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Archaeology from Space: Advanced Satellite Imagery Through the Work of Sarah Parcak

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"Think about what would happen if Indiana Jones and Google Earth had a love child," Sarah Parcak said during her interview with Stephen Colbert. "Hold on, I'm thinking about it. I'm thinking about it," Colbert joked back, making the crowd laugh. Although Parcak may jokingly boil her work down to an easy-to-follow analogy involving Hollywood's thrill-seeking, old-timey archaeologist and today's most widely used, high-tech geographical information system, her work is no laughing matter. Although Sarah Parcak is a young archaeologist, her innovative thinking and progressive techniques have opened a whole new realm for archaeological research, proving that there are many more discoveries to be made.

Sarah Parcak at TEDSummit2016 (Bret Hartman/Creative Commons).

"What Do You Mean, 'Space Archaeology'?"

In her interview with Stephen Colbert, Parcak showcased one of the monumental finds she has made using advanced satellite imagery: the lost city of Tanis, featured in the Indiana Jones films. "Advanced satellite imagery" is an umbrella term used to describe the manipulation of the electromagnetic spectrum on satellite images in order to uncover objects that are not otherwise visible. "Space archaeology" refers the use of this technology to uncover objects that are hidden by vegetation or sediment or tha lie in a region that is inaccessible, thus furthering the goals of those who study human history and prehistory by way of excavations and artifact analysis. To examine Parcak's research contribution and career trajectory to date is to get a birds-eye vie upon the emerging field of space archaeology and its many possibilities.

Sarah Parcak's "passion for finding things" and her love for the past began when she was just a young girl looking for sand dollar shells. In a 2012 TED talk ("Archaeology from Space"), Parcak related the beachcombing methods she used as a child to the methods she currently employs to recover lost structures and cities across the world. Back then, she relied on looking for pattern and shapes that would help her spot the hard-to-find shells in the sand, just as she now relies on looking for shapes and patterns left behind by ancient ruins. However, before she became one of archaeology's newest innovators, her passion for the past

brought her to the doorsteps of a couple of the most renowned schools in the world. Parcak studied Egyptology and archaeology at Yale, and then went on to receive her masters and doctoral degrees from Cambridge (Trinity College) in Egyptian Archaeology. At the time, archaeology was poised to move beyond its longtime reliance on aerial photography. Effectively, technological evolution along with the new availability of satellite data created a paradigm shift.

Parcak's pioneering position within a new generation of archaeologists using advancing technology has been recognized by a string of awards and distinctions: to name just a few, Parcak was National Geographic Fellow and a TED Fellow in 2012 and 2013. In 2016 she burst into the limelight as a TED Prizewinner for her previously mentioned talk, "Archaeology from Space." Parcak's talk briefly discussed two distinct techniques she has used extensively in her work. As she explained, infrared and false color technology can be used to see the chemical changes caused by human activity and building materials from hundreds of years ago. Parcak also discussed the use of topographic data to create models and analyze landscape changes over time. Her use of these techniques has evolved in significant ways – as have the technologies themselves – over the span of her career to date.

From Pharaonic Traders to Contemporary Looters: Parcak's Contributions to Archaeology in the Middle East

A good example of Parcak's early use of satellite imagery is found in an article she published in 2003 with fellow archaeologist, Gregory Mumford (Mumford and Parcak 2003). The investigations by the husband and wife duo focused on the El-Markha Plain site of South Sinai and sought to "trac[e] pharaonic routes to the turquoise and copper mining region, investigat[e] pharaonic an indigenous camps, mines, and their material cultural assemblages … and [assess] Egypto-Sinaitic cross-cultural relations" (82). Based on Mumford's analysis of ancient writings that referred to titles such as "(sea) captain" and "overseer of ships' crews," the article explored the seasonality of mining, trade, and travel across the Sinai (89). While Mumford's role was to establish the historical context and questions guiding the research, it was Parcak's analysis of satellite imagery—a far more cost and time effective technique than comprehensive ground surveying— that allowed the entire region of the El-Markha Plain to be mapped and better understood. As Mumford and Parcak put it, satellite image analysis "makes it possible to pinpoint key regions for archaeological reconnaissance and to assess human settlement patterns" (103). In effect, Parcak's research provided the team with areas to investigate. To do this, Parcak went about identifying green plant biomass, which returned sixteen possible sites (113). This was followed up with on-site observation, the only true way to detect small to medium-sized sites in some kinds of eroded desert environments with minimal topographical differences. This 2003 article is a great example of the use of satellite technology in Parcak's early work, where it primarily appears in a supporting role as a cost-effective alternative to surveying. Although this consideration has continued to play a role throughout her career, in Parcak's subsequent work she would explore the potential to do much more with satellite images.

In 2007, Parcak published an article on her work investigating and monitoring the destruction of archaeological sites in contemporary Egypt. Here, her agenda and methods took center stage. Parcak focused on two areas of the Nile's floodplain lying in the East Delta and Middle Egypt (Parcak 2007: 65). Parcak had to utilize different techniques in each zone because of variations in such factors as vegetation, weather, the ability of satellites to capture sandstone interference, as well as the flow of the Nile itself, which deposits silt across the floodplain at varying depths in different locations (67). Through her use of multiple techniques for satellite detection combined with ground-

truthing visits, Parcak was more than 90% successful in locating known archaeological sites within both regions (71). During ground-truthing visits, Parcak and her team physically went to the sites to analyze them. Finding these sites allowed her to assess the dramatic changes that have taken place in the floodplain since the first written accounts of the Delta, describing them as a shift from "a landscape dotted with hundreds of 'anthills' to a landscape full of tells and tombs suffering from the urbanization of Egypt and increasing population size" (76). As before, Parcak's work focused on the most cost-effective ways to analyze an area. However, growth and development in her methods was also clearly evident. First, she adapted her methods to the different environments under investigation, using different programs and satellite information sources. Also in this article, Parcak begins to emerge as a voice for the past, advocating for the continued monitoring and increased protection of historical sites (Parcak 78).

A SPOT Satellite Image of the Suez Canal (CNES/Wikimedia Commons).

With the publication of Parcak's 2015 article, simply titled *Archaeological Looting in Egypt: A Geospatial View*, Parcak takes on a global issue affecting archaeological sites everywhere. Looting in Egypt was examined through closer analysis of four specific sites. Each was an important, ancient site that was the focus of a great deal of press coverage from 2011 onward (Parcak 2015: 197). The reason why this article focuses on looking at the time period after 2011 is to highlight the damage done to these sites after the Egyptian revolution that occurred in January 2011. Through the examination of Google Maps and Quickbird imagery, Parcak and her team were able to look at each individual site from before the revolution all the way into 2015. Observation of the areas over longer periods of time allowed them to monitor the progression of the looting (196). Looking at a time period before the country was in turmoil allowed them to discount looting pits that were actually made before the revolution, allowing them to have higher accuracy. It was the ground-truthing visits, however, that solidified the data and presented the team with a better understanding of the timeline of the increase in looting (200). On such visits Parcak was able to see back fill and trash that would start to accumulate in the older pits. Overall they were able to determine that in all the sites, the peak of the looting happened during 2011-2013, and with the ongoing analysis of the images from 2014-2015, they are able to determine that for three of the sites, looting has "largely slowed down" (201). Not only did this article specifically focus on a zone that had been plagued by looting-related issues in the past, but it was also the beginning of a battle that Parcak would fights in her future work. By exposing the amount of looting taking place, she became an even stronger voice for the past.

Parcak was busy in 2016, releasing two papers relating to different topics and uses for satellite technology in archaeology. The first article (Parcak and Tuttle 2016) pertains to a new find in Petra where Parcak uncovered a platform structure that had never been seen before, which was only possible because she was looking through the satellite images. Specifically, Parcak mainly used WorldView-1 and WorldView-2 images that were taken on June 29, 2010 (37). After the satellite data were analyzed using the program ERDAS ER Mapper, there were four initial zones of interest. There was little found on the first three ground-truthing visits. There was, however, an interesting find in the form of a forgotten excavation trench that actually dated back to the first scientific excavation of the area that took place in 1929 but was never marked on any maps (39). The platform that was found measures around fifty-six meters by forty-nine meters and atop it was a second, smaller platform constructed which was originally paved with flagstones. This site "has no parallels at Petra or [anywhere] in its hinterlands at present" (42). Finding a monumental

structure just nine-hundred meters southwest of a major city center is just one example of how archaeological history can be found and made with satellites. (36).

The Monastery of the Ancient City of Petra (Dielgo Delso/Wikimedia Commons).

In her second article of 2016, Parcak widened her scope from one famous site to look at the reasons behind looting in the broader context of what was happening in Egypt as a whole between 2002 and 2013. Looting has always been an unfortunate part of Egypt's history. It has long been thought that times of trouble bring on looting. But looting during Egypt's earlier uprisings and revolution hasn't been well documented in the media. This changed after the Arab Spring and the Egyptian Revolution in January 2011, when sites were left defenseless. Parcak goes into detail as to how the satellite images of the areas were created combining various images (Parcak et al. 2016: 190). Her analysis of 1,100 sites across the whole country, showed a clearly visible increase in looting. All ambiguous results were excluded which means that this research provided the "*lowest possible* count of looting pits" (191). From 2002 to 2008 there were some looting pits but not a staggering number; the same goes for encroachment in site areas (2016: 193). However, in the next two years (2009-2010), site damage increased more than 400% (adjusted), with "more than 34,500 newly visible pits appearing" (2016: 195). This four-fold increase is staggering even before one remembers that 2002-2008 covers seven years whereas 2009 and-2010 only cover two. The pattern of looting being tied to economic stability can explain the reasons why this dramatic increase occurred; 2008 and2009 were the beginning of the international economic crash. The Arab Spring took place soon after, and the unstable economy create by the Revolution only drove up looting in Egypt in the years following. The time following the Revolution has the "highest overal total values of both looting pits and encroachment" (Parcak et al. 2016: 196). This work was immensely important because it was able to quantify the looting, which had previously eluded measurement despite the fact that many were aware of it. In 2016 alon Parcak has thus significantly expanded the range of uses for satellite image analysis in archaeology.

Conclusion: A Look To The Future And A Reflection On The Past

Looking beyond her published work, Parcak has been an active participant in the global discussion revolving around the future o archaeological sites that are threatened by looters and infrastructure, as well as in promoting the future of satellite archaeology. As mentioned above, Parcak was the 2016 TED Prizewinner and later appeared on the Colbert Report, where she explained what she planned to do with the one million dollars she would receive to fulfill a "wish for the world." The realization of her wish is a program named GlobalXplorer, which was recently launched for Peru with the hope of expanding it to more countries in the future. The goal of GlobalXplorer is to crowdsource satellite archaeology, so that anybody can monitor and view sites from space and become "space archaeologists" themselves.[1] By making it more affordable to use satellite information, Parcak hopes to expand the use of the technology in archaeology as well as to stimulate further developments in the technology itself. In the meantime, Parcak stays busy as a professor and advisor at the University of Alabama at Birmingham, where she has taught many courses ranging from the introductory to the graduate levels. Her influential reach goes far past the classes she's taught and the students she's advised, though, because as a TED Fellow and National Geographic Explorer, she has given over 150 public talks, making her outreach expansive indeed (UAB News).

There is no denying that Parcak's work has greatly evolved over the years. When read alongside one another, the five articles discussed here alone clearly show the progression in Parcak's use of satellite technology as well as her point of view as a scholar.

For example, in one of her most recent articles (Parcak et al. 2016), she advocates strongly for increased site protection, (Parcak e al. 2016), and for organizations like the Egyptian Ministry of Antiquities, which she credits with valiant attempts to protect sites (Parcak 2015). As far as her motivations for embracing satellite technology go, Parcak has expanded well beyond her initial concerns with cost effectiveness (Mumford and Parcak 2003). This remains a concern in her later work, but since 2007, Parcak's interest has shifted more towards the technology's potential for facilitating discoveries and site protection. Early works focused on finding structures known to exist within the region. In her 2007 article, we see her focus on the benefits of analyzing satellite images, especially for identifying and protecting sites against harm or even destruction. Then, as her work turns specifically to th effects of looting she explores the role of technology in monitoring sites in dangerous regions, where ground-truthing cannot be conducted (Parcak 2015). Here she applies the cost-effective technology that she has come to know so well to the monitoring of sites that are falling victim to looters on a massive scale. She provides a powerful example of not only her ingenuity but also her constant reinvention of satellite technology with the final paper examined here. Here, at the culmination of Parcak's work to date we see that her ability to monitor the whole of Egypt for signs of looting bypasses the scale of even her largest prior projects. Parts of Egypt are still unstable, but thanks to space archaeology and Sarah Parcak, this doesn't mean that archaeologists need t turn away until the famous sites of the region are once again protected and accessible for excavation on the ground. And althoug her last article does represent the culmination of Parcak's work to date, there is no way to predict where Parcak will next take advanced satellite imaging technology.

References

Sarah Parcak: Archaeology from Space | TED Talk | TED.com. TED Talk, Mar. 2012. Web. 10 Dec. 2016.

Mumford, Gregory D., and Sarah Parcak. 2003. Pharaonic ventures into south Sinai: El-markha plain site 346. *The Journal of Egyptian Archaeology* 89 : 83-116, http://www.jstor.org.libproxy.unh.edu/stable/3822493.

Parcak, Sarah. 2007. Satellite remote sensing methods for monitoring archaeological tells in the middle east. *Journal of Field Archaeology* 32 (1): 65-81, http://www.jstor.org.libproxy.unh.edu/stable/40026043.

Parcak, Sarah. 2015. Archaeological looting in Egypt: A geospatial view (case studies from Saqqara, Lisht, and El Hibeh). *Near Eastern Archaeology* 78 (3): 196-203, http://www.jstor.org.libproxy.unh.edu/stable/10.5615/neareastarch.78.3.0196.

Parcak, Sarah, and Christopher A. Tuttle. 2016. Hiding in plain sight: The discovery of a new monumental structure at Petra, Jordan, using WorldView-1 and WorldView-2 satellite imagery. *Bulletin of the American Schools of Oriental Research*(375): 35-5 http://www.jstor.org.libproxy.unh.edu/stable/10.5615/bullamerschoorie.375.0035.

Parcak, Sarah, David Gathings, Chase Childs, Greg Mumford, and Eric Cline. 2016. Satellite evidence of archaeological site looting in Egypt: 2002-2013. *Antiquity* 90 (349) (02): 188-205, http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=113473249&site=ehost-live.

Parcak, Sarah. Sarahparcak.com. http://www.sarahparcak.com (September 19, 2016)

"What Is a Satellite Image?" Reference. Accessed December 10, 2016. https://www.reference.com/geography/satellite-image-545a02bdf1e8807a.

"UAB News - Parcak, Sarah." *UAB - The University of Alabama at Birmingham - Home*. N.p., n.d. Web. 10 Dec. 2016.

[1]GlobalXplorer can be accessed at https://www.globalxplorer.org/

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