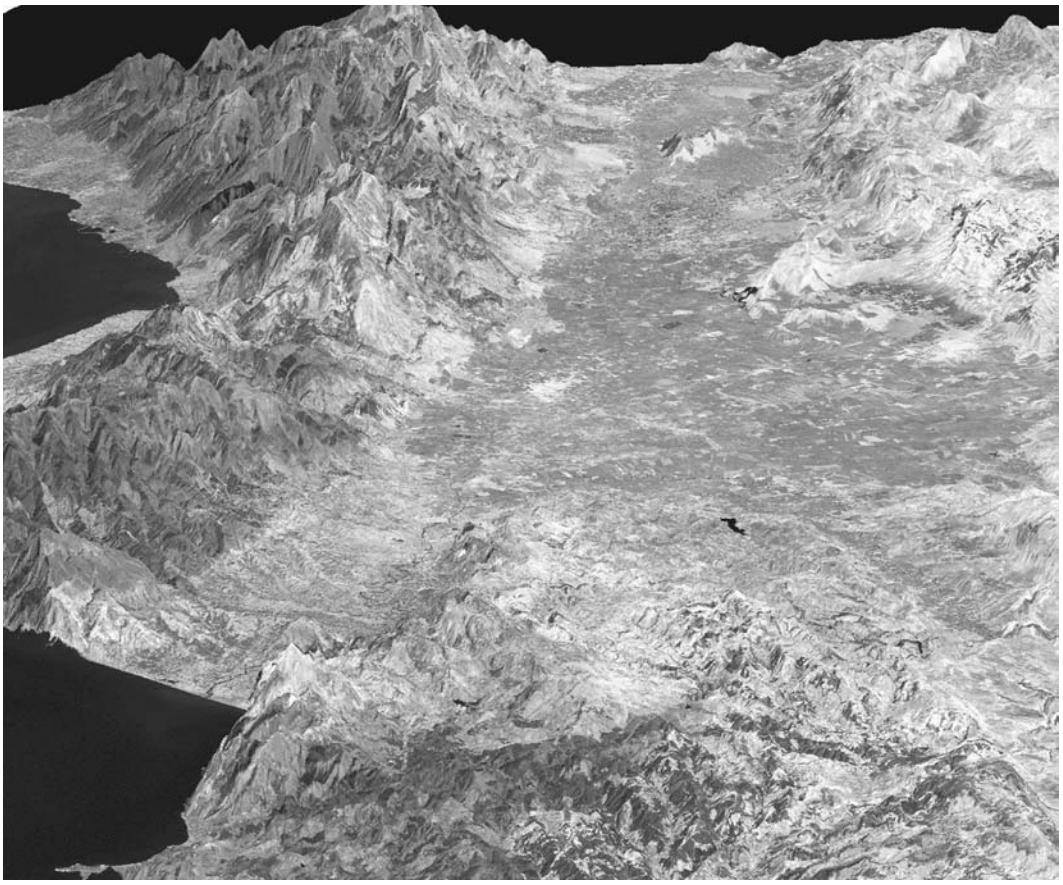

Figure 8. Three-dimensional view of the Amuq Valley, showing landscape features visible on the surface of the plain. Processed by Jesse Casana (Corona image courtesy of U.S. Geological Survey, used with permission)

the looting of the Iraq Museum, but it is important to appreciate that in recent months the archaeological sites of Iraq have also suffered considerably, both from looting and from the ravages of war. Satellite images, taken over a period of some forty years (i.e., since the early 1960s), therefore provide a crucial and invaluable tool for monitoring archaeological sites as well as their preservation or loss. War is not the only force that results in the loss or damage to archaeological sites. These can be destroyed as a result of the expansion of agricultural lands or the development of roads, suburbs, and other forms of industrial urban land use. Satellite images are therefore ideally suited for the long-term assessment and monitoring of archaeological sites. Clearly this type of reconnaissance is particularly useful once the date and size of a site are known from field surveys. After this, it is then possible to monitor the recent life history (or the demise) of archaeological sites and to establish when they are under threat from encroaching developments or when they first started to be plundered. As McGuire Gibson points out, many sites in southern Mesopotamia have been so heavily plundered in the last few months that they now resemble waffles. Such types of damage is readily recognizable on high resolution satellite images, and these techniques therefore should contribute in future to the safeguarding of archaeological heritage throughout the Near East.