

NIPPUR AND UMM AL-HAFRIYAT

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The Nippur Expedition made significant discoveries this year, even though the team was not in the field. Still kept from new excavation by the embargo on Iraq, the project nevertheless gained new data to combine with older material. The new material consists of satellite images and radar images of the area, both of which provide a kind of aerial view that we have not had in years.

During the 1960s, with the sponsorship of the Iraqi Department of Antiquities, I was allowed to buy from the Iraqi government an entire set of maps and aerial photographs of southern Iraq. The photographs, taken by airplane, made it possible to find sites and long-abandoned rivers and canals that were neither on maps nor visible from ground level. With the photographs, we could make detailed plans of ancient canal systems and even, in some cases, to see and record ancient fields, complete with furrows. After I had made use of a small portion of the aerial photographs for the area around ancient Kish, an important early city north of Nippur, Robert McC. Adams, the Oriental Institute's former director, utilized them for an even larger area. Each time we used them, we were obliged to return them for safekeeping to the Directorate of Antiquities. Unfortunately, with the start of the Iran-Iraq War in 1980, the Iraqi Army requisitioned the maps and aerial photographs from the Antiquities Department, and we no longer have access to them.

Since the 1980s, scholars have been able to purchase images made by a European orbiting satellite called SPOT. These images, however, were very expensive and ready coverage tended to be limited to the border, where Iran and Iraq were at war, or to more industrialized sections; there was no commercial or military interest in the non-strategic desert between the two rivers, where our sites lay. We had to commission an image of the area at even greater expense, meaning that the satellite was directed to focus on our particular area in the course of one orbit. An added disadvantage of the SPOT images is the fact that they are of relatively recent date, taken after the landscape of Iraq has been altered greatly by development in agriculture, industry, infrastructure, and the war effort. Often, in these images, ancient sites that we visited in the 1960s no longer exist, or lie in the midst of cloaking irrigation.

Relatively recently, it has been possible for scholars and the general public to buy relatively cheaply some of the older LANDSAT images. These images, because of their huge scale, are invaluable for some long-term, broad-scale analyses of environmental and geographical change, but are of much less use for small area studies. Now, the United States government has declassified and made available a very low prices a set of satellite images called CORONA. Some of these images are on a scale somewhat comparable to aerial photographs and were taken in the period between 1966 and 1970, before much development occurred and exactly when Adams and I were doing survey work in southern Iraq. What we have here is images that approach the old aerial photographs in clarity and scale, and though taken later than the aerial photographs, show the landscape before it had been altered very drastically. Thus, we can look at these images from 1966 and can recognize conditions,



Figure 1. Kite photograph showing ancient buildings underground in Area WC at Nippur. The walls show as white because they have not been as moistened by rain as the surrounding ground

sites, and canal features that we remember from our surveys at that time. Knowing what an identifiable feature looks like on the images allows us to assume that other features giving off similar signals when the images are subject to computer manipulation are of the same type. Thus, we should be able to locate additional sites and may be able to extend the mapping of canals of a given age even though we cannot visit the area at this time. Because the images are so reasonable in price, we can buy a number of them for one area, expecting images to have been taken under different conditions and thus give complementary kinds of information. In short, when manipulated and enhanced in a variety of ways on a computer screen, these images can give an aerial view that is similar to and potentially much more informative than aerial photographs.

Let me give more specific examples of the use of these images. Since 1990, during the pause in Iraqi field work, we have been engaged in analyzing and writing up reports on our work, in some instances knowing that very important information could be provided if we had access to the aerial photographs. For instance, we know from our experience at Umm al-Hafriyat, a pottery-making center in the desert 30 km east of Nippur, that there are numerous canals cutting through and around the site. In fact, one day after a rain in 1990, we visited Umm al-Hafriyat to map the exact locations of the 400-plus pottery kilns that are visible on and around the site. That day, we could see very clearly a previously invisible river course with major canals coming off it, and smaller canals running from them. It was very easy to see that many of the kilns, rather than being randomly located, were lined up alongside

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those canals, where water would have been easily available. In 1977, we had excavated for two months at this site, but we had never been able to see such details as clearly as this. The canals were made visible that morning because it had rained moderately the day before. The moisture that had soaked into the ground was being evaporated from the ground at different rates, depending on the nature of the soil. The sand that had accumulated in the canals and the river bed had soaked up more water than the banks, made of denser clay. Therefore, the beds of the streams showed up as darker, damper lines in the desert. We had our photographic kite with us, intending to take aerial views of the clusters of kilns. Now, we saw an even more important use of kite photographs, because the canals would have shown up brilliantly from a couple of hundred feet up. But there was no wind that day, and the kite never left the ground. By the end of the day, the soil had dried out and the desert once again presented a uniformly featureless face.

Now, with access to satellite images, we have a chance to recover some of the canal network that we saw that day, if we can find an image taken just after the right amount of rain. We are, therefore, ordering several images from a variety of dates. The visible detail will not be as sharp as that available from a kite photograph, but these images, when manipulated, should show features that would not be visible to the naked eye or on a standard photograph. We have additional resources here, however. Our collaborator, Ben Richason of the St. Cloud State University, paid for a radar image to be made of the Nippur/Umm al-Hafriyat area. Radar images are extremely sensitive to differences in water retention of soils. So far, the radar image has not been manipulated very extensively, but already I can see very small canals that I know are in particular locations around Nippur and Umm al-Hafriyat; these canals did not show up on the aerial photographs we used in the 1960s nor do they appear on SPOT images. It is clear, therefore, that by studying and manipulating the radar image along with the variety of satellite images that we now have, and being able to identify certain features because of our long acquaintance with the Nippur area, we can derive extremely detailed information about the ancient landscape.

We should be able to use the images to derive new information on the site of Nippur itself, not just its surroundings. The images may allow us to extend and clarify the nature of buildings that we discovered with the use of kite photographs in the 1980s. In Area WC, at the south corner of the city, where we excavated remains of Ur III (ca. 2200 BC), Kassite (ca. 1250 BC), and seventh-century BC city walls and buildings, kite photographs also showed the plans of unexcavated houses and two other buildings of extraordinary size and complexity. The plans of all of these buildings showed up on the photographs as dark lines on a lighter ground. Here, we had the phenomenon of water retention in reverse of what I have described for the canals at Umm al-Hafriyat. Several days before we took the kite pictures, a very heavy rain had thoroughly soaked both the looser, sandier soils that had accumulated inside rooms and the denser unbaked clay brick walls. As the ground dried, the looser soils gave up their moisture faster than the unbaked bricks, resulting in the walls appearing on the photographs as dark lines. On other days, the kite photos showed the walls lighter and the rooms darker. One of the houses in WC-1 proved, upon excavation, to be Kassite, but if we had decided on the basis of that information to date all of the buildings on the aerial photographs were to be given the same

date, we would have been wrong. Another house and a much larger, more unusual building in WC-2 were proved by excavation to be of seventh-century date. About 200 m to the north, the kite photograph shows an even larger, more complex building that must be an administrative building, which I assume was also built in the seventh century, but we will not know for sure until it is excavated. Our plans to continue the excavations in WC were frustrated by the Gulf War. With the new satellite images, we may be able to locate and map other buildings in the same part of the site, in preparation for a return to the site some time in the future.

As in past reports, I must once again admit that we still have not finished the major monographs that I thought would be out by now. The report on Umm al-Hafriyat has priority, and I am making major progress and intend to have it done in the next nine months. James A. Armstrong is nearing completion of revisions of his brilliant dissertation that was based on the excavation of Area WC-2 and Area TC. Judith A. Franke's important report on the Old Babylonian houses at Area WB will be her "only focus of work this September," she pledges from Dickson Mounds Museum.

In the meantime, I have just written, with Augusta McMahon, an article for the journal *Iraq* as a follow-up to one we did in 1995 on the Early Dynastic Transition. I have also revised and expanded a preliminary report on the seventeenth Season at Nippur (1987), in which I gave details of the city walls of Nippur and a small Islamic site that appeared a few hundred meters northeast of the Ziggurat, outside the walls, when the dunes that used to sit on Nippur moved away. I have also begun preliminary work on a general article on Nippur for the *Reallexikon für Assyriologie*. Donald P. Hansen and Richard L. Zettler, who know the Inanna Temple best, will be coauthors on this piece.

As usual, I need to thank staff and students of the Oriental Institute for help in analyzing and writing up the Nippur and Umm al-Hafriyat material. John and Peggy Sanders are still an invaluable part of the expedition, supplying plans and illustrations. Clemens Reichel, Jason Ur, and Justine Way have stepped into the roles of student assistants, and show as great promise as their predecessors.

I also wish to acknowledge the great help the project derives from those donors who still give financial help although they know we cannot send back exciting news of fresh discoveries from the field. The exciting new finds from satellite images, or fresh insights we derive from the combination of data as we put together the books, must suffice for now.
