From West to East

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Current Approaches to Medieval Archaeology

Edited by

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INTRODUCTION

This volume is an exploration of current archaeological studies of Medieval Europe and the Mediterranean world. The focus is on work presented at conferences in America, with the majority of chapters based on presentations at the Conference on Medieval Archaeology held at the State University of New York at Cortland in October 2013. These studies are nearly all rooted in anthropological approaches, given the disciplinary focus of archaeology in North America in departments of anthropology.

In the United States, you can attend conferences on nearly any arena of archaeological study, from local societies to nearly any specialty in method, region, or time period. The exception to this is the archaeological study of Medieval Europe and the Mediterranean. There is a growing exploration of why this specific period has seen so little investment in the anthropological study of medieval archaeology (e.g. Fazioli 2014), which is a necessary step toward improving the stature of medieval archaeology as part of American archaeology. Another step was to have an annual conference where medieval archaeology was the focus. The closest option to that in North America is the Kalamazoo International Medieval Congress, but with 50 to 100 archaeologists among 5000 attendees, Kalamazoo can be both overwhelming and challenging to find your peers. There are dozens or scores of Medieval Studies programs across North America, drawing on history, literature, art history, and similar disciplines. Anthropology and archaeology should be part of that discussion, but often are not.

It can be difficult to get training and support for doing archaeology of medieval Europe or the contemporary Mediterranean world (Goodson 2012). This absence is particularly glaring when you consider that the medieval world has shaped our own experiences in the modern world, from fundamental aspects of our culture to the very institutions, colleges and universities, where we study archaeology. These arenas of study, while quite distinct, are best explored together because the social, economic, political and religious practices of the Mediterranean world and Europe north of the Alps are inextricably linked or entangled. While every region needs specialist study, you cannot understand what is happening in one region without the broader context of the rest. Jones et al address this topic in Chapter 12 as part of their discussion.

As an undergraduate, I was interested in the medieval world, but there was no dedicated archaeology course for it at my institution, just classes in history, literature, and art history. Instead, I took an independent study arranged by my department to supplement my normal coursework. When I graduated, I wanted to continue in medieval archaeology, but was not prepared to do my graduate studies in Europe. Again, there were few options to take classes in anthropological archaeology looking at the medieval world, so I took classes in history and art history. I also took an independent study course as a graduate student, with my department supporting me to the best of their ability. Once I completed my doctoral work, I wanted to make things easier for my students. As a professor, I have taught medieval archaeology at three institutions to over 100 students, and I have had several students tell me they wanted to continue their graduate studies in medieval archaeology. I felt they needed an opportunity to meet with other scholars studying the same time and place, and to be able to learn about the latest developments and discoveries in the discipline, without the need to cross the Atlantic Ocean. This led to the 2013 conference, held in Cortland, New York, at the state university. There were fourteen presentations, and many of those papers form the core of this volume. As I write this, the 2014 conference is but weeks away.

The topics of the papers span the range of the medieval world, from Viking Vinland to Islamic Jordan, revealing the depth and complexity of current approaches in medieval archaeology. The main focus of this volume is on work that has been done by scholars from North America, though not exclusively. The interaction between scholars in North America, Europe, and the Mediterranean world is vital to a vigorous debate and a deeper understanding of the medieval world. That is part of the reason for the title for this volume: what can those scholars in the western hemisphere contribute to a better archaeological understanding of the medieval world? The volume is also organized by place and date, moving from west to east, and earlier to later in time. The goal of the selected chapters is to show what we can learn and how we can practice medieval archaeology as best we can, from methodologies to interpretations, and drawing on as many types of information as possible from material evidence to documents to the latest means of non-invasive exploration and documentation of sites. This is intended to be a collection of “best practices;” whether we achieve that is up to the decision of individual readers, but even if we are lacking, that has been our goal.

One recurring theme is that of landscape and the built environment. Chapters 1, 3, 5, 6, 7, 8, 9, and 12 all explore aspects of the use of space at the immediate level of the built environment or at the level of landscape, but with different emphases. The study of architectural remains and the place of society in the landscape has long been a topic of investigation by archaeologists, and an archaeological approach can be very illuminating for these topics. As shown in this volume, the approach to landscape and the built environment has taken a different turn from past studies, and is applying perspectives rooted in anthropology and experiential practice to the use of space in the medieval period.

Chapter One is a discussion of methods, specifically methods in archaeogeophysics and how it can contribute to archaeology as a whole and to medieval sites in particular. Rogers looks at what has been done and provides a (non-medieval) example of what you can get from a particularly good case of the complementary evidence from different technical approaches.

Chapter Two is an exploration of interpretation and the need to understand issues of ethnicity and identity when examining a medieval population. Linking behavior and practice to material culture is a central goal of anthropological archaeology, and associating that behavior with a specific population is always a challenge. Fazioli uses a ceramic study from the Alps to explore this theme as a means to identify distinctions between Ostrogothic and Slavic populations.

Chapter Three is as far west as possible for the medieval world, and examines one of the most fascinating topics of early medieval archaeology: the presence of Norse explorers and settlers in North America and what "Vinland" actually refers to. Wallace applies her deep experience with the material remains from Canada and a nuanced reading of the sagas to come to a conclusion about Vinland that opens exciting possibilities for future research.

Chapter Four is an exploration of both the archaeological record and the modern interpretation and promotion of archaeology in the service of national identity in Ireland. Shaffer Foster uses the study of lithic material from Early Medieval Ireland, itself a rare topic of investigation in the Middle Ages, to reveal conceptions of identity which are then compared to the construction of identity in modern Ireland.

Chapter Five looks at symbolic authority expressed on the later medieval Irish landscape. Schryver uses castles and fortified residences to examine how medieval lordship was constructed, figuratively and literally, on the landscape, and how continuity of landscape provided a means to justify continuing patterns of authority despite changing political circumstances.

Chapter Six studies the central medieval noble household in England as a tool for hierarchical display. Weikert looks particularly at noble sites such as manors and castle keeps and their organization in regard to prestige and authority through the technique of access analysis. This approach takes a complex architectural layout and reduces it to a graphic model of spatial use to clarify specific questions about how space was used.

Chapter Seven is an overview of domestic space from peasant houses to palaces in later medieval England, using a similar approach to that used in Chapter 6 but with a different goal and different results. Residential space in England became remarkably similar, regardless of the social level of those who built, lived in, and experienced that space.

Chapter Eight is a detailed study of a specific church in Hungary and the implications of its material form for political and social history. Kocsis places the church in its historical context and explores different reconstructions of its original form to explore the possibilities of its use in the medieval period and what that means for the history of the region.

Chapter Nine is a fundamentally important introduction to a rural Byzantine site in central Anatolia. Cassis and Steadman document their current and on-going work at Çadır Höyük as a non-elite, non-religious site. This work moves the focus of Byzantine archaeology away from the elite and religious practice and into the study of everyday people and sites. This study shifts the exploration of Byzantine studies toward the kinds of questions that are asked by anthropological archaeologists.

Chapter Ten also explores a site in medieval Anatolia. Crabtree and Campana analyze faunal remains from Kinik Höyük, a multi-component site in Cappadocia with a complex political and social history. This chapter is one piece of a larger study of agropastoralism in this region that extends from the origins of agriculture through the early modern period, showing the variations and continuity in social practice across millennia.

Chapter Eleven approaches archaeology from across the disciplinary divide with history, combining a strong documentary study with archaeological data to develop a better understanding of medieval life. Lachman shows the need for not just interdisciplinary work, but an integrated course of study that gives equal weight to all forms of evidence and tools of investigation. This study of food habits and culture shows the many aspects of cultural practice linked to diet, from medieval conceptions of science and cosmology to practices of display and the expression of power through food.

Chapter Twelve finishes the volume in the east, with a study of the medieval period in Jordan. Jones, Najjar, and Levy explore the link between metallurgy and sugar production at sites in Jordan, and discuss how the interpretation of this material can be linked to a "medieval" perspective on the material. This does not mean a “religious” and “premodern” perspective as some have defined medieval, but a way to investigate a specific time period and bridge the gap between contemporary Islamic and European archaeology of the medieval world.

I hope this volume serves as a start for those interested in medieval archaeology in North America to see what is being done today, and will continue to serve as a reference for the projects described on these pages. There are many people engaged in medieval archaeology in the United States and Canada, mostly as individual scholars in departments across the continent, from Florida to California to Minnesota to Ontario and Quebec. While a small step, the conference and this volume intend to be the beginning of bringing those disparate researchers into a community of like-minded scholars who can support each other, debate their findings, and perhaps argue together over medieval archaeology.

Scott D. Stull
September, 2014

CHAPTER ONE

VISUALIZING AN INTEGRATED LANDSCAPE USING ARCHAEOGEOPHYSICAL AND 3D LASER SURVEYING

MICHAEL ROGERS

After decades of successful use on archaeological projects, archaeogeophysical survey can now be considered a reliable tool in the archaeologist's toolbox. With continued advances in microcomputer processing speeds and increased storage capabilities archaeogeophysical surveys are now using higher resolution sampling and gathering data across entire landscapes (Buteux et al., 2000; Keay, Parcak, and Strutt, 2014; Kvamme, 2003). Archaeogeophysical survey is comprised of conductivity, earth resistance, ground-penetrating radar (GPR), magnetometry, magnetic susceptibility, metal detection, and the more recent addition of airborne and terrestrial 3D laser scanning (a.k.a. lidar) (Aspinall, Gaffney, Schmidt, 2009; Conyers, 2013; Gater and Gaffney, 2003; Rogers, 2011; Schmidt, 2013).

Conductivity, earth resistance, GPR, and magnetometry instruments are carried by a single operator or towed by an all terrain vehicle (ATV) with the instruments positioned close to or in contact with the ground. Data are gathered along transects with readings spaced every few centimeters along transects with transects spaced 50 centimeters or less. During single operator surveys the site is often divided into smaller survey units (20 m x 20 m; 20 m x 40 m, and 40 m x 40 m are typical sizes) with transects marked by some form of line (I use a 0.95 gauge plastic monofilament line). A real-time kinetic differential global positioning system (RTK-DGPS) is used to record data locations when instruments are towed by an ATV. These types of surveys can rapidly cover large areas, but the survey area must have significant open space free of trees, fences, and other obstacles (Gaffney et al., 2012).

Archaeogeophysical surveys have been conducted at a range of medieval sites. The focus of these surveys varies from landscape scale to looking beneath floors in cathedrals to searching for buried human remains. The 2012 discovery of King Richard III burial site beneath a car park in Leicester, England used GPR to guide the excavations (Buckley, Morris, and Appleby, 2013). The Viking town of Birka—part of the UNESCO World Cultural Heritage Site Birka-Hovgården—located on the island of Björkö in Sweden has been surveyed using a range of archaeogeophysical instruments dating back to 1990. Trinks, Neubauer, and Hinterleitner (2014) provide an overview of the history of archaeogeophysical surveys at the site and a discussion of the 2006 GPR and magnetometer single operator surveys. The GPR surveys covered a 50 m x 100 m area taking data every 0.05 m along each transect with transects spaced 0.50 m apart. The magnetic gradient surveys covered a 150 m x 100 m area containing the GPR survey area and an additional 50 m x 50 m survey area taking data every 0.10 m along each transect with transects spaced every 0.50 m. The surveys were able to identify individual property boundaries, houses, track-ways, and parts of the outer defenses giving new insight into the town layout. In 2008 the site was further investigated using the new multi-antenna GPR system mounted on an ATV (Trinks et al., 2010). An area of 150 m x 62 m was surveyed in 5 hours with an inline spacing of 0.08 m and a transect spacing of 0.08 m (note that the 2006 survey used a transect spacing of 0.50 m). After 3 days of surveying the team covered approximately 3 hectares taking readings every 8 centimeters. Similar techniques that also included terrestrial laser scanning were used at the Iron and Viking age settlement Uppåkra in Sweden (Biwall et al., 2011). Surveys in 2010 gathered 40 hectares of magnetic data and 10 hectares of GPR data. The 2011 magnetic surveys covered 110 hectares of the site. The landscape scale archaeogeophysical surveys at Uppåkra identified pits, postholes, hearths, and grave mounds no longer visible on the surface due to plowing.

GPR surveys at the Prediger Church built in the middle of the thirteenth century and replaced in the fourteenth century in Zurich are an example of small scale surveying within a medieval structure (Leckebusch, 2000). A preliminary survey covered 8 m x 19 m with an inline spacing of 0.025 m and transects spaced every 0.500 m. A detailed survey covered 2 m x 7 m with an inline spacing of 0.025 m and transects spaced every 0.050 m. The GPR survey obtained information about the remains of the thirteenth century church residing beneath the early twentieth century concrete floor. The buried walls of the original choir and a previously unknown altar were identified in the GPR data. GPR surveys at the Cistercian abbey of Valmagne—located southwest of Montpellier, France—identified features of the twelfth century Romanesque church buried beneath the thirteenth century Gothic church (Udphuay et al., 2010). Additional GPR signals may correspond with Roman features beneath the church. GPR surveys in a modern clothing store in Chester, Chestershire, UK, identified the location of a Medieval undercroft and associated passageways (Pringle, Lenham, and Reynolds; 2009). The GPR surveys at Chester provide a good example of how archaeogeophysical survey can provide information about subsurface features of interest in an "open for business" commercial shop.

The 3D-Arch project is using a combination of laser scanning, photogrammetry, and architectural design software to create virtual models of castles in Trentino province in northern Italy (El-Hakim et al., 2007; Remondino et al., 2009). The 3D-Arch project examine four castles—one eleventh century (Avio) and three thirteenth century(Buonconsiglio, Stenico, Valer)—with the goal of digitally documenting the inside and outside of each castle. These four castles were chosen due to differences in their architecture that provided case studies for digital preservation techniques. Lubowiecka et al. (2009, 2011) used a combination of terrestrial laser scanning and GPR to examine historic bridges in the region of Galicia in Northwest Spain. The bridges range in age from the Roman period to Medieval period, with laser scanning providing a digital record of bridge exteriors and GPR providing information about internal construction.

The remains of medieval castles and tower houses are often seen out of context of their original landscape, which would have had work areas, defensive elements, and possibly outbuildings. Earth resistance surveys and archaeological excavation at the Castle of Zena—a thirteenth century fortress located between the towns of Fiorenzuola and Piacenza, Italy—uncovered evidence for a more complicated landscape (Compare et al., 2009). The surveys located a stone icebox, a brick making furnace and workrooms, and the foundation of an additional wing of the castle that was destroyed in the eighteenth century. The Rattin Castle Tower House in County Westmeath, Ireland was built in the middle of the fourteenth century. Magnetic and earth resistance data were gathered over 6.7 hectares surrounding the tower house (O'Rourke and Gibson, 2009). The surveys identified subsurface evidence for an outer defensive (bawn) wall, a possible gatehouse, a network of fields and enclosures, and military road that may be older or contemporary with the building of the house.

Figure 1-1: Archaeogeophysical Instruments (A) Conductivity Meter, (B) Earth Resistance Meter (C) Ground-penetrating Radar, (D) Optically-pumped Magnetometer (foreground) and Fluxgate Magnetometer (background), (E) Magnetic Susceptibility Meter, (F) Time of Flight 3D Laser Scanner, and (G) Laser Triangulation 3D scanner.

Brief Review of Archaeogeophysical Instruments

Conductivity (a.k.a. ElectroMagnetic Induction)

Figure 1-1A shows a Geophysical Survey System Inc. EMP-400 multifrequency conductivity meter. Conductivity is a measure of how easy it is to pass current through a material. A conductivity meter uses an alternating current in a coil of wire to create an alternating magnetic field. The instrument is held near, but not touching the ground surface. The alternating magnetic field interacts with the near surface soils to create an alternating current in the soils. This alternating current then travels through the soils and subsurface features. A conductivity meter has a second coil of wire that records the strength of the alternating magnetic field created by the current that passes through the subsurface. A stronger magnetic field corresponds to higher conductive materials between the two sensors. Conductivity readings are taken in even intervals as the instrument is moved along each transect. A plot of these readings shows changes in conductivity due to changes in soil types and buried features (Doolittle and Brevik, 2014)..

Earth Resistance

Figure 1-1B shows a Geoscan RM15 with Multiplexer in Multi-Twin Probe Array mode. Resistivity is the inverse of conductivity and is a measure of how difficult it is to pass a current through a material. A resistivity meter has two or more metal spikes that are pushed into the ground to make electrical contact with the soil. Once inserted into the soil one of the spikes creates a current and the other reads the voltage between the two probes. Knowing the current and the voltage allows for the calculation of the earth's resistance between the probes. An earth resistance meter is moved along each transect in a fashion similar to the conductivity meter. Passing over more highly resistant buried features such as a stone foundation will record a higher resistance compared to the surrounding soils. A plan view plot of the earth resistance will show these differences, and with readings taken at appropriate intervals shapes such as buried foundations become apparent (Schmidt, 2013).

Ground-penetrating Radar

Figure 1-1C shows a Geophysical Survey Systems Inc. SIR-3000 with 400 MHz antenna mounted on a cart. Ground-penetrating radar uses radio waves to measures differences in relative dielectric properties of subsurface soils and features. An antennae housing containing a transmission antenna and a receiving antenna is placed in contact with the ground surface while being pulled or pushed along each transect. The transmission antenna emits 25,0000 to 50,000 pulses per second with transmission frequencies of 180 MHz to 900 MHz typically used for archaeological research. As the radio wave travels through the soil part of the wave will reflect upon contact with an interface between materials and part of the wave will continue deeper into the subsurface. The greater the relative dielectric permittivity between materials the greater the intensity of the reflected wave. The intensity and two-way travel time—the time for the wave to travel down to an interface and back to the receiving antenna—are recorded by the receiving antenna. The part of the wave that continued deeper into the subsurface will continue to send reflected waves back to the receiving antenna with each interface encountered. Data are typically recorded every few centimeters along the transect, every few centimeters or less vertically in the subsurface, and transects are spaced 50 centimeters or less. The maximum depth depends on the transmission power of the antenna, the antenna frequency, and the properties of the soils and buried features. A 500 MHz antenna will typically penetrate 1.5—3 m; although much shorter penetration depths can occur under certain site conditions (Conyers, 2013).

Magnetometry

Figure 1-1D shows a Geometrics G-858 dual cesium optically pumped magnetometer system mounted on a cart (foreground) and a Geoscan FM256 fluxgate gradiometer (background). Optically pumped and fluxgate magnetometers are the two common instruments used for archaeological surveys. Both measure the Earth's local magnetic field to 1 nanoTesla or less with the Earth's magnetic field varying from 30,000 to 60,000 nT. Subsurface features and the iron content of soils will have their own magnetic field or an induced field that interacts with the Earth's magnetic field. This creates small changes in the Earth's magnetic field near the ground surface. Optically pumped magnetometers measure that total magnetic field, whereas a fluxgate magnetometer measures only the component of the field inline with the sensor. Commercial fluxgate systems used in archaeology have two sensors within a single housing to create a gradiometer. These instruments measure the difference in the magnetic field between the two sensors, and reduce variations in the signal being recorded due to the motion of the sensors (Schmidt, 2013).

Magnetic Susceptability

Figure 1-1E shows a Bartington MS2 magnetic susceptibility meter with a surface scanning probe. Magnetic susceptibility is a measure of how easy it is to magnetize materials. The Bartington surface scanning probe uses electrical current in a loop of wire to generate a magnetic field. This magnetic field interacts with the soils in a fashion similar to a conductivity meter. The surface scanning probe then measures how easy it is to magnetize the first few centimeters of soil. Near surface changes to the soils can lead to variations in magnetic susceptibility. Metal detectors can use a range of methods for detecting ferrous and non-ferrous metals. The most common metal detectors use a method similar to a magnetic susceptibility meter where current is passed through a coil of wire resulting in a magnetic field. The magnetic field interacts with soils and buried objects in the first half meter beneath the surface. A second coil of wire records the changes in the magnetic field due to the buried objects. A metal detector alternates the current to create an alternating magnetic field, which generates an electrical current in buried ferrous and non-ferrous, electrically conductive objects. The major differences between magnetic susceptibility meters and metal detectors is depth, sensitivity, and the metal detector's ability to identify non-ferrous (not attracted to a magnetic) metals.

Time of Flight Laser Scanning (Lidar)

Figure 1-1F shows the Leica C-10 time of flight laser scanner. This type of scanner sends a laser pulse that reflects from a distant object, and the instrument records the time it takes for the pulse to travel to and return from the object. Because the speed of light in air is known this two-way travel time is converted into a distance between the instrument and the object. The instrument also records the horizontal and vertical orientation (angles) of the transmitter which when combined with the two-way travel time establishes an x, y, z location of the object with respect to the scanner. If the scanner is oriented on a survey grid in a fashion similar to orienting a total station, the x, y, z coordinates will be coordinates within the grid system. The scanner also records the intensity of the reflected light, and instruments equipped with a color camera can also record the color of the object. The Leica C-10 can send laser pulses 50,000 times per second, and spins the transmitter to obtain readings across surfaces to an accuracy of a few millimeters per reading.

Triangulation Laser Scanning

Figure 1-5 shows a NextEngine triangulation 3D laser scanner. A triangulation scanner uses a laser line or lines and a camera(s) to record the x, y, z locations of points being scanned. Instead of using time of flight the triangulation scanner uses the information about the triangle formed by the transmitter, camera, and object to calculate the x, y, z location of the object with respect to the scanner. The distance between the laser transmitter and the camera form the base of a triangle, and the field of view of the camera or the angle of the transmitter or both provides one angle needed to calculate the position. The NextEngine scanner only scans small objects located about half a meter from the scanner. Objects can be rotated on a platform allowing for multiple scans that create a 3-dimensional digital version of the object. The NextEngine scanner records a reading approximately every 0.1 millimeter making it effective at scanning artifacts and fine architectural details.

Case Study: Old Fort Johnson National Historic Landmark

Although not a medieval period site[1], the Old Fort Johnson National Historic Landmark site (figure 1-2) is an ideal case study of how archaeogeophysical survey contributes to visualizing an integrated landscape (Stull, Rogers, and Hurley, 2014; see also Watters and Wilkes 2014). The Old Fort Johnson National Historic Landmark in Fort Johnson, New York, United States of America is located approximately 30 miles northwest of Albany, New York. The fortified house was built in 1749 by William Johnson who was later given the title of 1st Baronet of New York and who served the British Superintendent of Indian Affairs in the Northeast. The house is a two story, central passage house (figure 1-3) with a working basement and attic. The rear of the house contains gun ports and no first floor windows or doors (a door was added later) with the rest of the house being contained within a wooden palisade.

Figure 1-2: Old Fort Johnson National Historic Landmark shown with the Leica C-10 3D laser scanner in the foreground.

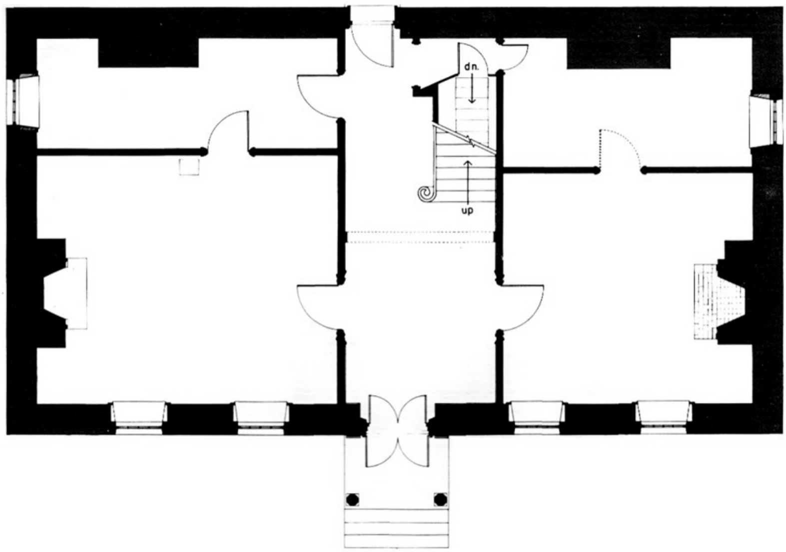

Figure 1-3: Example of a central passage house. First floor plan of Old Fort Johnson modified from figure 55 of the Fort Johnson Historic Structure Report (Mendel et al., 1977).

A drawing of Fort Johnson was done in 1759 by Sir William Johnson's nephew Guy Johnson (Figure 1-4). This drawing shows the palisade, buildings in front and to the side of the house, and additional outbuildings on the rest of the property; all of which no longer exist at the site. William Johnson was born in 1715 in County Meath, Ireland. In 1738 Johnson moved to the Mohawk River Valley in the province of New York to assist his uncle, Peter Warren, establish a settlement. Johnson fought with the British in the French and Indian war, with his wartime accomplishments earning him a baronetcy. Johnson's ability to work with the Mohawk nation and the rest of the Six Nations led to his appointment as northeastern British Superintendent of Indian Affairs in 1756. He served in this capacity until his death in 1774.

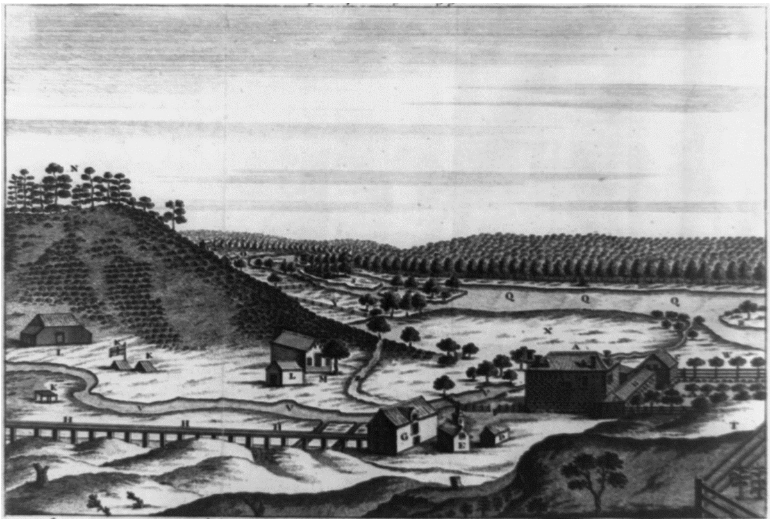

Figure 1-4: Drawing by Sir Guy Johnson of Old Fort Johnson from the rear (looking south), 1759.

Sir William Johnson built Old Fort Johnson in the midst of his rise in status among the colonial elite. The house fort was constructed with defensive elements, but also as an expression of Johnson's elite status. The site makes for a good case study because all of the archaeogeophysical methods used at the site have provided information about features of interest. Because archaeogeophysical instruments measure different properties of soils and buried features it is more common for only some instruments to provide useful information. The results from the archaeogeophysical surveys at Old Fort Johnson also highlight the complimentary nature of archaeogeophysical instruments with some features showing up in one data set, but not others.

Archaeogeophysics Survey and Processing Methods

Archaeogeophysical survey units were established at the site using a Leica TPS1100 total station. The property in Sir Johnson's time was much larger than the current size with many of the original outbuildings no longer in existence. The survey units were aligned on the house and placed within available space around the house. Plastic plumbing pipes cut into stakes were driven into the ground to mark the corners of each unit. Fiberglass (non-magnetic) survey tapes were stretched between the corners and monofilament line was run every meter in the north-south direction to provide a visual guide to aid the operator walking in a straight line. All survey instruments used a bidirectional survey method where data were collected going south to north along the first transect line and north to south along the second transect. The surveys used a Geometrics G-858 dual cesium optically-pumped magnetometer mounted on a cart, a Geoscan FM256 fluxgate magnetometer, a Geoscan RM-15 with multiplexer resistivity meter in twin parallel probe configuration, and a Geophysical Survey Systems Inc SIR-3000 GPR with a 400 MHz antenna mounted on a cart.

The inline sampling was 0.05 m with the cesium magnetometer, 0.625 m with the fluxgate magnetometer, 0.50 m with the resistivity meter, and 0.01 m with the GPR. The distance between transects was 0.25 m except for the GPR, which used 0.50 m. The GPR gathered data every 0.002 m in the vertical direction. During data acquisition the data are stored on the instruments' control unit and then downloaded to a laptop or laboratory computer post-acquisition. Data are then post-acquisition processed using the following steps:

1. Examine data for positional errors and correct those errors.
2. Remove any dropped readings.
3. Remove any large spikes caused by very near surface modern contamination (despiking).
4. Correct data for changes in walking speed along each transect (destaggering).
5. For GPR data: apply bandwidth filters, horizontal background removal, migration, and gain filters if needed.

6. Convert data from unevenly spaced data to evenly spaced data (gridding).
7. Adjust units to a common average so edges match (edge matching).
8. Plot using image plot, contour plot, dot density, or shaded relief plotting methods (image plots are commonly used).

A Leica C-10 3D laser scanner used the same grid system as the other instruments to record the outside and inside of the house. From each station outside of the house a context scan records points every 0.025 m x 0.025 m x 10 m to capture the trees, ground, neighboring houses, road, and other site features at a lower resolution setting to provide context for higher resolution scans of the house. The house was also scanned with points recorded every 0.010 m x 0.010 m or closer together. Photographs were taken at each scan station to facilitate the use of actual color. Each room inside the house was scanned from two locations with points recorded every 0.010 m x 0.010 m or closer together. Photographs were taken from every scan station within the house.

The basement and attic required a different sampling strategy due to the exposed structural elements. Scans in the attic were taken between low hanging rafters with scan stations positioned between every other rafter. A scan was also conducted from a platform on top of the rafters, and close to dormer windows. The basement used a similar method with scan stations positioned periodically along the length of the basement and near elements such as fireplaces and stairs. A scan was also conduct on the intermediate landing of each staircase. It took 1-2 minutes for each context scan, 4-9 minutes for each detailed scan, and 10 minutes per scan station for photographs. The laser scanning survey used 8 outside and 34 inside scan stations. A complete laser scan of an historic structure similar to Old Fort Johnson can be accomplished in approximately 6 days. Old Fort Johnson's central passage design simplified establishing interior scans due to line of sight access into each room from the central passage. More complicated floor plans will require additional survey time.

The research team also piloted the use of a higher resolution scanner designed to scan smaller objects such as artifacts. The NextEngine scanner has a resolution of 0.1 mm and is positioned approximately 0.50 m away from the object being scanned (see figure 1-5). Intricate details such as mantle pieces or carvings may not show up completely in the Leica C-10 scan, and the NextEngine scanner can fill in those details. Due to the NextEngine's narrow field of view the instrument was moved multiple times to scan a single mantel piece. This type of scanner can be used to