

## Chapter III

# The Discovery of Archaeological Materials by Survey

Once we have identified the goals of an archaeological survey and decided on the general type of survey most appropriate to those goals, we need to identify specific factors that may affect the survey strategy's effectiveness at intersecting, detecting and recognizing the archaeological materials we seek. Characteristics of those materials and of the environments in which they are found are among these factors. Others are post-depositional factors that affect patterns in the distribution of those materials, or are inherent in our methods or sensors and the way we deploy them.

Careful consideration of these factors can lead to advantageous survey designs, as well as furnish grounds for evaluating the surveys' effectiveness and accuracy.

### 1. FACTORS AFFECTING ARCHAEOLOGICAL DETECTION

In the 1970s, a rapid expansion of archaeological survey activity, in part fueled by the growth of Cultural Resource Management, led to detailed consideration of some of these factors and new terminology to describe them. Summary papers on archaeological survey design by Ammerman (1981), Cherry (1983), Schiffer et al. (1978) and Plog et al. (1978) helped to standardize this terminology. Subsequently, a number of authors investigated some of the factors affecting detection by particular methods, notably sub-surface testing (e.g., Kintigh, 1988; Krakker et al., 1983; Lynch, 1980; McManamon, 1980; Nance, 1983; Nance and Ball, 1986; Shott, 1985; Stone, 1981; Wobst, 1983). Here we will deal with these concepts as well as some others and their relationship to similar concepts found in geophysical remote sensing, search-and-rescue, and Operations Research (e.g., Kolesar, 1982; Koopman, 1980; McCammon, 1977; Stone, 1989).

Many of the factors that archaeologists have studied concern the probability that a particular survey will *intersect* archaeological materials. However, archaeologists have recognized for a long time that intersecting a site or any other item of interest does not by any means guarantee that it will be detected.

As geophysicists, mineral prospectors, and experts in search-and-rescue and naval operations have known for a long time, the factors that affect detection of a "target" can be classified as ones that depend on the properties of the target, ones depending on the

type of signal that communicates information about these properties, ones that depend on the medium of signal propagation, ones that depend on the kind of sensor or method of inspection, and, quite importantly, ones that affect our ability to recognize the signal and correctly identify it.

All of these collectively contribute to *detectability* (Shennan, 1997:390-93; Thompson and Ramsey, 1987; Thompson and Seber, 1994; 1996). Detectability involves the possibility of failing to notice the target even when it is included in an observation. For example, an archaeologist might intersect an archaeological site with an auger hole, but still not find anything in the sediment that the auger removed to indicate that the site is present, either because there is no artifact in the sediment or because the archaeologist did not notice or recognize it (Krakker, et al., 1983; Lovis, 1976; McManamon, 1980; Nance, 1979; Nance and Ball, 1986; Stafford, 1995; Shott, 1989).

## 1.1 Method of Inspection

One of the more obvious influences on the probability that a survey will detect particular kinds of archaeological materials is the method of inspection. Most archaeological surveys are based on visual inspection of the surface while walking across the landscape, but other methods, such as ones that use aerial reconnaissance or geophysical remote sensing, are better at detecting some kinds of materials in some situations.

More generally, method of inspection involves at least two interacting factors. One is the type of signal that communicates information about some material of interest, including the target. Another is the sensor with which we detect this signal and its sensitivity to variations in signal due to the contrast between a target and its environment. For example, the signal could be visible light and the sensor could be a person's eyes. In that case, successful detection depends on the ability of surveyors' eyes (and associated visual processing in the brain) to distinguish the subtle differences in patterns of light reflected from various surfaces.

Whatever method or methods a survey employs, it is important to evaluate the capabilities of sensors, and particularly their ability to deal with anticipated challenges to visibility and the way in which their ability to detect materials of interest decreases with distance (see sections 1.2 and 1.4). Both these factors affect the choice of method and the desired spacing of observations.

### 1.1.1 Visual Inspection in Surface Survey

Survey by visual inspection is what archaeologists normally mean by "archaeological survey." Older archaeological surveys typically entailed searching visually for archaeological remains on horseback or from a motor vehicle (so-called "windscreen surveys"). In some regions with dense bush, it has been common to survey streambanks or lakeshores by canoe or boat. Although such surveys continue, at least for preliminary reconnaissance, it is now much more common for visual inspection of the surface to be accomplished through pedestrian survey.

In pedestrian survey (Department of the Environment, 1980; Fasham et al., 1980), team members typically distribute themselves across space in such a way as to inspect some geographical unit systematically. That is, they are spaced approximately an equal distance apart, with each team member responsible for searching some subset of the target space. Most commonly this is done by dividing the space into long narrow transects, perhaps 3 m or 10 m apart, with each team member walking the length of one transect to search for traces of material culture on the surface before beginning another such transect. By walking back-and-forth across a field or quadrat in this way, the team hopes to detect all archaeological traces (usually potsherds or lithics) that happen to be visible on the surface. Sometimes they arrange to have fields plowed before the survey begins as this removes vegetation and churns up artifacts in the plow zone, thus improving archaeological visibility.

One variation on this type of survey involves walking meandering or zig-zag paths instead of straight transects (Mortensen, 1979; Rupp, n.d.), or walking each unit a second time in a different direction than the first. In search-and-rescue at sea, a second search pattern is optimally oriented 45° to the first (Koopman, 1980:218), a practice that might be useful in archaeological cases as well. The purpose of these variations is to improve the likelihood that survey of a given space will indeed detect all material culture traces on the surface (much as to optimize the search for a life raft). Small overlaps between adjacent meandering transects or intersecting straight ones add a small amount of redundancy, while changing the searchers' viewpoint relative to incident light and minimizing the chance of merely duplicating previous survey work. A second search pattern at 45°, meanwhile, also maximizes inspection of previously untraversed space (Koopman, 1980:219).

An important variation is necessary when it is likely that archaeological materials could be buried by colluvium or alluvium. In these cases, we have little reason to expect archaeological materials to be visible on the modern surface except where some process, such as gullying or modern construction activity, has cut down into buried deposits. Surveys that give special attention to eroded surfaces, gullies, animal burrows, ditches, road cuts, wells, and construction sites will be much more successful at detecting buried sites (typically including the oldest sites), than ones that only inspect the surfaces of fields. Not only the cut itself, but also any spoil heap of sediment removed from it, may exhibit artifacts.

### **1.1.2 Visual Inspection of Aerial Photographs with Groundchecks**

The use of aerial reconnaissance to detect archaeological sites was pioneered in the years following the First World War (chapter 1), but has growing potential in some parts of the world. In addition to aerial inspection in visible wavelengths of light, modern survey can employ infrared, ultraviolet and even radar, and satellites and space shuttles now supplement airplanes and balloons as observation platforms (Bewley and Rackowski, eds., 2001; Dabas et al., 1998; Dassié, 1978; Deuel, 1969).

Aerial reconnaissance in visible light works particularly well in either deserts or where large expanses of pasture and agricultural fields with shallow soils experience seasonal water stress. In deserts, the lack of dense vegetation, high perspective, and the shadows that result from even tiny topographical variations in raking light, found in early morning or late afternoon, make certain kinds of sites much easier to recognize than they would be to an observer standing on the ground (see p. 66, figure 7). Traces of roads and stone or brick walls, even if they are buried, often appear clearly as linear traces. Low mounds with phosphate-rich, artifact-rich or ashy sediments will often appear quite different in color than their surroundings. In agricultural fields and pastures in western Europe, variations in the color and height of vegetation can be even more important than the “microtopography” of the surface. When it has not rained for a few weeks, for example, vegetation growing above buried ditches and pits will be greener and higher than surrounding vegetation, while vegetation above buried stone walls, by contrast, will be stunted. The combination of color difference and shadows in raking light can make some kinds of sites, especially those where stone foundations have been built or large ditches dug into underlying chalk, quite obvious. Even details of architectural plan are sometimes quite obvious. These kinds of traces in vegetation are called “crop marks.”

Targets detected by aerial survey require confirmation by groundchecking. Simply put, it is necessary to visit anomalous features seen in the aerial photos to find out if they are archaeologically significant and, if so, what they are. Groundchecking is likely to include searching for artifacts on the surface, and therefore may employ some of the same techniques as pedestrian survey. The main difference is that surface inspection focusses on particular landscape features or their relationship to other features, rather than arbitrary spatial units.

### 1.1.3 Survey by Test Pits, Divoting, Coring, or Augering (SST)

Sometimes either the leaf-fall from forests, grass cover, or overlying soil and sediment make it impossible to detect archaeological remains on the modern surface (see *visibility*, section 1.2). Furthermore, the paleolandscape approach (Stafford, 1995) requires information on both buried and surface archaeological remains. In these cases, it is usually necessary to employ a more intrusive form of visual inspection, which involves either digging sets of test pits or using a coring tool or an auger to extract material from below the surface, and then examining the removed sediment for artifacts or other archaeological traces.

In the interest of clarity, it is necessary to define some terms, as much confusion has resulted from using terms for these methods interchangeably (Stein, 1991). Coring is the removal of a continuous and relatively undisturbed column or cylinder of sediment or rock with a tool that resembles a hollow tube and has a straight bit. Augering, by contrast, uses a tool with a screw or helical bit that digs out sediment and pushes it into a cylindrical bucket for removal in relatively small increments, and thus disturbs the integrity of the sediment. Most archaeologists use the terms, “sub-surface testing” (SST), “test-pitting,” and “*sondages*” to describe manual excavation of relatively small (e.g., <

1 m x 1 m) areas to reveal buried deposits. Divoting is a variety of sub-surface testing that involves cutting a small, shallow square of sod or forest leaf-mat with a spade and turning it over to look for artifacts (Lovis, 1976). Manual execution of any of these can be hard work, especially where sediments are compacted or very stony, and in many contexts mechanical versions are an excellent investment. Stein (1991:142) notes that many CRM companies now routinely use truck-mounted hydraulic corers or augers to extract long cores or large-diameter auger samples in large numbers. In some parts of the United States and Canada, similarly, CRM archaeologists use series of trenches excavated by backhoes or peel off large areas of plow zone or sod with mechanical graders. In the former cases, crew members then check the walls of the trenches for stratification and signs of features, such as house-pits, while in the latter they look for the tops of pits, signs of post-molds, and artifacts on the newly exposed surface. Even firebreak plows have seen service in archaeological survey (Bloemaker and Oakley, 1999).

Where we use test pits, divots, cores or auger holes to prospect for or sample archaeological remains, the density and size of the probes is a major factor in the probability of site detection (Krakker, et al., 1983; Lovis, 1976; McManamon, 1980; Nance, 1979; Nance and Ball, 1986; Stafford, 1995; Shott, 1989). Clearly, a large number of closely-spaced auger holes is more likely to hit sites than a smaller number of widely spaced ones. This is a problem of *resolution*, which exploration geologists have investigated in detail and to which we will return in section 1.7. Also, a 2 m x 1 m trench is more likely to intersect a site than is an auger hole with a diameter of 15 cm. What is less obvious is that we have to consider the probability of actually recognizing a site if we hit it, a problem of “detectability.” Unless the artifacts or other “site constituents” on a site are very dense or nearly continuous, it is fairly likely that most cores or auger holes, even if they pierce the site’s deposits, will not detect artifacts or other materials associated with cultural activities. Artifact density and clustering are aspects of the site’s *obtrusiveness*. We will return to some of these issues below and in chapter 5.

Artifacts are not the only kinds of traces that can help us detect archaeological deposits in test pits or auger holes. In some cases, and especially in test pits of reasonable size (i.e., at least 1 m<sup>2</sup>), there may be stratification visible in the pit’s section that appears to be cultural. For example, there could be a thin, dark or ashy layer that has a high probability of being a living floor or “anthropic soil horizon” (Valentine, et al., 1980). One kind of trace that has been useful in some contexts is chemical content (Bakkevig, 1980; Cavanagh, et al., 1988; Cook and Heizer, 1965; Eidt, 1973; 1977; Heidenreich and Konrad, 1973; Heidenreich and Navratil, 1973; Proudfoot, 1976; Provan, 1971; Sjoberg, 1976; Woods, 1977). For example, because much of the rubbish that people discard on and around settlements, and particularly bone, is high in phosphate, their decay can elevate the phosphate level of the sediment substantially. However, anthropic soils and chemical anomalies may not be as ubiquitous as artifacts in sites, while chemical anomalies can also result from variations in bedrock (McManamon, 1984; see “chemical survey,” section 1.1.4.7).



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