# THE INTERPRETATION OF NEGATIVE EVIDENCE IN ARCHAEOLOGY

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One of the important changes in the archaeological paradigm that occurred in the 1960s was the expansion of the scope of the problems addressed by researchers. This expansion was sparked largely by Lewis Binford (1968:22), who maintained that "data relevant to most, if not all, the components of past sociocultural systems are preserved in the archaeological record." Binford argued that we are limited not so much by the nature of the archaeological record as by our lack of principles for relating archaeological remains to past human behavior (1968:23). Just as artifacts tend to reflect more than one component of a cultural system, each component of a cultural system should be reflected in various material remains. This meant that gaps in the archaeological record could be circumvented. Where decay had claimed important information, models could be devised that turned to other, nonperishable, remains (Binford 1968:19, 1975:256).

Binford's point is that interpretation can be made in spite of gaps in the data. This idea is important, but it raises a point that is rarely addressed: some interpretations must be made because of gaps in the data. For many questions, absences of certain phenomena in the archaeological record may be pivotal lines of evidence. This paper is concerned with the logic of interpreting such absences, which are termed "negative evidence."

Strong arguments from negative evidence are not common in the literature of archaeology. This may be partly due to the common experience of that last excavation unit dug, field surveyed, or specimen examined providing a "first case." So with negative evidence there is often nagging uncertainty: whole arguments can be toppled by a single observation.

In 1968, Stuart Struever wrote that Hopewell settlements in the Lower Illinois Valley were confined to the main river trench, a fact with certain implications for trade and subsistence. Examining his negative evidence, one would have found that no surveys had been conducted outside of the main river trench. Struever, at least, encouraged one of his students to survey a tributary valley -- in which numerous Hopewell sites were located (Farnsworth 1973).

Other scholars have erred in other ways in dealing with negative evidence; many have simply declined to interpret absences they may have observed. The epistemology of negative evidence may therefore be a fruitful topic to take up. While the main concern here is with survey data, many of the remarks should be relevant to other aspects of archaeological research.

## Definition of Negative Evidence

Negative evidence is a form of data. "Data" are taken to be observations made of archaeological phenomena, as opposed to the phenomena themselves (Sullivan 1978:189, among others). "Negative evidence" refers to the failure to observe a given pheomenon (or, lacunae in data sets).

In conducting most forms of investigation, the amount of negative evidence collected is infinite; obviously, the list of observations not made during a survey, excavation or analysis is as long as one has time and inclination to make it.

## Epistemology of Negative Evidence

In general, three situations can lead to lacunae in archaeological data: 1) Condition I - the unobserved archaeological phenomenon never did occur; 2) Condition II - the unobserved archaeological phenomenon did occur, but has since been rendered undetectable; and 3) Condition III - the unobserved archaeological phenomenon did and does occur, but the data collection program was not competent to observe it.

Some phenomena may not fall neatly into one of these categories. Are sites beneath twenty meters of overburden "undetectable?" Certainly not, but no archaeologist has the time or money to conduct surveys at that depth. (As this example shows, the fact that a data recovery program is "not competent" to make certain observations does not necessarily imply incompetence on anyone's part.) Is blood spilt during animal butchering "undetectable?" Here we would face more than practical limitations. Yet in some futuristic scenarios even this sort of evidence may be within reach. As archaeological and other sciences progress, different types of evidence will continue to slip out of the "undetectable" category (It is partly for this reason that some archaeologists store "contingency samples" of soil from excavations.)

It is only when Condition I exists that negative evidence accurately informs on the absence of past sociocultural phenomena. And the strength of arguments from negative evidence is determined by the certainty with which Conditions II and III can be shown not to exist. But while it is frequently impossible to independently rule out Conditions II and III, it is possible in many cases to shortcut the process by comparison to analogous data sets in which the same type of evidence wasn't negative. This may allow the case to be made that, although Condition II cannot be ruled out (because a detailed history of the archaeological matrix is not available), nor can Condition III (because the capabilities of the data recovery program are not fully understood), there are other reasons for believing that if the evidence had ever existed, it would have still been detectable, and detected.

In 1973, Brian Reeves argued that the lack of sites dating to the Altithermal period on the Great Plains did not represent a cultural hiatus, but instead resulted from destruction of floodplain surfaces from that period and from insufficient archaeological investigation of the area. His point was that Condition I (no sites) could not be assumed, since Condition II (eroded sites) and Condition III (unfound sites) were still likely contenders. James Knox (1978) later argued against Condition II by comparison to analogous data, pointing out that drainage systems at the margins of the Plains, where the hiatus does not exist, were subject to the same erosional processes. The key to such comparisons, of course, is in finding analogous data sets that are in fact analogous in all important respects.

## Interpreting Condition I

Once Condition I has been established, the significance of the negative evidence may be far from obvious. It is perhaps an insufficiently appreciated fact that the interpretation of absences involves all of the complications of interpreting "finds." Michael Schiffer has stressed (1972, 1976; Schiffer and Rathje 1973) that the study and application of principles concerning how objects become incorporated into the archaeological record are sorely needed. Such principles are termed "c-transforms," and are directly relevant to negative evidence: "Only c-transforms can be used to predict the materials that will or <u>will not</u> be deposited by a system"(Schiffer 1976:15, emphasis added).

In interpreting negative evidence, it cannot be assumed that the absence of certain remains reveals the absence of a certain behavior until it has been asked how that behavior may have been present yet <u>not</u> left the normally expected remains. In the Lower Illinois Valley, extensive excavations in Middle Woodland burial mounds have revealed no indications of violent death, but arrowpoints have been observed embedded in numerous Late Woodland skeletons (Perino 1973a, 1973b). Can it be inferred that intergroup violence was absent during Middle Woodland times? Not necessarily; arrowpoints, which are likely to become lodged in bone, were not introduced into the area until the Late Woodland Period (Buikstra 1977:80). Intergroup violence involving weapons that do not leave such obvious evidence remains a possibility; the negative evidence is not conclusive because the analogous Late Woodland data may not be analogous with respect to c-transforms.

An example of a strong case from negative evidence comes from Richard MacNeish's research in the Tehuacan Valley in Mexico. The Tehuacan project attained an unusually high level of thoroughness in data collection, including a nearly 100% surface survey and extensive excavations in stratified dry caves (MacNeish 1967). Optimal conditions for preservation occurred in these caves, as evidenced by the recovery of over 100,000 dessicated plant remains (MacNeish 1967:17).

A major debate over the origins of domesticated maize has focused on the Tehuacan data, with one side holding that maize is a culturally-produced progeny of the teosinte plant (Beadle 1977). The presence or absence of teosinte in the archaeological record of the Tehuacan Valley therefore becomes quite significant.

The Tehuacan data set allows for the elimination, with unusual certainty, of the possibility of Conditions II or III obtaining. The enormity of the collection and the specific interest in the recovery of small plant remains (MacNeish 1967:6) effectively counters the possibility that the recovery program was not competent to recover teosinte; the extreme dryness and protection provided by the cave settings argues strongly against such plant remains having been rendered undetectable. The recovery of a substantial assemblage of maize strengthens the case by analogy. It can therefore be assumed that the failure to observe or recover teosinte remains resulted from a Condition I.

As noted above, the missing archaeological phenomenon must be related to the past by c-transforms. The missing archaeological phenomenon here is teosinte remains and the past sociocultural phenomenon in question is the use of that plant as a food (Beadle 1977:621-622). It can be argued that teosinte kernels cannot practicably be eaten in unprocessed form, and that it would be unfeasible to process the kernels in the field where it was collected. One could therefore assume a high probability of at least some teosinte kernels having been deposited on living floors if it had been used as a food source. Again, the early Tehuacan maize remains strengthen this case by analogy. The lacuna in the data therefore provide a good indication of the important absence of a past sociocultural phenomenon.

## Assessing Condition II

It is obvious that evidence of a prehistoric culture can be rendered undetectable by a multitude of processes -- including the activities of the same or later cultures. In fact, the effects of one culture on the archaeological record of an earlier culture poses interesting questions in itself. Howard Winters has suggested (personal communication) that Mississippian farmsteads may have been purposefully placed on the deep, fertile middens left by earlier Middle Woodland villages. What materials would Mississippian farmers have removed from these sites? In a slightly different vein, why would the Hohokam have found it necessary to remove a trash mound dating to an earlier phase, only to construct another mound a few meters away (Haury 1976:83-84)? Interesting (and very immediate) problems are also posed by the relationships between the modern and prehistoric archaeological records (Staski 1980).

The main issues to be discussed here involve two general methods of dealing with the destruction of archaeological evidence. The first of these is the reconstruction of the geomorphologic history of the matrix in which evidence is being sought, particularly with respect to erosion and deposition. Numerous instances of such studies having had implications for negative evidence may be found. An example would be Karl Butzer's (1977:22-23) reconstruction of the ancient hydrology of the Lower Illinois Valley, which suggested that many pre-3000 B.C. sites in the area may have been destroyed by a rapidly shifting river channel. Similarly, Antev's (1952:376-377) study of arroyo-cutting in the Southwest establishes the possibility of archaeological evidence in arroyos having been eroded by processes set off by overgrazing in the 1870s. Lastly, James Knox's research (1977) in the Platte watershed in Wisconsin has indicated that the effects of the modern agricultural regime have included a marked increase in the rate of soil deposition, resulting in the burial of archaeological sites in certain locations.

Secondly, the study and application of principles of decay and disruption in the archaeological record can help to identify instances where negative evidence may have been produced by Condition II. Interest is now high in the study of such processes in ethnoarchaeological "laboratories." Archaeologists are perforce becoming increasingly ambitious in studying processes of disruption, tackling such problems as the downslope movement of materials (Rick 1976), plow mixing (Roper 1976), and the effects of animal behavior (Wood and Johnson 1978).

But there would seem to be abiding epistemological limitations in the endeavor to demonstrate that Condition II has not occurred. It is generally much easier to study processes of disruption under controlled circumstances than to apply the findings to specific archaeological cases. And more importantly, it is easier to determine that erosion, burial, faunal turbation, decay, etc., may have occurred than to show that none of these processes did occur. The use of analogous evidence may provide an out, but caution must be exercised. If one site can be observed on a given surface, it might be argued that sites from the same or later periods should likewise be observable on that same surface. But there is much room for error. For instance, this argument would not necessarily hold for younger surfaces in the same profile, as cycles of deposition and erosion could have occurred since the formation of the observed site. And, again, the argument from analogy only works for sites that are truly analogous in all relevant respects. For instance, the present detectability of remains from a long occupation, which may have been partly washed away, does not preclude the past existence of sparse remains from a short occupation, which would have been more vulnerable to total erosion.

## Assessing Condition III

Condition III may be related to such diverse factors as the inability to recognize the age of certain artifacts (note the history of research in the Valley of Oaxaca) to the outright failure to survey an area (as mentioned above). Personnel-related factors range from expertise to stamina to level of dedication to ability of visual discrimination.(In dealing with the last, at least one archaeologist has gone so far as to salt fields with variously colored and sized markers prior to survey to estimate the capabilities of the surveyors; it was my observation that surveyors tend to look harder when they know their collections will be scanned for these markers later.) The primary interest here, however, pertains to the formal capabilities of a program of survey.

The recent upsurge in interest in sampling has produced a considerable literature on the subject. This literature is primarily concerned with the problem of recovering representative data sets (for example, Binford 1964; Redman 1974; Mueller 1975). In the present discussion of negative evidence, the question of relative proportion becomes a side issue, as we are concerned with the logic of interpreting the absence of a single class of data.

No data recovery program is competent to observe all forms of archaeological manifestation. Every program therefore allows for various lacunae in the data to be accounted for by Condition III. Obviously, in order to eliminate the possibility of a Condition III, it must be demonstrated, with a degree of certainty deemed appropriate, that the program was competent to recover the class of data under consideration.

This particular topic is rarely addressed in the literature on sampling, due to the emphasis on representativeness in data sets. The counterpart of a representative distribution is a biased distribution, which is a separate concern from the presence or absence of a particular type of data. The question central to this issue is not, "What are the chances of recovering proportionate quantities of the various classes of evidence," but, "With a given data recovery program, what are the chances of observing a phenomenon with a given set of characteristics?"

In many areas, archaeological surveys must confront the problem of buried sites, which are normally sought by subsurface sampling (e.g., shovel probes). Although subsurface sampling is commonplace in many areas, geomorphological models predicting past deposition rates and dependable archaeological models predicting site locations are rarely available. Therefore, subsurface sampling strategies are frequently standardized over geomorphologically and archaeologically heterogeneous areas (e.g., Penman and Stone 1980).

Furthermore, the probability of observing various classes of archaeological phenomena with various subsurface sampling procedures has not yet been calculated. This means that after a field has been sampled, with negative results, the archaeologist is unable to answer the question, "What kinds of archaeological phenomena have I ruled out, and with what degree of certainty?"

A few preliminary steps have been taken towards calculating such probabilities. Frank Hole (1979) has used a statistical model to estimate probabilities of encountering subsurface sites, given the density of sites per square mile and the number of cores made, but his model does not consider the probability of recovering artifacts if a core does hit a site. Scott <u>et al</u>. (1978) used a computer simulation to calculate relative site-finding efficiencies of postholing and surface examination in various ground cover situations. South and Widmer (1977) present an interesting empirical case for the efficiency of postholing in recovering various classes of materials. However, the remainder of the literature on subsurface sampling deals largely with logistical considerations (Schoenwetter <u>et al</u>. 1973:25-26, 86-88; Percy 1976; Casjens <u>et al</u>. 1978:90-93).

In many cases it should be possible to estimate the chances that a certain kind of archaeological remains could have been missed; I have suggested elsewhere (Stone 1981) that the Poisson statistic may be useful here. The Poisson predicts the probability of a given number of events occurring, given relevant parameters of the population. By manipulating the formula so that the number of events being predicted is zero, one can begin to estimate the chances that, for instance, a certain kind of site has been missed in a survey. The probability of zero "events" (that is, the chances of finding zero artifacts in a sample from a site) is given by $e^{-\lambda}$, where e is a constant equal to 2.7183 and $\lambda$ is equal to the expected number of artifacts in the sample area. Lambda is obtained by dividing the sample area (number of probes expected to fall on the site x probe size) by the artifact density (square area containing an average of one artifact).[1]

Let us say that a survey has been conducted in an area of a floodplain where recent deposition has made it necessary to use shovel probes, and that no small sites were detected by this method. But an archaeologist has hypothesized that there should be small special-purpose camps on the floodplain, and wonders if the subsurface survey might have missed such sites. In other words, he wishes to evaluate the negative evidence from the survey. Based on data from excavation of similar sites, or perhaps on ethnoarchaeological findings, the archaeologist estimates that these sites would be roughly circular, on the order of 30 meters in diameter, and would contain an average artifact density of two per square meter. What are the odds that at least one artifact would have been found?[2]

Let us say that the surveyors had placed shovel probes with a square area of .07 m. (a diameter of roughly 30 cm) systematically at 15 m. intervals. The probabilities of two, three, and four probes landing within the site limits would be .27, .46, and .27 respectively.[3] The probabilities of finding zero artifacts in each of these three outcomes are given in Table 1. We can now calculate the probability that a special-purpose camp would have been missed in the survey. We know that such a site would have been hit by two, three or four probes. If it had been hit by two probes (.27 probability) there would have been a .76 probability of recovering no artifacts, so the probability of the site being missed by two probes is (.27)(.76)=.21. Following this procedure, the probability of missing the site with three probes is .30, and with four probes is .15. The sum of these probabilities is .66. The archaeologist might therefore conclude that his hypothesis has not been disproved by the negative evidence, since there is a .66 probability that a small special-purpose camp would have been missed by the survey.

But it is clear that a site with different characteristics -- for instance, with a higher artifact density -- would have stood a better chance of detection. If a site had an artifact density of ten per square meter, there would only have been a .15 probability of its having been missed (see Table 2).

Admittedly, this methodology is somewhat cumbersome, and does not work well outside of the context of evaluating negative evidence. But it is my conviction that future researchers will be obliged to ask such questions of the data base now being collected. It also seems inevitable that our impoverished collection of data on sites of low detectability will prove to be a major obstacle to satisfactory reconstructions of prehistoric behavior. This may be particularly true of our data on small sites. Despite highly persuasive arguments in the literature for the invaluable information potential of the small site (Kroeber 1963:70; Moseley and Mackey 1972:76; Binford 1980:9-19), extant data on such manifestations are certainly, at best, inconsistent.

Table 1. Probability of Missing a Site of Diameter=30 m. and Density=$2/m^2$ with 2, 3, and 4 Probes (Probe area=$.07m^2$)

| NUMBER OF PROBES HITTING THE SITE | SAMPLE AREA | $\lambda$ | PROBABILITY OF ZERO EVENTS ($e^{-\lambda}$) |
|---|---|---|---|
| 2 | .14 $m^2$ | .28 | .76 |
| 3 | .21 | .42 | .66 |
| 4 | .28 | .56 | .57 |

Table 2. Probability of Missing a Site of Diameter=30 m, and Density=10/$m^2$ with 2, 3, and 4 Probes (Probe Area=.07$m^2$)

| NUMBER OF PROBES HITTING SITE | PROBABILITY | $\lambda$ | PROBABILITY OF ZERO EVENTS ($e^{-\lambda}$) | PROBABILITY OF PROBE NUMBER x PROBABILITY OF ZERO EVENTS |
|---|---|---|---|---|
| 2 | .27 | 1.4 | .25 | .07 |
| 3 | .46 | 2.1 | .12 | .06 |
| 4 | .27 | 2.8 | .06 | .02 |

TOTAL (Probability of missing site) = .07 + .06 + .02 = .15

Footnotes

1 The vertical dimension is not a variable in this model. The site is treated as a two-dimensional surface that is within reach of the probe.

Use of the Poisson requires the assumption that artifacts are randomly distributed. While this assumption is artificial, it is a useful starting point. Further work is needed to determine the conditions under which probabilities computed with the assumption of randomness are valid.

2 Obviously, one artifact does not a special-purpose camp make. It is assumed that upon finding one or more artifacts, investigation would be intensified in the immediate area.

3 The probabilities were determined empirically, using a scale model.

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