

# **SUMMARY AND CONCLUSIONS: PROYECTO PREHISTORICO ARENAL**

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Anthropology

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## **RESUMEN**

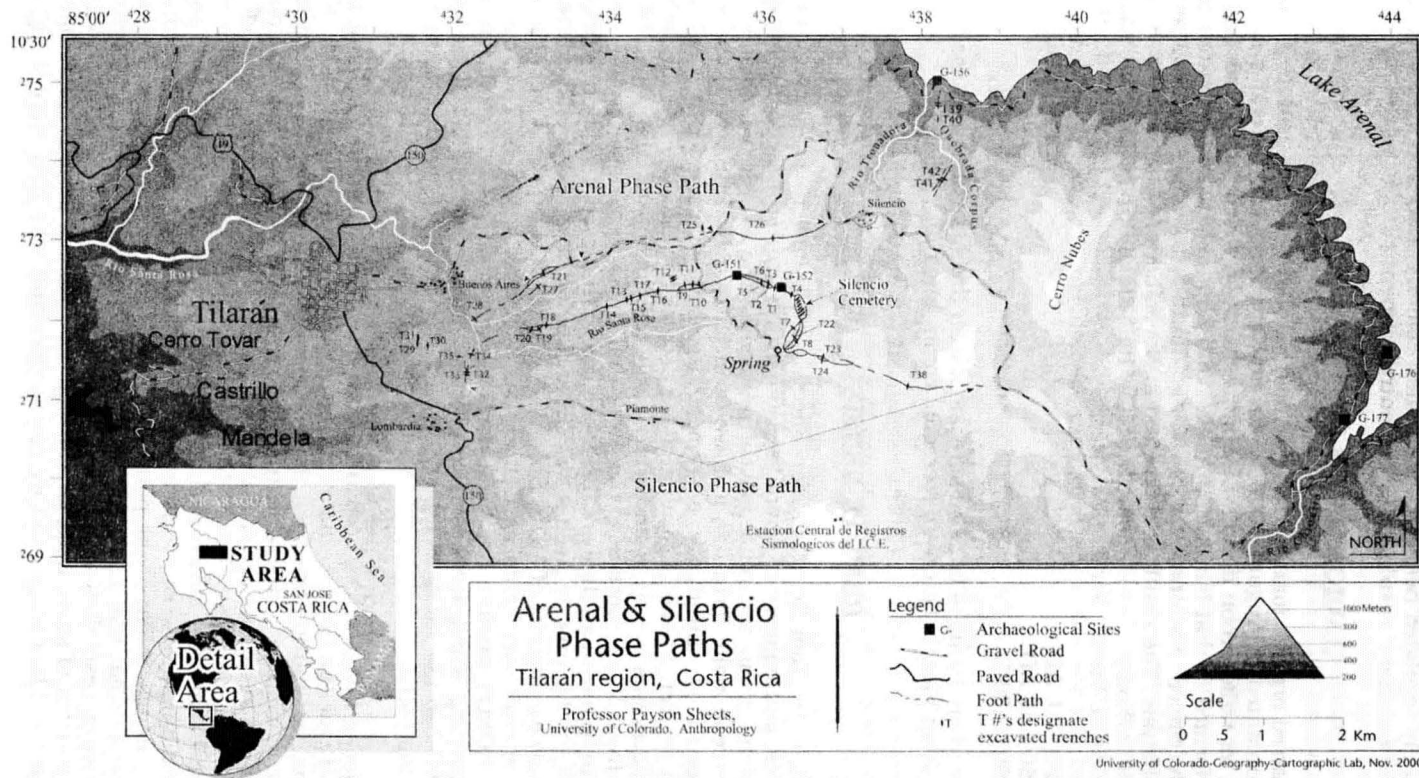
*El Proyecto Prehistórico Arenal llevó a cabo investigaciones multidisciplinarias en el área de Tilarán-Arenal, Guanacaste, Costa Rica, durante las décadas de 1980, 1990 y recientemente en el 2002 y 2003. La mayor parte de los trabajos de prospección y excavación se realizaron durante los años 80, con imágenes de sensores remotos provistas por la NASA gracias a la gestión del Dr. Tom Sever. El Proyecto Prehistórico Arenal ha tenido la fortuna de contar con la colaboración de calificados científicos en diferentes disciplinas, quienes ayudaron a responder preguntas de la arqueología del noroeste de Costa Rica. Excelentes estudios geológicos, de campo y laboratorio, han permitido localizar la fuente de la mayoría de la piedra usada en la construcción del cementerio del sitio Silencio. La investigación vulcanológica ha documentado varias erupciones explosivas de los volcanes Arenal y Chato, acaecidas en los últimos miles de años. Mediante las prospecciones y excavaciones arqueológicas se han identificado cambios en las sociedades humanas, desde los grupos cazadores y recolectores del periodo Paleoindio hasta la llegada de los españoles. Las imágenes de percepción remota fueron provistas inicialmente por el Instituto Geográfico Nacional de Costa Rica, en la modalidad de fotografía aérea convencional en blanco y negro, y luego por la NASA en formato analógico (óptico) y digital, desde avión y satélite. El satélite IKONOS brindó imágenes remotas de alta resolución, a su paso sobre el área de investigación, siempre y cuando la cobertura nubosa fuera menor al 5%. Bajo esas condiciones fue posible obtener y almacenar gigabytes de datos. En las imágenes de IKONOS pudimos fácilmente ver senderos de las fases Arenal y Silencio que ya habían sido confirmados sobre el terreno. Habíamos utilizado el análisis de imágenes para la detección de anomalías lineales, algunas de las cuales han resultado ser segmentos de esos senderos, especialmente en el lado occidental (Pacífico) de la divisoria continental. El sondeo remoto condujo al descubrimiento de anomalías lineales que han sido confirmadas como antiguos senderos de las fases Arenal y Silencio. El seguimiento de los senderos nos ha permitido conectar cementerios con sus sitios de habitación y con los manantiales y las fuentes geológicas de la materia prima empleada en la construcción de tumbas.*

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## ABSTRACT

*The Proyecto Prehistorico Arenal conducted multidisciplinary research in the Tilaran-Arenal area of Guanacaste, Costa Rica, during the 1980s, 1990s, and as recently as 2002-2003. The majority of survey and excavations were done in the 1980s, with extensive remote sensing imagery provided by NASA aircraft, arranged by Dr. Tom Sever. The Arenal Prehistory Project has been very fortunate to have the assistance of some of the top scientists in different disciplines, assisting in resolving archaeological problems in the research area of northwestern Costa Rica. Excellent geological research, in the field and in the laboratory, has found the source of the majority of the stone used in construction of tombs at the Silencio cemetery. Volcanological research has documented numerous eruptions of Chato and Arenal volcanos during the past few thousand years. Archaeological survey and excavations have traced the changes in human societies from the earliest hunting and gathering peoples in PaleoIndian times up to the coming of the Spanish. Remote sensing imagery was provided initially by the Instituto Geografico Nacional de Costa Rica in the form of conventional black-and-white aerial photography, and then by NASA in analog (optical) and digital formats, from aircraft and satellite. The IKONOS satellite provided high resolution remote sensing imagery, as it examined the research area every time it flew over it, looking for less than 5% cloud cover, and when it found those conditions, gigabytes of data were obtained and downloaded. In the IKONOS imagery we can easily see the already confirmed footpaths of the Arenal and Silencio phases. And we have used the imagery to detect other linear anomalies, some of which have turned out to be segments of those paths, especially on the western (Pacific) side of the divide. The remote sensing led to the discovery of the linear anomalies that have been confirmed as ancient footpaths during Arenal and Silencio phases. Following the paths has allowed us to connect cemeteries with villages and with the springs and the sources of stone needed in the cemeteries.*

The Proyecto Prehistorico Arenal conducted multidisciplinary research in the Tilaran-Arenal area of Guanacaste, Costa Rica, during the 1980s, 1990s, and as recently as 2002-2003. The majority of survey and excavations were done in the 1980s, with extensive remote sensing imagery provided by NASA aircraft, arranged by Dr. Tom Sever. One field season occurred in the 1990s; during that decade the project research largely consisted of examining and processing the imagery, especially the digital imagery. Remote sensing technology improved dramatically over these decades, and by the early 21st century satellites finally were obtaining sufficiently detailed imagery to satisfy our archaeological needs. This removed a major obstacle for our research, as the NASA aircraft with some 30 technicians aboard routinely had to wait at the airport near San Jose for cloud-free conditions. Because those waits extended for days and weeks, we were delaying many other NASA remote sensing missions. We were not popular. The IKONOS satellite provided anxiety-free remote sensing imagery, as it examined the research area every time it flew over it, looking for less than 5% cloud cover, and when it found those conditions, gigabytes of data were obtained and downloaded. In the IKONOS imagery we can easily see the already confirmed footpaths of the Arenal and Silencio phases (Fig. 1). And we have used the imagery to detect other linear anomalies, some of which have turned out to be segments of those paths, especially on the western (Pacific) side of the divide. We are reconstructing the movement of people



**Fig. 1** Map of the Arenal phase path from lake shore village, up over the divide, and down into the Pacific drainage to the Castrillo and Mandela cemeteries. The Silencio phase path is also mapped, running from the cemetery south to the spring, and beyond to the east. It also runs west to the Tovar source of laja used for construction of tombs.

across the landscape. It is becoming clear that during the Arenal and Silencio phases, movement was ritually regulated between village and cemetery, and from cemetery to resource used in the cemetery, resulting in path entrenchment.

### **RADIOCARBON DATING**

A sample of charred organic matter from the inside of a sherd from the Poma site (G-725 Pm) was submitted in August 2003 to the Stafford Research Laboratories in Boulder, Colorado, for radiocarbon dating. Sample preparation by standard acid/base treatment was performed in that lab during August and September, and then sent to the Lawrence Livermore National Laboratory's Center for Accelerator Mass Spectrometry for analysis. The result was received in November of 2003. The  $^{14}\text{C}$  age is 1505 +/- 35 Radiocarbon years old, using the Libby half-life of 5568 years. The calibrated ages, from OxCAL Viewer Version 3.5 are:

- 1 sigma: 535-620 CAL AD.
- 2 sigma: 430-650 CAL AD.
- 3 sigma: 420-660 CAL AD.

Thus, the radiocarbon dating is in close agreement with the age estimates based on ceramic dating by Juan Vicente Guerrero (personal communication, 2003).

### **REMOTE SENSING**

The second article, by Tom Sever, Payson Sheets, and Daniel Irwin, surveys the methods, techniques, and imagery of remote sensing in the project area, and some of the results of applying them to archaeological problems. The Proyecto Prehistorico Arenal has been exceptionally fortunate to have been chosen by NASA and NSF to receive an unprecedented abundance of remotely sensed imagery for a Central American research project. At the beginning of the project two decades ago the only remote sensing imagery was the black-and-white airphotos purchased at the Instituto Geografico in San Jose. It is important to point out that these were useful in the past and they continue to be useful as they are the only imagery that record landforms prior to the expansion of the Laguna de Arenal by ICE, and before the massive landslides triggered by the huge earthquake of 1973. Since 1984 NASA has provided digital and analog data from aircraft overflights as well as imagery from satellites. The recent imagery from the IKONOS satellite has been particularly useful, as its resolution is fully capable of detecting small archaeological features that were invisible in earlier satellite imagery. We can use IKONOS imagery to discover linear anomalies, many of which are ancient footpaths.

The remote sensing imagery has been useful in many ways, such as helping to delimit bioecological zones and find Arenal phase cemeteries. Certainly the most important remote sensing contribution has been the detection of linear anomalies, many of which have been confirmed as ancient footpaths. Archaeologists have detected constructed linear features in various areas of the world such as Roman roads, Inca highways, and Chaco roads, but never before in archaeology have mere footpaths been detected in a tropical rainforest environment. These paths were not constructed, but formed by sustained human use of precisely the same path for generations, resulting in erosion and deep emplacement of the path where slope was sufficient. Prior to this research none of us thought that it would be possible to discover ancient footpaths. With the footpaths we can establish a contemporaneity of cemeteries with villages, with springs, and with sources of stone used for construction. We can map the movement of people in their ancient landscape, and we can understand why they were using a

particular path by determining the activities at its endpoints. For instance, there was considerable foot traffic between the Silencio cemetery and the spring to its south, and that diminished to about a third of that foot traffic on the path leading farther to the east of the spring. We interpret that as indicating that people spent a lot of time in the cemetery and need a considerable amount of water for drinking and cooking. Other lines of evidence (smoke-blackened cooking pots, thermally fractured cooking stones) also indicate a lot of cooking there.

Had the Proyecto Prehistorico Arenal to rely only on the black-and-white air photos for remote sensing, the project would have been of short duration, and it would have done some excavations and survey in the area, and established an artifactual and architectural chronology for the area. I doubt we ever would have discovered the ancient footpaths in the black-and-white air photos, although we could see their traces once they were discovered in the color infrared imagery and confirmed with excavations. Remote sensing enriched the project in ways that are still being exploited and explored.

### **THE GLOBAL POSITIONING SYSTEM AND THE GEOGRAPHIC INFORMATION SYSTEM**

Michelle Butler reports on how the Proyecto Prehistorico Arenal has been using the Global Positioning System (GPS) satellites and a hand-held GPS receiver to more accurately record the location, in three dimensions, of footpaths, sites, and other features of importance in ancient times. The accuracy has been greatly improved using GPS technology. As she explains, the system is complex, and an understanding of how it operates, and the nature of errors and how to correct them, are essential to improve accuracy. Daily calibration using the closest base station is also essential. Specious (false) accuracy would result from the uninformed use of a handheld receiver.

Butler also describes how GPS locational data can be integrated with remote sensing imagery and with confirmed footpaths, villages, cemeteries, and exploited spot resources such as building stone and springs. The ideal tool for such integration is a Geographic Information System (GIS), which is being constructed by Michelle Butler and Errin Weller for the project. The variety and richness of remotely sensed imagery, both digital and analog, in the Arenal-Tilaran area is unusual for an archaeological project, and a GIS to integrate and make useable all these data are essential for current and future research.

### **SURVEY AND EXCAVATIONS IN THE FINCAS OF CASTRILLO AND MANDELA**

Devin White describes the various pedestrian surveys and the excavations on the two adjacent fincas of Castrillo and Mandela, conducted in 2002 and 2003. We were led to this area by following the Arenal phase path westward from the village on the shore of the Laguna de Arenal, over the divide, and down into the Pacific drainage past Tilaran. What we encountered on these two fincas was extraordinary: a cluster of at least a dozen Arenal phase cemeteries, and with full survey what probably would total about two dozen cemeteries. Two petroglyph loci were also found. This clearly was a very special area.

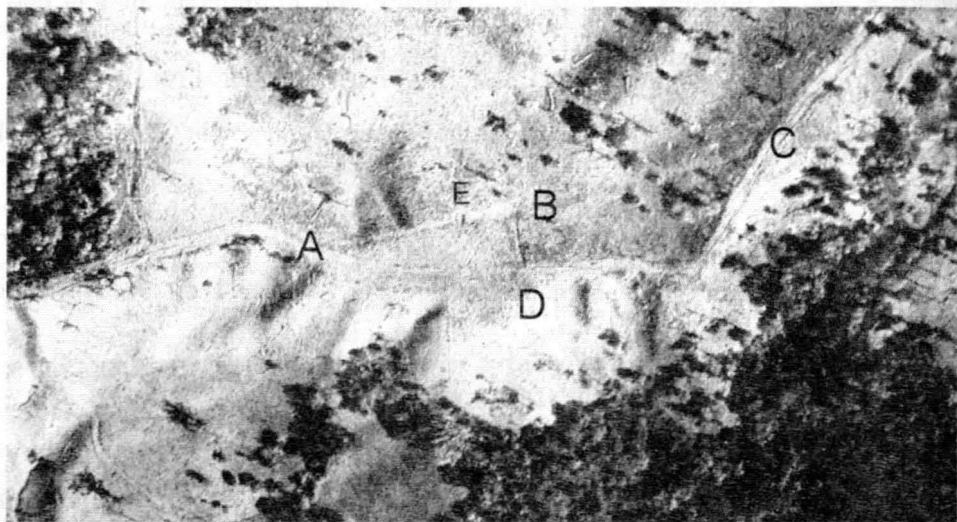
The intensity of historic land use has obscured many of the ancient footpaths, thus making out remote sensing-trenching system of detecting them more difficult than in other areas. In spite of that, some segments of paths were detected and confirmed by trenches, especially on Hilma Jenkins' finca and on Finca Mandela associated with the Poma cemetery (see Fig. 1, and Butler's article in this volume). Two footpaths leave that

cemetery, heading parallel to the east and up the slope. They apparently met on top of a hill and then continued upslope as a single path. It is possible that this is a segment of the abovementioned Arenal phase path that led all the way to the lake.

Two interesting historic ovens were found on Finca Mandela adjacent to two homesteads occupied by a family in the mid 20th century. The ovens were created by someone carving out a firing chamber and vent tube out of a highly weathered tufa boulder. Each boulder was so weathered it had largely turned to clay. But that clay, in addition to being easy to carve, fired to a hard surface when the ovens were used. The zone of hardening was about 2 cm thick. Here is one of the unusual cases where the use of something hardened and actually improved it. The family was known for baking their own bread.

### **SILENCIO PHASE PATHS: SURVEY AND TRENCHING**

Errin Weller describes the project efforts to examine the linear anomalies discovered in the digital and analog imagery, particularly focused on the Silencio phase footpaths. Once discovered in the imagery, project members locate the anomaly on the ground and examine it to see if it might be an ancient footpath or a more recent phenomenon. When warranted, shovel testing for stratigraphy is conducted, particularly to see if the anomaly formed before the tephra Unit 20 fell at about AD 1500. If it formed after Unit 20 fell, it clearly dates to historic times. Weller explains the formation processes of the paths, as well as how they can be preserved and detected in the high-resolution



**Fig. 2** Black-and-white version of Color Infrared transparency airphoto taken by NASA aircraft, east side of Harry Jenkins' finca. The ancient Silencio phase footpath is the direct line from **A** to **B** and continuing to **C**. It is more clear between **A** and **B** because of greater slope, and the small dark rectangle below the letter **E** is our backfilled Trench 17 that confirmed this as the ancient path. The perpendicular short path that leads from **B** at the bottom of the hill to **D** at the top of the hill is Spur 1. The meandering line from **A** past **D** to **C** is a road made in the early 20th century used for cattle drives and occasionally for a 4-wheel drive vehicle. Note how the ancient path heads straight downhill from **A** to **B** and then straight uphill from **B** to **C**.

imagery. Research on the Silencio phase paths had been very successful in previous years, but the area near Tilaran that she describes was taking place in a difficult area where path formation processes were weaker and landscape changes were greater. It was difficult and frustrating working in what we called "La Cuenca de Lagrimas" but our occasional successes were very important. Thus, a high percentage of the anomalies were found to have been formed in historic times, with only a few trenches confirming segments of the ancient footpath.

One very important discovery in the imagery was a faint perpendicular line that led from the main Silencio path straight up to the top of a hill (Fig. 2). Weller describes how that line was confirmed as a path, called "Spur 1." Based on relative erosion from use, most foot traffic continued up and down the main path, but perhaps a fourth of the people took the perpendicular to the hilltop and then back down, to continue their trek. The route of least effort would have been to contour from the main path to the hilltop, but that was not the way people got to the top of the hill. Rather, they took the more difficult but apparently culturally prescribed perpendicular from the very bottom of the hill straight to the top. The strict linearity in routing along the path probably had deep religious significance, and likely was ingrained as the "proper" way to move across the landscape when travel was cemetery related.

Weller describes the major discovery of a segment of the earlier Arenal phase path on the Jenkins' and Vargas' fincas. While we were looking for the Silencio phase path, we were surprised and intrigued to find this older path in this location. It evidently is a continuation of the previously confirmed path that leads all the way to the Laguna de Arenal south shore village or villages. Finding this path in this area focused our attention farther downslope to the west, which led to survey on the fincas of Castrillo and Mandela and the discovery of the dense cluster of cemeteries in that area, described by White above. White describes two trenches into linear anomalies that formed in historic to recent times in his appendix to this article.

#### **EXCAVATIONS AT THE CASTRILLO CEMETERY (G-724CT)**

After Devin White and I discovered the segment of the Arenal phase path farther west than we had documented it before, we decided that a survey in the area toward which it was pointing would be warranted. As we walked the terrain east of that segment, we discovered a cemetery on the finca of Francisco Castrillo in 2002. Although it appeared to have been heavily looted, we decided to conduct some excavations to date the cemetery to the Arenal phase and to try to find some unlooted deposits. During the 2003 excavations, we were successful in dating by obtaining an extensive collection of ceramic (and some lithic) artifacts, indicating that the footpath and the cemetery date to the same phase. The estimated date is about AD 500. Guerrero *et al.* consider the dating of this cemetery with their ceramics, and found quite a range of time covered (see Article 9). We had underestimated the magnitude of looting, and we found only a couple areas that probably were undisturbed: the base of a looted tomb and a few subrounded river rocks at the base of the mound. Errin Weller describes the excavations in detail. It was of considerable interest that both subrounded river rocks and laja were used in cemetery construction, with the river rocks constituting the bulk of the mound construction, and the laja stones forming the cist tombs, apparently. It is possible that this cemetery represents the transition from river rock to laja in cemetery architecture. The proximity of the Tovar laja source must have facilitated the beginnings of this transition.

#### **EXCAVATIONS AT THE POMA CEMETERY (G-725 PM)**

After finding no intact tombs at the Castrillo cemetery, we decided to move south to

another of the multitude of cemeteries discovered while surveying eastward past the Arenal phase path segment discovered in 2002. After consulting with the landowners, we selected the Poma cemetery as probably satisfying our needs for good preservation. It had only a few small looters' pits, which were easy to avoid, and we were abundantly rewarded with excavations below intact Unit 20, indicating that there was no historic or recent disturbance, as described by Michelle Butler.

We also were very pleased to discover two parallel paths, moderately deeply incised, that led straight up the hill from the cemetery, toward the east. As White notes above, they continue to the top of a hill, and apparently coalesce into one that continues farther eastward to the top of the next hill. They could very well connect with the segment of Arenal path discovered in 2002, and thus lead over the divide to the village on the Laguna de Arenal shore. The cemetery, these paths, the 2002 segment, and the previously-confirmed path to the lake shore, all do date to the same phase.

The dating of the Poma cemetery is by various means, all of which are in general agreement. The use of subrounded river rock indicates the Arenal phase, as do the ceramics (see Guerrero *et al.*, this volume), and the features are sandwiched between Units 55 and 40/41, and the calibrated radiocarbon date is close to AD 500. The ceramic dating, more specifically, would place the Poma cemetery late in the Arenal phase, and extending into the Silencio phase (Article 9). As Butler describes, each burial tomb was constructed by hauling subrounded river rocks, probably from the Río Quebrada Grande, and creating 6-7 circular courses of rock. Only the lower courses remained in situ; tree root action apparently disturbed the upper courses. Each tomb was beehive-shaped, with some river rock added in between to fill in the cemetery mound. During the construction of the tomb, and probably after as well, pottery vessels were smashed on or near the rocks. It is possible that these were personal possessions of the deceased (Guerrero, personal communication 2003). A moderate amount of fire-cracked rock was found at both Castrillo and Poma cemeteries, indicating that cooking was a part of the funerary (and probably post-interment) rituals. The burned food incrustations on some sherds also indicate cooking was done at the cemetery, and in these cases, excessive cooking to the point of carbonization occasionally occurred.

The incised footpaths almost certainly point to the village(s) that served as the source of dead bodies and of tomb constructors and feasting participants, and that direction is east. In striking contrast, with only a few exceptions, most of the imported pottery vessels at the cemetery were made to the west, in the Guanacaste lowlands. So, if people were bringing those vessels into the cemetery from the west, they left no discernable paths into the cemetery. We checked all sets of imagery for paths heading west from Poma, and walked the terrain, and found no indication of a westward path. I think it is possible that people traveling from village to cemetery were operating under sacred prescription and kept to the proper straight path, but people traveling from pottery manufacturing locus to cemetery or village would not be operating under such sacred prescription, and would more likely follow individualized routes of greater transport convenience, and thus not develop deeply incised paths. As Guerrero *et al.*, note, the great majority of pottery in both cemeteries was not imported from either area, far to the east or west, but was made locally.

### **EXCAVATIONS ON THE HILL OF SPUR 1**

While inspecting the remote sensing imagery along the Silencio phase footpath on Harry Jenkins' finca in 2001 (particularly the color infrared transparencies from the NASA aircraft overflight, and the IKONOS imagery), I noticed a faint linear anomaly



that apparently connected that footpath with the top of a hill to the south (see Fig. 2). It was visually striking in that it was quite precisely perpendicular to the main footpath but did not cross it, and it faded out at the top of the hill and did not seem to continue over the top and down the southern slope of the hill. As Weller describes above, the two trenches confirmed it as a path contemporary with the main Silencio phase path. The use of it was a small fraction of the use of the main path, judged by the relative amounts of erosion. Apparently most path users would continue up and down in the incised main path, but a few people would make a strict 90° turn up to the top of the hill and then back down again to rejoin the main path. My estimate of relative traffic is four times as much on the main path compared to that on the spur, based on relative amounts of erosion relative to slope.

I have inspected the imagery and the hill slope to the south of the top and I can detect no evidence of either erosion on that slope, or of the path continuing on that slope. In this regard Derek Hamilton and I disagree, as he thinks there may have been significant erosion on that slope. I have looked for evidence of erosion in the imagery and on the ground, and have not found it. I do agree with Hamilton that the hilltop was smaller in ancient times, with more steep slopes away from its peak.

Hamilton describes the excavations conducted on the hilltop where the Spur 1 path fades out, with the objective of exploring why people might have wanted to travel from the main path to this location. We could find no particular resource or construction or activity area on top of the hill. As Hamilton describes, we only found four sherds from broken ceramic vessels and two percussion flakes. There were very few artifacts on this hilltop, certainly not enough to define an activity area. Rather, they seem to have derived from an occasional accidental breakage of a pot, or the flakes from deliberate shaping or inadvertent edge damage to *laja* being transported to the Silencio cemetery.

The Silencio cemetery is not visible from a long stretch of the main path on Jenkins' finca, but it is visible from the top of this hill. Thus, I believe the most likely interpretation of these data is that some people felt a need to climb the hill to directly view the cemetery, and they did so within the strictures of sacred movement across the landscape while traveling to or from the cemetery. They used the strict perpendicular path for this purpose.

### **CERAMICS FROM THE CASTRILLO AND POMA CEMETERIES**

The ceramics from the Castrillo and Poma cemeteries are described and interpreted by Juan Vicente Guerrero Miranda, Monica Aguilar Bonilla, and Jeffrey Peytrequin Gomez. Their principal objectives are to locate the ceramics in the chronological sequences that are currently known for northwestern Costa Rica, to identify locally made pottery versus the pottery that was imported from either side of the research area, and to interpret the pottery within a cultural context. They were quite successful, and were even able to suggest some chronological revisions of the ceramic-based phase sequence for the general Tilaran-Arenal region as follows:

Arenal phase 500 BC - AD 300,

Silencio phase AD 300 - 900, and

Tilaran phase AD 900 - 1500.

This article, on ceramics, was the last of the articles in this journal issue to be written. Because all other articles were written earlier, there was not time for other authors to consider these chronological suggestions and therefore consider the implications for each. Future research will need to give these suggestions careful consideration.

## **LITHIC ARTIFACTS FROM THE CASTRILLO SITE (G-724CT)**

As Errin Weller reports above, the Castrillo cemetery was so extensively looted it appeared that many looters were simply re-digging already looted areas, and it appeared like the cemetery had been put through an immense blender a few times. The majority of the volume of construction was with large subrounded river rocks, with the thin laja slabs apparently having been used to make the actual stone boxes for the burials. The looting resulted in many percussion impacts of river rocks against the thin edges of the laja stones, resulting in inadvertent fracture of flakes. The measurements of the inadvertent flakes divulged two indicators of their being accidental: they are wider than they are long on average, and they have a high standard deviation in width. This results from a combination of the randomness of impacts on the laja edges and the fact that the impact usually occurs where there is no convex ridge on the laja edge. Convex ridges are used in deliberate stone fracture to guide and thus elongate the fracture surface. Only a few dacite percussion flakes from laja were found at the Castrillo site that could have been considered deliberate. One chert flake was clearly deliberate, and a quartzite core is obvious evidence of making flakes, presumably for a wide range of cutting applications. The scraper is further evidence of stone tool manufacture and use, perhaps in shaping wooden implements such as digging sticks. Someone tried a few times, and failed, to resharpen it. Perhaps out of frustration it was harshly broken into pieces, or perhaps it ended its use life in a ritual smashing.

The finding of thermally fractured cooking stones is important evidence of cooking activities at the Castrillo cemetery. Castrillo thus joins the list of other cemeteries in the area with incontrovertible evidence of cooking having occurred in them, presumably a part of extensive feasting activities. The Castrillo cemetery also yielded some important small artifacts. A tiny fragment of an incised laja was found. It carries a decoration quite common in Arenal phase pottery. Incising laja seems to have been an important funerary-associated activity in the Arenal and Silencio phases, ranging from small incised laja up to huge incised pillar of stone from a laja repository (G-151). Also a tiny axe was found; it is so small, and made of a weak material, that its function was probably in the symbolic domain. Two manos probably were used for food grinding, of maize or other hard grains likely, and they appear to have been deliberately broken in a termination ritual. Thus the lithics from the Castrillo site, in spite of extensive looting, do provide a window on funerary and ritual activities.

## **LITHICS FROM THE POMA CEMETERY, G-725PM**

At the Poma cemetery all tomb construction was done with subrounded river rocks. The lack of laja could be because of greater distance from source to cemetery, but I think that is unlikely, given the distances already documented that people are willing to carry laja. Rather, it likely is chronological, with Poma predating Castrillo. The other striking difference for our research is that the areas where we excavated in the Poma cemetery were not looted. They were sealed by intact Unit 20 tephra from the Arenal volcanic eruption that dated to the decades just before the arrival of the Spanish.

We were able to roughly estimate the total weight of rock in excavated tombs as in the range of between 2000 and 4000 kilos, and impressive accomplishment when one realizes they had to have been hauled about 5 km in horizontal distance, and upward about 80 meters in elevation. Would centralized authority and a society more complex than an egalitarian tribe be necessary to build these tombs? I do not think these constructions are beyond the capabilities of egalitarian societies, particularly if multiple households participated in construction and the feasting and post-interment rituals that were held in the cemeteries.

It was clear that the subrounded river rocks were exuberantly smashed into place (as with the Bolivar cemetery, see Hoopes & Chenault, 1994), resulting in numerous inadvertent percussion flakes to be detached. Some sharp edges were also produced by weathering that resulted in exfoliation. Both produce edges that would be useable in an expedient fashion, but no usewear was detected in the collection. The percussion flakes in this collection were longer on average than those from Castrillo.

Only one ground stone artifact was found, a well-formed mano that was only slightly used. Like the manos from Castrillo, it too was broken, probably deliberately as a termination ritual.

Taken as a whole, the deliberately made artifacts of chipped stone and ground stone from both cemeteries do support the interpretation that people were participating in the "Periodo Bagaces" social-religious phenomenon noted in the Cañas to Liberia area (Guerrero, Solis, & Vázquez 1994). Certainly there was considerable cooking in both cemeteries, as evidenced by the amount of thermally fractured cooking stones found. And both cemeteries had cooking pottery, smoke-blackened on the bottom, and occasionally with burned food residues inside. Pottery vessels were deliberately smashed, and they may have been the prized personal possessions of the people being buried (Juan Vicente Guerrero personal communication 2003). The picture is one of local self sufficiency, as virtually all the materials for chipped and ground stone tools were obtained from nearby sources. The only exceptions were few (chert flake, quartzite core) and they apparently came from some 30 km away, not a long distance trading system by any means.

### **CERRO TOVAR AS THE SOURCE OF LAJA FOR SILENCIO SITE TOMBS**

Jorge Barquero reports on the results of his 2002 geological fieldwork looking for the source of laja used to construct the stone cist (box) tombs at the Silencio cemetery. For many years I had been searching for natural sources of laja that conceivably could have been the source, but I had very little success. By asking local people and by scouring the countryside I had tracked down a few sources, specifically on ICE land and two sources on the Finca Casa Blanca immediately west of the Finca Mandela. And I had found a small dispersed source at "Cabra" on the southeast side of Cerro Tovar, just west of the contemporary cemetery of Tilaran. When most people think of a laja source they think of the massive *in situ* bedded deposits of laja, and so nobody with whom I talked considered Cabra to be a laja source because of its weathered and dispersed nature.

Jorge Barquero visited all of these natural laja sources, and compared each to the lajas used in the Silencio cemetery. He compared them in terms of the matrix, the grains, the size of pieces, the surface morphology, and the weathering rinds. He found that the lajas from Cerro Tovar matched the lajas used in the cemetery in all categories. The lajas from the ICE and both the Casa Blanca sources did not match the cemetery lajas, in all categories. So, he concluded that Cerro Tovar apparently was the source. The Cerro Tovar source also has elongated stones that could serve as "mojones" in the cemetery. That Tovar was the source seems to us to be quite reasonable, as the Silencio phase path seems headed in that direction where we last confirmed it (Fig. 1 of the Introduction article).

### **PETROGRAPHIC AND CHEMICAL INDICATIONS OF THE LAJA SOURCES FOR THE SILENCIO CEMETERY**

In designing the research program I decided to have the field geology be conducted separate from the laboratory analyses, to see the degree to which they would corre-

spond, or differ. The laboratory analyses are reported by Briana Agar and Charles Stern. They conducted detailed petrologic and chemical analyses. The petrology indicated the majority of the lajas from the Silencio cemetery evidently came from the Cerro Tovar source. There is another way to calculate the percentage, because three of the samples (SC-C1, AS-D1, and SC-E1) were not obviously laja, and may well have been local country rock. Hence, 12 of the 17 Silencio laja, or 71%, match the Tovar source. This is supportive of Jorge Barquero's research results. But what is also important is that 29% of the Silencio laja samples did not match Tovar, meaning that there is another laja source supplying a minority but still a significant amount of the laja being used in the cemetery.

It is of considerable analytical significance that the geochemistry of key elements, measured by x-ray fluorescence precisely to parts per million, derived the same groupings as did the petrology. This provides powerful support for the majority of cemetery laja deriving from Tovar, but some coming from a yet-unknown source.

The two kinds of geology, field and laboratory, are strongly supportive of each other, confirming Tovar as the principal source. And, we have the intriguing laboratory result that over a quarter of the lajas, according to this sample, came from a source that has yet to be identified.

### **THE TEMPISQUE PERIOD IN SOUTHERN GREATER NICOYA**

Mauricio Murillo contributes an extensive consideration of what is known about the archaeology of the Tempisque period (500 BC to AD 300) in the southern portion of Greater Nicoya. The Tempisque period encompasses most of the old Zoned Bichrome period (500 BC-AD 500). His overview is quite comprehensive, and provides a very useful context for the archaeology articles. His period ends about two centuries before the two cemeteries of primary interest to the Arenal project, and therefore his article sets the stage for their consideration. Or, in terms of the Guerrero *et al.* chronological suggestions in this volume, the end of the Tempisque period corresponds to their suggested end of the Arenal phase. Murillo presents the major issues facing archaeologists working in this time period and geographic area, including subsistence, residential mobility, demography, and social inequality. Greater Nicoya residents did engage in agriculture, but their reliance on wild species by gathering, hunting, and fishing was greater than contemporary Mesoamerican societies to the north. And within Greater Nicoya it appears to me that Arenal area people relied on agriculture less than people in lowland areas. Murillo states that Greater Nicoya settlements probably were not fully sedentary, and that also provides a clear contrast with Mesoamerica at that time. And the increase in population density in the period is certainly intertwined with the emergence of social differentiation. I suspect the degree of differentiation was variable within the area, with the Arenal area experiencing less social inequality than their lowland neighbors. How and why that inequality emerged and was sustained is an important research domain for the present and future in Costa Rica. The Arenal area seems to me to have been more conservative, more culturally stable, and less socially differentiated, than groups in the Guanacaste lowlands during this time span.

### **THE CUTRIS SITE AND ITS ROADWAYS**

Ricardo Vázquez, Juan Vicente Guerrero, and Julio Sanchez contributed an article on the fascinating and impressive Cutris site, near Venecia, in the Llanura de San Carlos. The Cutris site is at 200 meters of elevation, on the almost flat plains that drain northward into the Caribbean sea. It is in a very wet environment, receiving an ave-

rage of 3120 mm of precipitation per year. A surprising result of the ceramic analysis is that Cutris was at its apex from about AD 600 to 900, thus placing it centuries earlier than the other chiefdoms such as Fortuna and Guayabo de Bagaces. And then later, it was largely depopulated when the other known chiefdoms were at their heights. It may have been a forerunner, an innovator in the emergence of complex society. I do think it is likely, as research is done in some of the other chiefdoms that are poorly known, that some others will be found to have been as early as Cutris. While it was beginning its apex, at AD 600, the Arenal phase was ending (or by the revised chronology of Guerrero *et al.*, the Silencio phase was well underway). They both share some characteristics, such as the use of subrounded river rock in construction. Importantly, they both have prominent long earthen features, but how they formed is very different. The Arenal (and Silencio) phases have inadvertent sunken pathways; the Cutris site has immense constructed sunken roadways. I here suggest that the chiefs at Cutris, when they were in search of monumentality, decided to elaborate on the cultural standard of sunken entryways that had developed many centuries before, in simple societies such as in the Tilaran-Arenal area. I am not suggesting this was the only place that these sunken paths developed, and thus is the sole source of the idea that was "writ large" at Cutris, as I have also seen them in other areas of Costa Rica.

The center of the Cutris site is bounded by a stone perimeter wall, roughly circular, that is now 1.2 meters high, built of river rocks. It has stairways 3-5 meters wide. I doubt a wall that low, with such open entryways, could have served a defensive function. Within the perimeter wall are about 20 circular platforms, averaging 25-30 meters in diameter, and 1-2 meters high. Some had stone facing/retaining walls. The largest is 40 meters in diameter, and one of the largest sunken entryway roads ends facing right into it. I suspect these platforms served different functions, with some being platforms supporting the residences of the chiefly family and other important community members, while others were for proclamations, performance, and perhaps feasting events and hosting of visitors from other communities. Cutris center is a rather impressive site, one where the construction effort and continued maintenance of the perimeter wall and the platforms do merit the category of monumental. But what I find particularly impressive are the sunken roads.

There are four principal roads radiating out from Cutris. The effort to construct and maintain these had to have been immense. Each averages 6 m in width, and was excavated down a few meters to a flat bottom, with sides sloping back 40° into the berm built up with the excavated sediments. Each widens dramatically in its 1 kilometer closest to Cutris center. Road A widens to 40 meters, while B widens to 35 meters, and the other two slightly less. Their lengths, taken from the conventional black-and-white airphotos of the Instituto Geografico, are 6.7 to 9.4 km. I suspect if color infrared aerial photography and satellite imagery were used in remote sensing, more roadways could be detected. Each of the four principal roads radiates from Cutris center to another community, each of which evidently was smaller than Cutris. I think Vázquez *et al.* rightly interpret the system as a local interaction sphere with Cutris as the principal center. Such a system of roadways must have been to facilitate contact, probably in political, economic, social, and religious ways. Such a built facility is not serving defensive functions, not within the system.

As Vázquez *et al.* point out, it is an impressive sight to walk into Cutris using one of these sunken walkways. Away from the site center, while one walks in the sunken walkway you get little or no view of the surrounding territory. But as one approaches the site center, a little bit of a view of that center begins to appear. Then when one actually enters the site center, the entire site opens up to view. Even now, with all the centuries between them and us, and not sharing a common culture and value system, it is an emotional experience to walk the sunken road and see the site open up to view.

But when we consider the very high annual precipitation, and the fact that the area frequently gets torrential rainstorms, one wonders how water was controlled. Vázquez *et al.*, have looked extensively for evidence of erosion caused by excessive runoff, and have not found it. They think that the base of the sunken roads may have been built of specially-compacted sediments. I think we have a lot to learn about what people did, and how, with these sunken roadways. They are an engineering marvel in this climate.

Vázquez *et al.* describe the secondary roads, which are associated with the radiating primary roads, but are located just outside the perimeter wall. They give access from one primary road to another, without going through the site center. Each is 2-3 meters wide, and was dug the same way as the primary radiating roadways. There are two kinds of secondary roads, one being long curving segments that connect three of the four main roads. I would call them "ring roads" and they may have facilitated communication and contact between processions or delegations coming from the communities at the ends of the radiating primary roads. The other kind of secondary road follows a zig-zag pattern between two of the primary roads, and also connects a platform with a drainage arroyo.

### **CONCLUSIONS**

The Tilaran-Arenal area of northwestern Costa Rica has been occupied by people for some 12,000 years before the arrival of the Spanish. The research of the Proyecto Prehistorico Arenal has documented the changes in life style, residential mobility, subsistence, artifacts, and architecture for that span of time. Society remained egalitarian throughout that span of time, although the boundaries of egalitarianism may have been pushed during the Arenal and Silencio phases, for about two thousand years. It is during those two phases that people separated villages from cemeteries, and walked precisely the same route between them, in single file. This ritually-prescribed travel had not existed before, and it ceased a few centuries before the Spanish arrived (the Tilaran phase). Such travel along the same path had the unanticipated consequence of eroding and entrenching. I believe what began as inadvertent became a prized cultural standard for entering a special place, by an entrenched long straight path. Later, when complex society developed to the east, such as at Cutris, chiefs in search of monumentality appropriated the concept of an entrenched entryway, and built sunken roads that led many kilometers from other settlements into their central place. Still later chiefdoms, such as Guayabo, maintained the monumentality of the impressive constructed entryway and long straight roads approaching the central place, but they shifted to stone for more durable construction in the moist tropical environment. Thus, the seed of monumental construction in the later complex societies was planted inadvertently by people living in simpler times.

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