The "Espontosa Light Horse" ready to ride to Frightful Cave for the day's work. Left to right are: Pedro Gonzalez, Guadalupe Romo, Juan Meta, Albert Schroeder, and Walter Taylor.

STUDIES IN PRE-COLUMBIAN ART & ARCHAEOLOGY NUMBER THIRTY-FIVE

SANDALS FROM COAHUILA CAVES

with an Introduction to the Coahuila Project
Coahuila, Mexico: 1937–1941, 1947

Walter W. Taylor

Editors
Nicholas J. Demerath
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Patty Jo Watson

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Contents

List of Figures

List of Tables

Preface

At first glance, *Sandals From Coahuila Caves* might seem an unusual addition to *Studies in Pre-Columbian Art & Archaeology*. To many, Walter W. Taylor's inclusion as an author in this series would appear to be at odds with the kinds of works that have previously been published. Taylor, after all, has been viewed as a kind of "John the Baptist" calling loudly for a distinctly new approach to research that later was formulated as the New Archaeology. Thus, it might seem strange for a work that involves these kinds of theoretical issues to be published by Dumbarton Oaks. Scholarship at Dumbarton Oaks has tended to take rather particularist approaches, in Pre-Columbian Studies concentrating on details of life and thought in the ancient New World mostly in the region from Mesoamerica through Central America into the Central Andes.

It is true that Dumbarton Oaks has a reputation for emphasizing distinctly Humanistic forms of scholarly research. But this is a broad approach to Humanism and one that embraces the joining of the forces of science with arts and letters in order to explore what is uniquely human against a backdrop of those universal laws and restraints imposed by nature. In particular, Pre-Columbian Studies has long been a research program in which science and the humanities frequently work together symbiotically. Studies of Mesoamerican blood sacrifice have included not only the symbolism of palpitating hearts but also the surgical procedures by which they were removed. Discussions of the meaning of houses among the Maya appear in the same volumes as quantitative studies of construction processes. Studies of writing systems (glyphs, *khipus*) have drawn upon and contributed to issues in linguistics and communication theory. Thus, it is in this spirit of serving as a place where detailed studies and broad syntheses, hard science and humanistic interpretations, dirt archaeology and object-oriented investigations may all find a place that this volume is welcomed at Dumbarton Oaks. And, happily, *Sandals From Coahuila Caves* is all these things and more.

The main focus of this book—the lowly sandal—is emblematic of the way in which archaeology as the study of past human behavior and art history's focus on objects may fruitfully come together. Taylor likely would never have considered himself as conducting a project in art history and some art historians might not consider sandals as worthy objects of study (though many would). In some ways, it does not matter what this research is called, whether the "Conjunctive Approach," the "New Archaeology," "archaeology," "material culture studies," or "art history." What matters is that this work is a major contribution to research on the prehistory of Northern Mexico/the Desert Southwest and to a particular set of material remains. It will stand, I believe, as an exemplar of how careful research can elucidate a wealth of information about objects and the people who used them.

Walter Taylor played an important role in calling for a new kind of archaeology to be carried out in the United States and the impact of his message still reverberates today. At the time he made his pronouncements, many of his colleagues asked him to practice what he preached. This book is a case study of the sort he had been called upon to produce, although, unfortunately, it is published posthumously. And, there seems to be more than a little irony in the fact that in his role as a herald of things to come, this work should be about sandals. John the Baptist remarked that he was not worthy to undo the laces of the sandals of the one who would come after him. But it will be through this very lowly form of footwear that Taylor makes his final contribution to posterity and achieves some measure of justification, perhaps even a form of redemption, for his energetic advocacy of a new vision for anthropological archaeology.

As General Editor of this series, I wish to thank the editors for their very hard work in bringing this project to fruition, especially Patty Jo Watson, with whom I have worked most closely. Special thanks also are extended to David L. Browman for his commentary and to James M. Adovasio for his careful review of the manuscript and his contribution on the chronology of the cave. I also extend a very special thanks to Allan Maca. As a Fellow at Dumbarton Oaks in 2001–2002, it was he who first drew my attention to this manuscript and its need for publication. I thank him not only for his astuteness in seeing an ideal match of manuscript and publisher, but also for his fine sense of humor and collegiality during his time at Dumbarton Oaks.

Jeffrey Quilter
Director, Pre-Columbian Studies

Editors' Foreword

This volume has a complex history, some of which is recounted in the Author's Acknowledgments, Preface, and Introduction (see also Reyman 2001). It remains for us to describe the final phases of that history, and to provide a little more context for the monograph, which was actually printed in 1988 but then withdrawn from distribution at the insistence of Taylor. The 1988 version was called *Contributions to Coahuila Archaeology*, and was to have been published by the Center for Archaeological Investigations (CAI) at Southern Illinois University, Carbondale, as number 52 of their Research Papers series. Taylor was dissatisfied with the printed results, however, and asked the publisher not to distribute the volume.

In March of 1992, Taylor showed Demerath the manuscript as he had finally corrected it, and asked Demerath if he would help him get it published. The two men had been personal as well as professional friends since the mid-1950s, when they were introduced by Clyde Kluckhohn. Both were committed to the behavioral science approach that Kluckhohn and Talcott Parsons (Demerath's mentor) were promulgating at that time. Taylor and Demerath also shared preferences for country life, Mexico, and *la dolce vita* centered in academe.

Demerath knew how heavily Taylor's albatross weighed upon him. He obtained a power of attorney as Taylor's editor and agreed to see the corrected 1988 manuscript through to publication. The fact that a Washington University colleague of Demerath's, Patty Jo Watson, was known to Taylor and was willing to provide archaeological expertise also appealed to Taylor.

So at Taylor's request, Demerath and his secretary, Mrs. Elsie Glickert, edited the aborted 1988 version to incorporate Taylor's corrections, and Demerath contacted Watson for advice and assistance. She spoke with Mary Kennedy, who agreed to accept the job of technical editor for the manuscript. Kennedy worked from the 1988 printed version, *Contributions to Coahuila Archaeology*, as amended and edited by both Demerath and Taylor, and also from the original typescript Taylor submitted to the CAI. From these documents she produced the text of *Sandals from Coahuila Caves*. She reformatted some of the tables and revised captions and headings for greater clarity. She restored two items (Table 4-3 and Figure 5-4 here) that were omitted from the CAI printing. She also reorganized the photos and some of the text (especially Chapter 4 and the Author's Preface).

Once Kennedy completed this very demanding technical editing, Watson asked her departmental colleague, David Browman, if he would be willing to provide a commentary for the final edited manuscript, which he kindly agreed to do (see Appendix C). Watson then approached various potential publishers. Taylor, who had been afflicted by serious medical problems for several years, died in 1997. In the fall of 2002, an essay by James Adovasio on the chronology and stratigraphy of Cueva Espontosa (Frightful Cave, the major site excavated by Taylor [Appendix D]) was added, and the manuscript was accepted by Jeffrey Quilter for publication at Dumbarton Oaks. We are very grateful to Kristin Arntzen for translating our WordPerfect computer files to Microsoft Word, and for other much appreciated assistance at Washington University with the final, pre-submission work on the manuscript; we thank Jim Railey for redrafting Figures 7-1 and 7-2.

Remarks about the Present Volume

Taylor's Chapter 1, "A Short Chronicle of the Coahuila Project," is a historical document, a strong evocation of Mexican archaeology in a bygone era, when a lone gringo with a little money, a love of the country and its people, and a good command of Spanish could carry out a successful field project in territory previously uninvestigated by professionals. Only a small part of the information in the well-preserved and abundant materials, still at the Smithsonian Institution, is presented in this monograph, however. Taylor gives us his views about how and why that is the case (see especially the first paragraph of his Preface, below). But those familiar with Taylor's 1948 book, *A Study of Archeology*, may perhaps come to alternative conclusions, as do Reyman (2001) and Browman (Appendix C in this volume).

A Study of Archeology is an important volume, in itself, and historically within the development of Americanist archaeology. Although the *ad hominem* tactics Taylor employed as part of his critique did him—and his approach—considerable damage, the theory and the exposition he provides are still well worth reading (for further discussion, see Watson 1983; 1995).

But the comprehensive program Taylor carefully works out in *A Study of Archeology*, the conjunctive approach, is extremely demanding in field and laboratory practice. It was, in fact, impossible to do full-scale conjunctive archaeology at the time the book was published. Even now, with easy access by archaeologists to powerful computer hardware and software, with greater knowledge of site formation processes, and greater interest in eliciting ancient ideational systems, it would be a tall order. So it is not surprising that Taylor himself was unable to meet the challenge he issued to Americanist archaeologists at the beginning of his career. What he has left us here in his study of the Coahuila sandals is a painstaking, empirical analysis of one, seemingly not very promising (as perceived at the time) artifact category that he—true to the spirit of the conjunctive approach—demonstrates to be productive of cultural information:

> ". . . sandals are relatively complex and culture-sensitive artifacts, the number and specificity of whose characteristics make them possibly the most useful cultural category available to the archaeologist fortunate enough to be working in sheltered sites in the area of arid America. At the same time, sandals are probably more closely connected with people as biological beings than any other cultural category that we have at our disposal in north Mexican archaeology . . . fiber sandals are also intimately connected with the local environment and contain, within the materials of their manufacture and the imprint upon them of the human factor, much information on aspects of cultural and natural ecology that could be of great interest to the archaeologist as interpreter and student of cultural and natural contexts" (Walter W. Taylor).

Nicholas J. Demerath*
Mary C. Kennedy
Patty Jo Watson
Washington University, St. Louis
November 2002

* As indicated here and in Taylor's Acknowledgments, Nicholas Demerath initiated and carried through much of the work necessary to prepare Taylor's revised Coahuila manuscript for publication. Sadly, however, Nick did not live to see the book in print.

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Acknowledgments

A great number of people have been involved with the Coahuila Project over the years, and the manner in which each has been concerned has varied greatly. At the risk of prolixity, I would like to recognize them here and to give them my sincere thanks—and by doing so indicate to those who might not now be aware of it the extent to which outside help and expertise are of vital importance to an archaeologist's work.

The late Walter C. Teagle, Jr., of Glen Cove, Long Island, my schoolmate, college roommate, and longtime friend, contributed funds for the work of 1940–1941. Mrs. Jay Madden of Greenwich, Connecticut, and Dr. Ralph Kolb of New York City gave generously to the Northern Mexico Archaeological Fund of the Smithsonian Institution, and this helped us continue the work after World War II. Frank M. Setzler, Head Curator of Anthropology, U.S. National Museum, was an understanding and supportive immediate superior during all the years that the project existed before his retirement; Alexander Wetmore, first as Director of the U.S. National Museum and then as Secretary of the Smithsonian Institution gave much time and help; Albert H. Schroeder, my assistant during the 1940–1941 season, probably contributed more than anyone else to the success of that period of excavation. Through the experiences of other seasons and other assistants, I have come to realize what luck it was to have him with us.

In the United States, many people helped the project in many ways. Jonathan Glass, of Eagle Pass, Texas, proved a concerned and warmhearted banker. Ferenz Fedor, photographer of Albuquerque, New Mexico, took much care and expended much professional expertise in processing, without charge, all of our photographic records from the season of 1940–1941. Carlos Casteñeda, of the University of Texas Library, and Omer C. Stewart, of Boulder, Colorado, contributed valuable archival and bibliographical information about the Spanish *entradas* into what is now Coahuila and about the Indians of northeastern Mexico. Kirk Bryan, of Harvard University and Raymond Emerson, of Cambridge, Massachusetts, let me use their archaeological collections from Coahuila and provided knowledge of certain "outlying" parts of the state. Harry P. Mera of Santa Fe, New Mexico, Donald J. Lehmer, a former classmate at the University of New Mexico, and Jesse D. Jennings, University of Utah, studied and passed judgment on the few, and thus very important, potsherds found during our work in Coahuila. J. Alden Mason, University Museum at Philadelphia, generously provided unpublished information about his work in Durango, Mexico. Morris E. Opler, student of the Apache, looked at some pictographs that might have been Apache—but evidently were not. Emil W. Haury, E.B. Sayles, Joe Ben Wheat, all at that time of the University of Arizona, and Robert M. Zingg, student of the Tarahumar, generously furnished expertise and also loaned specimens for comparative analysis. Victor J. Smith, of Sul Ross College, Texas, was a friendly and helpful but demanding critic of some of our Coahuila work, and he had some good advice about the excavation of caves. Ellen S. Quillin and J. Walker Davenport, both of the Witte Museum, San Antonio, Texas, gave me the run of the museum and, with George C. Martin, shared their knowledge of cave cultures in west Texas. John A. Graham and his family, Mr. and Mrs. Thomas Graham, of Del Rio, Texas, provided hospitality and valuable information about life and archaeology in west Texas.

In Coahuila, there were a number of men who worked for the project at various times. Jésus Chacón, of Zacatosa on the railroad, acted as a guide and tower of strength at the very start of the work. Manuel Castro, prodigious chauffeur of Cuatro Ciénegas, was always ready to go any place at any time with his vehicles, even if they were not quite so accommodating. Pedro González G. came to us at the very start of the 1940–1941 season as a teenager and left at the end as a mature, responsible worker and friend. Juan Mata, ex-Presidente Municipal of Cuatro Ciénegas, was late in starting with us but remained to become our rock of stability and true *compadre*. Juan's cousin, Guadalupe Romo, brought his horses and himself to our camp, and it was difficult to tell which of them served us better, although Lupe was certainly the more temperamental. During 1940 and 1941, we had two camp cooks, first Armado García Ortega and then Miguel Salas, both well acquainted with frying pans, chiles, and beans. Eusebio ("Chebo") Pérez G. was a good companion and the "buffer state" between me and the realities of Mexico for the long, hard season of 1947.

Also in Coahuila we were helped by many friends, both American and Mexican. Juan Gil, of *Almacenes del Norte* in Monclova, gave us good counsel, good prices, and banking credit. In Cuatro Ciénegas, all the time that I worked there, Pedro R. González, the other Pedro's father, gave us welcome and cheer and introduced us to many estimable things and people, particularly his son and Chebo Pérez; he actually encouraged our use of his *cantina* as an office and clearinghouse for information. Harvey Pollay of Eagle Pass, Texas and *Rancho La Encantada*, Coahuila, gave us shelter and guidance when we needed it most at the very start of the work. At *Rancho Castillon* far in the desert, Tirso Castillon was a gracious and generous host on more than one occasion. In the Bavia Valley, Hal Mangum of *San Geronimo* provided gasoline and food when both were badly needed, and Robert Steward, of the American Smelting and Refining Company mine at Santa Elena, showed keen interest in our work and provided shelter, livestock, good food, and companionship on several occasions. Earl Johnson, miner and rancher of Cuatro Ciénegas, helped us with information on the *Sierra del Carmen* and the northern part of the state. David McKellar of *Rancho Mariposa* and Clarence (José) Davis of the *Piedre Lumbre* ranch contributed valuable information on sites as well as welcome hospitality under trying circumstances. Mining engineer Bernard Hodson gave us maps that were very important in our work, not only because maps in and of Coahuila were very scarce but also because his maps were accurate, also a rare characteristic. Thanks are also due to Valeriano and Ramon Diego of Villa Acuña and *Rancho Santa Rosa* and Juan Quiroz of *Rancho La Chuparrosa* for permission to work on their ranches and for many kindnesses.

Many people served as research assistants in the study and processing of the Coahuila data. They deserve to be named here and thanked for their help and the interest that they took in their work: Boyd Wettlaufer, Barbara Feller Esser, Margaret Aber Poag, Jean Owens King, Hilda Delgado, Gretchen Hays, Thomas E. Holien, Jonathan E. Reyman, Barbara A. Peckham, Kim Dammers, Robert Lafferty, and Neal Altman.

There has also been a very great number of colleagues who have looked at our material and made identifications and suggested natural/cultural implications. I wish to name them and give them my sincere thanks for rallying around so generously and enthusiastically. Their contributions have meant a great deal to me personally and to the Coahuila Project in general:

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Human hair: Oliver H. Duggins, Mildred Potter.

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Editorial Note: The words presented in italics were originally underlined in Taylor's text.

Radiocarbon dating: H. R. Crane, Robert Stuckenrath.

Ichthyology: Carl L. Hubbs.

Marine worms: Olga Hartman, Waldo L. Schmitt, J. P. E. Morrison.

Conchology: Robert J. Drake, Harald A. Rehder.

Finally, and most recently, I am especially indebted to my friend Nick Demerath and his colleagues at Washington University in St. Louis: archaeologists Patty Jo Watson and Mary Kennedy; and to Elsie Glickert secretary *extraordinaire*. Without their efforts beginning in 1992, or lacking the good offices of the Smithsonian Institution (an institutional friend of long standing) this book might never have been.

Walter W. Taylor
Rockaway Beach, Oregon

September 30, 1993

Author's Preface

At long last, the time has come when a report is to be published on the Coahuila Project and its excavations made in northern Mexico, specifically in the State of Coahuila that lies south and southwest of Texas across the Río Grande. This work has been conducted, starting as a personal venture in 1937 and continuing from 1940 under the aegis of the Northern Mexico Archaeological Fund of the U. S. National Museum, now the National Museum of Natural History. The purpose of the work was to carry into Mexico the study of cave cultures of the Big Bend of Texas and to develop a link between the early native cultures of the western United States and those of northeastern Mexico. The archaeology of the latter area was virtually unknown, and yet there seemed to be significant cultural ties between the two that might throw some light on prehistoric relationships across the present border in the arid lands of both countries.

As a preamble to the strictly archaeographic contribution of this report, it is important, nay essential, that some explanation be made of its delayed publication and incomplete character. The Coahuila excavations ended in 1941 and have not been resumed, although subsequently several seasons of reconnaissance survey were carried out in an (unsuccessful) attempt to locate sheltered sites that would fill out our record and answer some important questions. Analysis of the excavated materials began on my return to the U. S. National Museum in the early fall of 1941 and continued intermittently and in several locations until 1954. At that time, almost all laboratory work had been completed; a major part of the descriptive writing was completed in first draft by 1960. There still remained, however, several tasks, including writing the missing descriptive sections, a cultural context, and a discussion of the cultural and historical significance of the material. The delay in completing these tasks can be attributed to many things: military service, changes of residence and work, the procrastinations of increasing age, plus a severe reaction to the professional reception of my monograph, *A Study of Archeology*.

After a long hiatus, this final draft of the sandal paper was written in 1979–80 and sent to the publisher at the beginning of 1980. In 1985 the manuscript had to be recalled because of problems with the first publisher. In 1989 it was recalled from a second publisher. My long-time friend Nicholas Demerath sensed my growing despair. By the spring of 1992, Nick saw what the manuscript and I needed, and, at my request, he got it done!

Underlying the relief and pleasure I have in seeing even a small fraction of the Coahuila material published in substantial detail, I experience chagrin that there is neither time nor space to publish a full report presenting the fabulously full range and detail of the material resulting from the field work in Coahuila and now lying fallow in the voluminous files of the Coahuila Project. But at this late date I believe that my obligation to the data already processed outweighs any obligation that I might have to myself or to my profession. The basic introduction to the Coahuila Project plus my descriptive section on sandals and sandal ties are being published here.

I wish to confirm my awareness of certain glaring gaps in what is presented in this report on the Coahuila Project. One gap reveals the lack of comparisons between cultural traits from Coahuila and those from sites in northern Mexico and adjacent areas in the United States. Culture descriptions in the literature do not cover the same range of topics, and methods; so after a number of attempts, I found that what comparisons I could make were no more than partially informed guesses.

Another gap exists because the major part of the descriptive sections of this report is concerned only with perishable artifacts, and discussions of open sites and unexcavated sheltered sites are not presented at all.

Finally, cultural context has not been written, because I have been able to present only a very small part of the cultural corpus excavated by the Coahuila Project.

CHAPTER 1

A Short Chronicle of the Coahuila Project

1937: INTRODUCTION TO COAHUILA

The idea of doing archaeological fieldwork in the state of Coahuila, Mexico, was given to me by Leslie Spier in 1935–1936 during my first graduate year. I had just returned from a summer of excavating Anasazi ruins for the Museum of Northern Arizona. The country, its people, and their way of life strongly appealed to me, and I told Leslie I would like to find an archaeological project that would take me back. He suggested that I look into northeastern Mexico, where extant historical accounts of aboriginal life had never been tested in the field. His proposal interested me because, among other things, it reflected the then-current fad of "filling the gaps" in the archaeological record. He wrote me specifically: "No one has worked in that area since Edward Palmer, a botanist, about fifty years ago; he found very interesting material, but we know almost nothing about it."

And so, after a summer and fall of fieldwork in Georgia, I returned to the Southwest in January 1937 looking for some sort of archaeological work to tide me over until summer, when I intended to go to Mexico. I found no work and eventually enrolled for the second semester in the Department of Anthropology, University of New Mexico. I wanted to study with Donald Brand, one of the few anthropologists who, at that time, had done fieldwork in northern Mexico. During the course of that study, Brand had me write to several people who had traveled in northeastern Mexico, and one of them, Colonel M. L. Crimmins of San Antonio, Texas, was especially welcoming in his response. Among other things, he suggested that I contact Dr. Dudley Jackson, also of San Antonio, who had just returned from one of his many excursions into Coahuila bringing with him some very interesting specimens of "Basket Maker" material. After the semester was over, J. Charles Kelley, a fellow student at New Mexico, and I made a short reconnaissance trip into the Big Bend of trans-Pecos, Texas, where he had done some digging in sites that he believed should be similar to what I would find in northeastern Mexico, specifically in Coahuila immediately across the Río Grande. After this brief indoctrination, I continued on to San Antonio to see Dr. Jackson.

"Dr. Dudley," as most people called him, proved to be a most fortunate contact. He took me into his house, fed me, talked freely, and shared his knowledge of Coahuila. He provided names of people to see and wrote letters of introduction. Along with his tall tales, anecdotes, and jokes, he passed on valuable tips about Mexico and Mexicans, about weather and roads and the availability or nonavailability of supplies, about how to get around without arousing alarm or animosity among the Mexicans or being stranded in the desert. In short, he convinced me that Coahuila was where I should work and provided me with a foundation of practical information that proved both valid and effective. Not least of all, he made my first work in Coahuila financially possible. Very early in our acquaintance, he asked me how much money I had in my pocket for the trip. I told him the truth: I had $50. At first he shook his head, then he laughed, then he hooted, and when he had quieted down he told me very seriously that my money was just not enough to make the trip even possible, much less worthwhile, that I would only starve or perish in the desert "out of gas." But then he continued. If I would take his sixteen-year-old son, Dudley junior, along on the trip, he would match my $50, and with the $100 it might be possible to go somewhere and do something in Coahuila without leaving our bones for the coyotes.

In the following years, Dr. Dudley remained an enthusiastic and understanding friend, and often a provocative gadfly tempering his stings with a joyous sense of humor and a well of human kindness. He visited us in the field, and we had many long and rambling talks in his San Antonio house. Twenty years later, when my wife became seriously ill in Mexico, it was Dr. Dudley who gave us the advice that eased her final years. He was a much esteemed godfather not only to

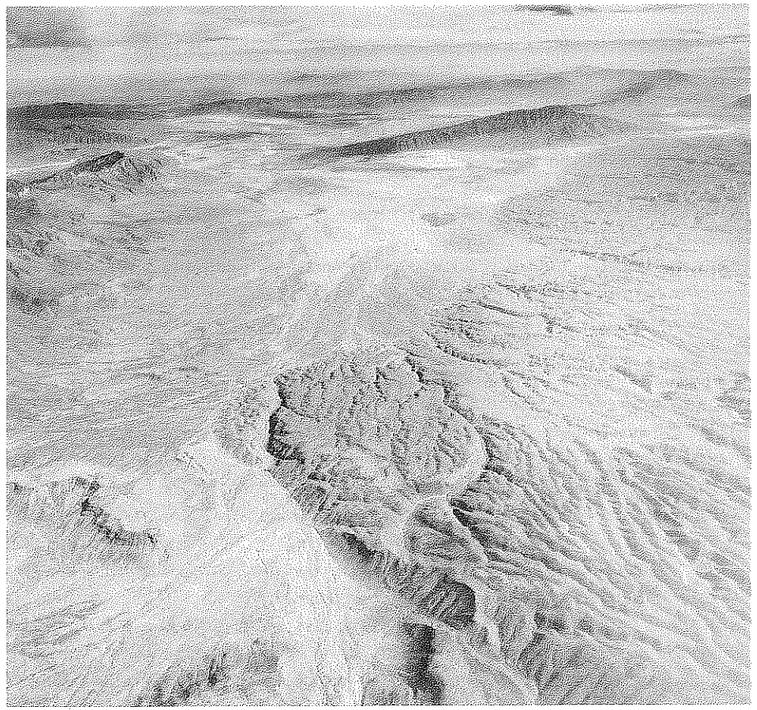


Fig. 1–1
The Cuatro Ciénegas basin, looking slightly south of east. The town is at the southern end of the pass indicated by the white streak that goes from north to south through the Sierra Madera range at the upper left of the photo. Cave Canyon is at the very northern tip of Sierra de la Fragua, the range that occupies nearly all of the right side of the photo. Frightful Cave (CM68) is on the basin side of the mountain that bounds the east side of the basin just beyond the uppermost white patches; it lies just left of center in the photo. Sierra San Marcos is the long, dark range that divides the basin in the upper right. Puerto San Marcos is the long white streak that separates Sierra San Marcos from Sierra de la Fragua in the upper right.

the Coahuila Project but also to me.

And so, early in the summer of 1937, with our hundred-dollar stake changed into 360 Mexican pesos, Dudley junior and I rode the train from Piedras Negras, Coahuila, on the Río Grande, to Villa Frontera, the station-stop for the historic, iron city of Monclova. There, thanks to a letter from Dr. Dudley, we met Manuel Aguirre, the head dispatcher of the *Norte de México* railroad, who was to become a good friend and a great help in our work. On this first occasion, he hired for us a seasonally unemployed Model-T Ford school bus of matronly years as well as its owner/driver, one Roberto Pino. He also persuaded Romualdo Guerra, a friend and hunting companion, to come along as guide to the "outback" and, I suspect, as chaperon and guardian of two babes in the Coahuila woods. With four mouths to feed, two daily wages to pay, an aged vehicle with a gasoline habit to support, and only 360 pesos to provide the wherewithal, I had no great expectations as to the amount of archaeological work we could accomplish in a rough country of such expanse—but we were on our way. Our major problem would be to get back before the money ran out!

We were gone two weeks and put some five hundred miles on the bus, zig-zagging through the mountain passes and into the dense growths of mesquite

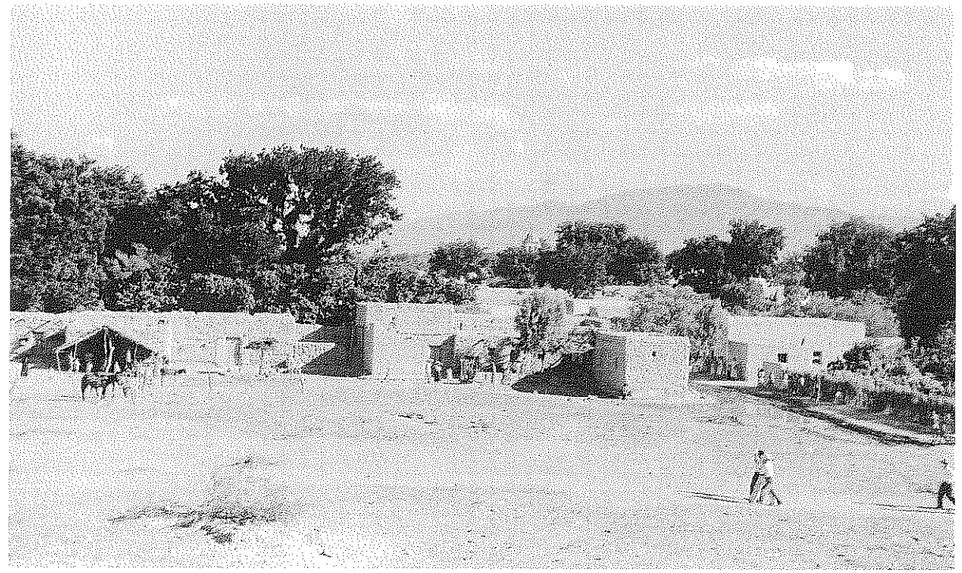


Fig. 1–2
The town of Cuatro Ciénegas from the north in 1939. Sierra San Marcos is in the background.

that border the playa basins, through the thorny cactus jungles of the *monte*, and over gravel terraces and down the rocky arroyos. Our voyage took us first to Cuatro Ciénegas, a small town of about one thousand inhabitants that served as the supply center for all of northwestern Coahuila (Figs. 1-1, 1-2), an area just slightly smaller than West Virginia. From there we went northeast to Valle Encantada within about 50 miles as the crow flies of the Río Grande but over 150 miles by the rut roads that a car had to travel. The old school bus performed well, and I was regaining my confidence until the third day out. On returning from a short reconnaissance on foot, Dudley junior and I discovered Roberto sitting on the ground busily scraping the inside of a cylinder with an old butcher knife and a piece of local bedrock wrapped in an oily rag. At his side was the cylinder head. The gasket, that delicate and indispensable wafer of cork, lay in the dust and rocks right in the middle of our camp—and at that time we were more than one hundred miles from any possible replacement and at least forty from human settlement. But the gods got things together again and, with no more serious problems, we made it back to the railroad and eventually to San Antonio.

As for archaeology, we found considerable evidence of prehistoric human occupation but no sites that looked promising for excavation. The banks of the arroyos were quite low and barren, not like those that Kelley had found in the Big Bend. Nor did we encounter any chipping areas, burnt rock middens, bedrock mortars, or other such "open" sites. We did find some pictographs and a few small rock-shelters that gave evidence of early human occupation in the form of nonperishable objects such as stone tools. But we began to develop the idea, later to be reinforced by experience, that the archaeological future of northern Coahuila would rest largely upon the discovery of sheltered sites.

1939: SECOND FIELD SEASON

In June and July of 1939, I went to Coahuila for a second survey season, again with Romualdo Guerra but in my own vehicle, a Ford roadster with a twenty-five-gallon auxiliary gas tank and twenty-one-inch wheels to get us over the high centers of the rutted tracks that passed for roads (Fig. 1-3). As in 1937, the border crossing was made over the Río Grande between Eagle Pass, Texas, and Piedras Negras,

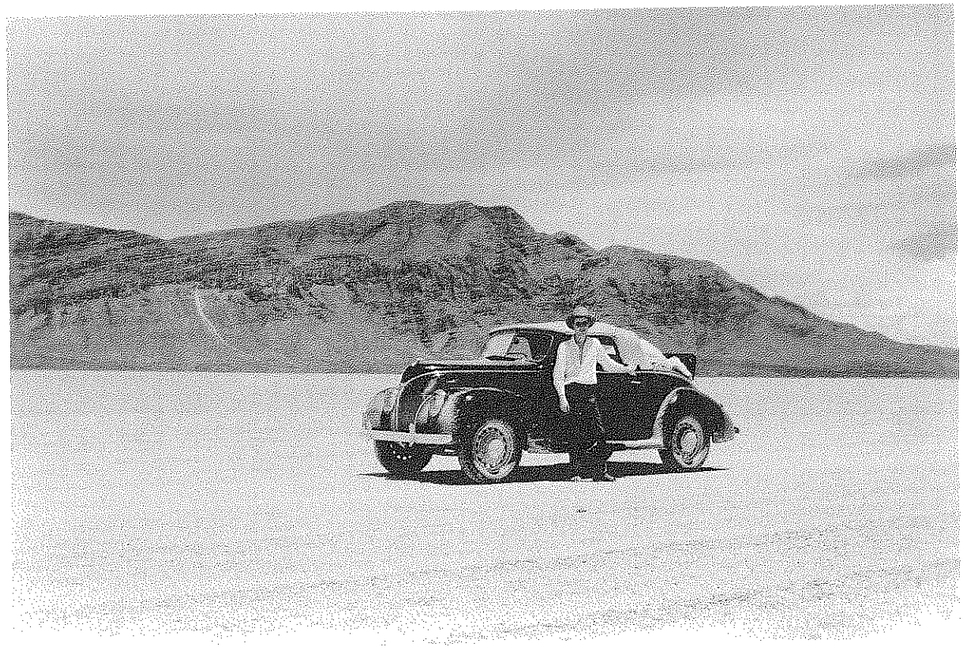


Fig. 1–3
Walter W. Taylor on the playa basin called Laguna de la Leche during the 1939 Coahuila Project. The photograph looks east across the basin.

Coahuila. Now began my struggle with immigration and customs officials to get myself and my equipment into and out of Mexico. At the very start, I discovered that Mexican money changers would not honor American Express traveler's checks, but this had a lucky turn. As I was about to cross back over the bridge to the United States to get my checks cashed, a man approached and introduced himself as Harold C. Wood, acting American Vice-Consul in Piedras Negras. This was one of the most fortunate events in all my work in Coahuila. From that day (which happened to be a Sunday, when he was officially off duty), Mr. Wood's eagerness to get us on the right path, his knowledge, and his personal generosity and friendship were to ease the way of archaeology and archaeologists in Coahuila until, in the late 1950s, he was transferred to another post. On this first occasion, he immediately took charge, insisting that I leave my loaded car for safekeeping at the American Consulate in Piedras Negras and driving me to the house of Mr. Jno Glass, Vice President of the First National Bank in Eagle Pass. There he vouched for me and arranged for cashing my traveler's checks then and in the future.

Just as we returned to the Mexican side of the river, a Mexican Immigration official stopped us and told me that a mistake had been made in the papers I had been issued and that I could not formally enter Mexico until other papers could be provided. But since the day was Sunday, the old papers had been locked in the safe and there was no one to attend to the matter until Monday. Of course, this meant that my car papers were also incorrect, and I could not drive it in Mexico. Mr. Wood suggested that I leave the vehicle at the Consulate until he could clear the matter with the Mexicans, and he invited me to stay at his house until all was in order and I could drive to Cuatro Ciénegas as planned. To reduce our sorrows and prepare for possible later disappointment, he offered to introduce me to "the best beer in the world," and thus I learned the lavish taste of Mexican Kloster draft in *chalupas* of sumptuous size. Later at their house in Eagle Pass, Mrs. Wood graciously invited me to go with

the family, including their two young sons, to their regular Sunday supper at Polo's Las Cabañitas restaurant in Piedras Negras, after which we returned to the Wood house and played bridge, in Spanish, with a secretary from the Consulate. From that day until the Woods left Eagle Pass, they had me stay with them whenever I passed through. Mr. Wood spent many hours of official and personal time attending to the business of the Coahuila Project. If it had not been for him, I am sure we would never have penetrated the red-tape jungles of either country and instead would have been borne down by my own mistakes and by the weight of bureaucratic bumbling that later was to plague us on both sides of the border.

The next day, Mr. Wood and I made several trips back and forth across the river to complete the necessary business and be assured by all concerned as to the correctness of my papers. Shortly after noon, I left for Monclova, where I picked up Romualdo Guerra, and for Cuatro Ciénegas, which had been chosen for our base of operations; it was the only town and supply center in the region where I planned to work (an area of some 23,000 mi^2) and I had a letter of introduction to Luis Uribe, who lived there.

For that year's survey, we planned to concentrate efforts west and northwest of Ciénegas and southward between Ciénegas and the Saltillo-Torreón highway. We spent 32 days in the field and were able to survey more extensively and intensively than had been possible in 1937. This time we found rock-shelters that had promising depths of cultural deposits, and in fact, we located three of the four sites that we eventually excavated in 1940 and 1941 with rewarding results. Once back on the border, it was discovered by the officials that the mayor of Monclova had issued me the wrong papers when I registered at the Palacio Municipal. The case would have been more than merely annoying if Mr. Wood had not stepped in and cleared up the trouble. This contretemps led him to point out to me a particularly valuable practice in dealing with officialdom on the border. Many officials, particularly those of the lower grades or in less active posts, often do not know the law very well. Therefore, a person wishing to cross the border with valuable and legitimate equipment should be able to recite the pertinent law that would permit him to bring it in—and get it out without risk of having it confiscated. For the same reason, he should never let a Mexican official "do him a favor" by permitting him to enter Mexico without the proper papers because, when he comes out, he may face a different official (or the same one) who could make his exit extremely difficult and unpleasant, even impossible without losing his equipment and paying a fine.

Once back in the United States, I went to Chaco Canyon, New Mexico, for my second season as a field foreman at the University's field school. The field director that year was Frank Setzler, Head Curator of Anthropology, U.S. National Museum, who had previously excavated sheltered sites in the Big Bend. We had many long talks about his experience there and the possible relationships with the materials from Coahuila immediately across the Río Grande. By the end of the summer, it had been decided between us that, if I could raise the necessary money, he would recommend me for an appointment at the National Museum and would begin a program of archaeological investigation in Coahuila within his department and under my direction. Early in 1940, Walter C. Teagle, Jr., a long-time friend, contributed $2500 to the project, a sum that Frank and I estimated would be enough for an initial season of excavation. The Coahuila Project was on its way.

1940 AND 1941: THIRD FIELD SEASON

During the summer of 1940, after a third and last season in Chaco Canyon, I went to Cuatro Ciénegas to make preliminary inquiries and arrangements for the field work that was to begin early in the fall. I spent my short stay in Monclova and Cuatro Ciénegas and then returned to the border, where my wife, Lyda, was waiting, and we drove back east. But the expedition was not to start as planned. Someplace between Chaco and Ciénegas I had picked up a case of typhoid fever.

The first wave hit me in San Antonio on the way home, the second at Jackson, Mississippi, and the third just as we arrived at Lyda's family house in Connecticut. Owing to my hospitalization and convalescence, we were unable to start for Mexico until mid-November.

In San Antonio, we met Albert Schroeder, who had signed on as my assistant, and we continued on to Eagle Pass. But we were not to cross for another three weeks, and since the problems lay in Mexico City and Washington, Mr. Wood could not help us. When fi-

nally the troubles cleared, we headed south, but the way was hardly smooth. We were stranded for three days in San Buenaventura, between Monclova and Ciénegas, waiting for the road to dry enough to allow us and a hoard of other vehicles to get through the westward pass. When at last we reached Ciénegas, it was Christmas Eve. We celebrated not only the Nativity but also our reaching the first rung of the Project.

Again Manuel Aguirre proved his worth. He found us a camp cook; he made it possible for us to obtain water from the tanks of the railroad section camps along the railroad right-of-way in the western desert between Cuatro Ciénegas and the mining town of Sierra Mojada; he gave us letters to many people in the west and, best of all, he gave us a letter of introduction to Luis Uribe of Cuatro Ciénegas. When I presented that letter to *don* Luis, he invited us to use his house as our base and provided a bedroom for Lyda, who was to perform laboratory and secretarial duties, and ample space for our laboratory, packing, and storage needs—and all at no expense to the Project. Most gratifying to us all, we were able to return some measure of thanks to the Uribe family: through Lyda's medical intervention and nursing care, *don* Luis's wife, *doña* Elena, survived a nearly mortal attack of undulant fever and phlebitis during that winter, when there was no doctor in Cuatro Ciénegas.

On January 4, 1941, we started excavations in Fat Burro Cave (CM24) about 20 miles west of Ciénegas. After finishing that site, we excavated Nopal Shelter and tested CM37, only to find it virtually barren. About mid-February, we moved camp to the *monte* at the mouth of Cañon Espontosa, an hour's horseback ride below Frightful Cave (Cueva Espontosa, CM68). Work ended there on May 23, and we moved into the Uribe house to be nearer to the laboratory and storage facilities. Our formal excavation program had been completed. Schroeder stayed in town to help Lyda with the final cataloging and packing, while Juan Mata, one of our excavators, and I did some further surveying in the far northwestern corner of the state. When all work in town had been finished, Schroeder, Mata, and I did salvage work in several vandalized sheltered sites to obtain human skeletal material to supplement our very meager collection from the excavations. On June 26, I took Schroeder to the border, so that he could make his way back to Tucson. After my return to Ciénegas, Lyda and I loaded the truck with our collections and personal belongings and left the little town on July 2.

Mr. Wood was waiting for us at the border, but once more there were difficulties about our papers. Again the problems lay in Mexico City and Washington, and this time there were seven weeks of idleness while we waited for their resolution. However, the time was not utterly lost, because during our delay I was able to visit collections of Big Bend and Coahuila material at Sul Ross College in Alpine, Texas, and at the Skiles store in Langtry, Texas. I was also able to go to the ruined mission at San Bernardo on the Coahuila side of the Río Grande below Eagle Pass with a party from San Antonio that included Colonel Crimmins, with whom I had corresponded back in 1937. The mission site was of interest as an historic monument to which, in the seventeenth century, Coahuiltecan-speaking Indians had been reduced and where not a few of them had died and been buried in a special cemetery. If permission could be arranged, the osteological remains from those graves should provide much-needed evidence to augment the meager collections from our excavations.

When finally we were free to continue on our way, Lyda and I drove the truck to Mexico City to have the archaeological material inspected and then back to San Antonio, where the vehicle was sold and the proceeds returned to the Project's account. Then we drove our own vehicle back to Washington, arriving almost exactly ten months from the date of our departure in 1940. Of our original stake of $2500 the sum of $97.02 was returned to the National Museum —causing quite a stir: I was told never, under any circumstances, to return "small money" from a grant. When the specimens arrived in Washington some time later by sea, I immediately began laboratory studies, first at the National Museum and then at the Peabody Museum, Harvard. This work was stopped in the spring of 1942 when, because of the imminent war, I shifted to the writing of my doctoral dissertation based largely upon ideas developed during the work in Coahuila.

COAHUILA ARCHAEOLOGY

Before abandoning the study of the Coahuila material, however, I was invited to give a seminar to the faculty and students of the Department of Anthropology at Harvard describing what we had found in Coahuila and what I believed to be the significance of archaeological work in that area. I began by stating two basic assumptions: first, that one of the major problems of American archaeology is the demonstration of the biological and cultural relationships among the prehistoric and modern peoples of what we now call the Greater Southwest (Kirchhoff 1943a:133–144); second, that one of the most productive methods in archaeology is that of proceeding from the known to the unknown.

On these premises, then, the study of prehistoric remains from Coahuila holds considerable promise. We already have a relatively large body of information from the cave cultures of the Big Bend of Texas immediately across the Río Grande north of Coahuila, and these data have at least generic similarities to those from other cave cultures and their descendants throughout much of the Greater Southwest. Southward from the Río Grande through the desert of western Coahuila, we have a gap in our information extending to the Laguna District of southwestern Coahuila, where there are small but very interesting collections from the isolated sheltered sites of the Palmer collection at Harvard and from Cueva Candelaria now at the National Museum of Anthropology in Mexico City. Beyond these sites, to the west and south, we have another gap extending to the site of Zape in the state of Durango and, in sort of a semicircle, southeastward around to the sites of Chalchihuites and La Quemada, both in the state of Zacatecas. These sites are generally considered to be the northernmost outposts of Mesoamerican culture and, thus, would constitute the final link in our studies of the cultural and chronological relativity between the cave cultures of the southwestern United States and high cultures of Middle America. In this record, it is propitious that rather sizeable river valleys, the Río Aguanaval from the south and Río Nazas from the west, lead from the vicinities of these sites into the interior basin of the Laguna District of Coahuila and could, therefore, have provided easy passage for cultural interchange.

In addition to these culture-historical problems, I believe that the archaeology of cave cultures, even as simple as they are in the Greater Southwest, presents an opportunity to work on problems of prehistoric culture per se. The first reason for this is, of course, the factor of preservation in sheltered sites, but possibly the major reason is because there is the chance that a fuller representation of the aboriginal culture roster, whatever it was originally, will have been preserved within the dry atmosphere and protecting walls of a sheltered site. Then too, in such sites the stacking of deposits within confining walls will have reduced, even eliminated, horizontal dispersal and hence loss and/or distortion of the true stratigraphic record as so often happens in open sites. In other words, I assume that sheltered sites contain a fuller and truer record of what cultural goods the inhabitants did have, although the culture itself may have been less elaborate than that of other types of sites.

1946 FIASCO, 1947 FIELD SEASON

In the fall of 1945, I moved my family to Santa Fe, New Mexico, where I wrote *A Study of Archeology*, which is a reworking of my doctoral dissertation, incorporating many ideas that I had acquired while working in and on Coahuila and had thought about during my participation in World War II. When that chore was completed, I turned once more to the Coahuila Project. Above all, I wanted to get back into the field to find sites that would throw light on culture-historical problems of northern Mexico and, by extension, on the nature and workings of culture itself as represented in that region.

In the spring of 1946, I requested the National Museum, of which I was still a Collaborator in Anthropology and now, in addition, Director of the Northern Mexico Archaeological Fund, to make application for the necessary Mexican permits. There was a long and ominous silence from Washington during that summer and early fall. A few times, in response to my proddings, they assured me that the American Embassy in Mexico was attending to the matter, was well aware of the appropriate procedures, and would obtain all the necessary papers in plenty of time for the work to begin in the fall as planned. But it was already late in the season when Washington informed me that the papers had been sent to the border; I left Santa Fe for Eagle Pass the next day, on October 12.

Upon arrival, I noticed that Mr. Wood was hardly joyous. In fact he appeared considerably worried even though he had in his hand my Special Passport and a permit to do archaeological work in Mexico from the Secretaria de Educación Pública, both forwarded from the American Embassy through diplomatic channels by way of the Consulate in Piedras Negras. The

next morning, however, we found that neither the Immigration nor the Customs officials had received any authorization from Mexico City to pass me or my equipment across the border. They were most solicitous, and also most correct, in pointing out that an American passport gave Mexican officials no authority to act on special immigration matters and that a permit from the Secretaria de Educación Pública did not authorize customs officials to act at all. What was needed were papers from the appropriate Mexican departments. Despite a snowstorm of telegrams, letters, and telephone calls between Piedras Negras, Washington, and Mexico City, no additional authorization arrived at any of the Mexican offices in Piedras Negras. On November 9, at the end of four long weeks of futile efforts, I left Eagle Pass for home because the time remaining before winter was too short to make worthwhile any further expenditure of time or money in either waiting at the border or working in the field.

In 1947, I again requested that Washington make an early start in applying for permits, this time explaining just what would be required. I added that I would not leave Santa Fe until I had received definite word from the American Consulate in Piedras Negras that all necessary and correct permits had actually arrived at the proper Mexican offices on the border: no more promises, no more "tomorrows," no more "we know bests," no more "why don't you do this or that [impossible] thing," in short no more waste of time and research funds waiting at the border. Toward mid-September, Mr. Wood wired me that the papers had arrived, and on the 13th, I left Santa Fe with a jeep and a two-wheeled military surplus trailer. After only a few small problems and one bang-up Mexican holiday, on September 18, Mr. Wood personally conducted me across the border, and by 7 p.m., I was at the Uribe house in Cuatro Ciénegas. The road from Monclova had been paved as a wartime measure during my six-year absence, but nothing else had changed. It was good to be home!

During that season, I spent sixty days in the field, again working northwest and south of Ciénegas. Eusebio ("Chebo") Perez G. came along as general helper, including duty as cook, camp watcher, automobile mechanic, occasional relief driver, guide, and most enjoyable companion. He eased my work and made much of the trip a pleasure, even though the weather was cold, rainy, and generally miserable for most of the time.

We found a considerable number of sites, but none of much promise. I began to realize that the ancient peoples of Coahuila occupied very few selected caves and apparently lived most of their lives in temporary, open sites, where their leavings are thin, scattered, and for long ages subject to disturbance. Deep deposits of cultural debris are extremely rare and, where they exist at all, have almost invariably been disturbed by random digging or by being thoroughly cleaned out to make way for goat pens. One of the tasks set for that season was to visit sites reported by two archaeologically interested Americans who had traveled the region: botanist Edward Palmer in the 1880s and Raymond Emerson, connected with the Peabody Museum at Harvard, in 1935. None of these sites proved worth excavating, although one of Palmer's sites, Cueva Candelaria in the Laguna District, would later be excavated in the 1950s and reported upon by Luis Aveleyra of the National Museum of Mexico. Thus, taken as a whole, the 1947 season added little to our prospects for future work. It did extend the known distribution of aboriginal sites and gave us ideas as to specific areas where productive occupation sites might be expected and where future survey and eventual excavation might be done.

But that season did have one positive and very valuable result. It had become apparent by the end of the second field season that it would be utterly impractical from a logistic standpoint to select an area at random, a mountain range, canyon system, or expanse of *monte* and then simply go there and look. The point of diminishing returns would set in too swiftly and with too devastating an effect. Selection of an area-of-work had to be made before entering the field and after explicit plans and logistic preparations had been made for reaching and returning from the selected target or targets. I learned to make detailed circular itineraries out from and back to Cuatro Ciénegas, usually occupying a span of two weeks, which was about the limit of the food and gasoline we could carry and not be stranded in some remote corner of a vast area (I will not relate the painful story of our attempts to set up local re-supply dumps other than to say that they did not succeed).

It had also become very apparent that we could not depend on getting serviceable information from the people living in the small settlements that sparsely

dotted the western desert. The men were often away at work, and we would wait, sometimes for days, for their return. When a possible informant did return, he was seldom interested in, or even knowledgeable about, the matters that concerned us. As for the women staying at home, they were uniformly shy, suspicious, and obviously frightened of strangers, and the very few we did get to talk proved even less interested and knowledgeable than the men. Nevertheless, we had to develop some method of obtaining information to guide our selection of areas for investigation.

THE CANTINA TECHNIQUE

Toward the end of the 1940 and 1941 season, I had come to realize that the most efficient and profitable method of obtaining information would most probably be to get potential informants to come to us rather than to search for them. We could assume an interest and some knowledge on the part of a volunteer informant, and the problem of the truth and value of his information would become a second-level matter that would ultimately be tested in the field. Our first step toward implementing this approach would be to start a campaign of word-of-mouth advertising to attract informants. In the spring of 1941, we began to broadcast as simply and succinctly as possible and at every opportunity the specifications of what we were looking for. We did not waste time on the whys and wherefores but dealt primarily with the descriptive details of the cultural remains that interested us. Soon we were being stopped on the streets of Ciénegas and in the field to be told of some find that, so the informant thought, would be of interest, even importance, to us. Of course, we heard much about what were obviously ancient elephant bones, early Spanish accoutrements, amazingly formed rocks and trees of wondrous shapes. That we had to winnow these outpourings of good will was our problem; the important thing was that the information was coming to us voluntarily and from sources that we would not have reached for years, if ever.

But in Pedro González's *cantina* in Cuatro Ciénegas the technique really paid off. It was the custom of both *campesinos* and townsmen to gather there on Sunday mornings to exchange a little gossip, tell a few stories, and take on a few, or not so few, warm beers to lubricate the fellowship and ease the road back into the parching desert. When in town, I sometimes joined them but had never made a regular practice of attending. A relative stranger, I did not feel completely at ease entering what was so obviously a long-standing circle of friends. But *don* Pedro's eldest son was working with us, and I felt that gave me some sort of entree. On one particular Sunday morning when I did attend, there was an unusually large group and more than the customary number of men who already knew me. As often happened, the talk at the big table before the bar turned to what we were doing in Ciénegas, what we were looking for by traveling over so much empty desert, and what we were going to do with what, if anything, we ever found or learned. As before, it was plain that they did not believe me when I told them the truth; it seemed outlandish to them that a grown man would devote his time to such things—as I recall, they conspicuously refrained from calling what I was doing "work."

When they tired of cross-examining me, I began to inquire of them. Where did they live? What sort of country was there? Had they ever seen evidence of *los indios antiguos*? Had they found any stone points or metates or pieces of broken pottery? Had they ever seen caves or rock-shelters in which there were sandals of fiber, baskets, or human bones? There developed among the men a gentle and probably unconscious competition as to who could report the most numerous and noteworthy discoveries. Many men who had remained silent on previous occasions began to volunteer information, and it soon became a matter of one-upmanship, of *kudos*, to see who could provide the *norteamericano* with the most exotic information. They were coming to me, and from then on that was the way it was.

Later, in 1947, an incident occurred that demonstrated another value of the "cantina technique," one that assisted my social advancement to a recognized and accepted place in their society and took me out of the class of outsiders. One Thursday afternoon, when I was in town to take on supplies for another circle into the desert, I went to the cantina for a short refresher. The group at the big table was much smaller than the usual Sunday gathering and included a rather large, florid man obviously of considerable prestige. After a few men had come forward with stories of finding *cosas de los indios antiguos*, this man somewhat hesitantly began to describe some things he had found on his ranch north of Ciénegas. He said that in a small

cueva far back in the mountains at the mouth of an isolated canyon, he had seen, in addition to the "usual" run of mats and sandals, a series of curious figures painted on one wall in some indelible white pigment. He said that one of the figures was "the number two," and he asked me why *los ancianos* would have painted such a thing. Suddenly I realized that he was talking about one of our survey sites that I had visited ten years earlier on a ranch called Palos Blancos. As usual, I had painted the site number, CM2, on the walls and, in this instance, had added my rubric, WWT. Here surely was an opportunity, and I began to ask him questions: Did the cave not have a large, limestone boulder just to the south of the entrance? Was there not a pile of burned arroyo stones in the very center of the platform in front of the entrance? Was there not a grove of desert walnut trees and a pole corral about one hundred meters down the canyon from the cave? Was not the mouth of the canyon about a league north of a place called Tinaja del Macho on a ranch called Palos Blancos? At first the man frowned and looked incredulous, then as the light dawned he slapped the table and laughed and shouted to his friends that here was an *estranjero* who knew his ranch as well as he did. He insisted on giving me a violent abrazo and bought a round of beer. Every once in a while for the rest of the afternoon, he would shake his head, chuckle, and laugh again in disbelief that so strange and wondrous a thing had happened on his ranch. As it came time for us all to leave, he said that I should come stay with him at his ranch, where he would show me many caves with "real" Indian paintings; he said we would have a fiesta and a *pique-nique* with a *cabrito al pastor* and beer and music. And so we did.

Friendship and patronage are contagious. That afternoon in Pedro González's cantina, I made a host of friends. Afterward in later years, *campesinos* and *rancheros* would wait for me in the cantina on a Sunday to remind all present of what happened that Thursday afternoon and to tell me of caves and other wonders that they knew of near their homes in the desert. I was a stranger no longer and had many volunteer sources of information throughout northern Coahuila.

But all was not clear sailing. Many times the facts did not fit the telling, and we had an outrageous number of wild goose chases. We would arrive at a cave that, as claimed by the informant, "could hold a hundred goats" only to find that two new-born kids and a nanny would be uncomfortably crowded in the tiny, barren, sun-scalded hole-in-the-rock to which we had been led. But failure to produce as so grandly promised never seemed to embarrass the informant-guide, even if he was present to participate in the fiasco. It seemed to make no difference whether the distance he had lured us was a few hundred meters or measured in leagues of stony, cactus-covered, pathless, and waterless desert. Of course, some men intentionally told tall tales, but a large majority of those who let their enthusiasm run away with the truth did so because they wished to please, to tell me what they knew I wanted to hear. Even after I learned not to ask leading questions and not to include the answer in my question, the tales induced by the excitement and competition in the cantina put a heavy burden on our survey work. I felt I had to check out each story or at least as many of the more likely ones as I could, because I had no sure way of telling which ones were false and which would prove a bonanza—as actually happened in the case of the fabulous Frightful Cave (Cueva Espontosa, CM68).

In closing this account of the "cantina technique," I should mention that it was also a great help in obtaining information on the presence and distribution of plants and animals throughout the region, something that would have been utterly impossible had we been required to do the biological fieldwork ourselves. In 1940, I brought with me a copy of one of my childhood books, *Wild Animals of North America*, published by the National Geographic Society. On later trips, I brought field guides to birds and plants as well. One at a time, these would be brought out at the cantina sessions for the purpose of starting discussions among the men. I kept notes as well as I could of the give-and-take with the purpose of constructing distribution maps of various forms to compare with findings from our excavations.

ADDITIONAL EPISODES

The last real season of work for me in Coahuila was that of 1947, but there remained several more episodes that added to our information and should be reported as part of the Coahuila Project. In 1950, I went to Cuatro Ciénegas to box the artifacts gathered during the 1947 season and left in storage at the Uribe house. After three days of fieldwork, cantina sessions, and sidewalk encounters, I took the boxes to Mexico

to be inspected and then returned by way of Ciudad Juarez, Chihuahua. Again, because of improper papers given to me by the authorities in Mexico City, I had to leave the crate of specimens with a customs broker at the border for later shipment to Santa Fe.

In 1952, accompanied by Norris Bradbury, Director of the Los Alamos Scientific Laboratory in New Mexico, I met J. Charles Kelley in Parral, Chihuahua. After a few days in the field looking at some of Kelley's sites near the city of Durango, Norris and I went to Cuatro Ciénegas for a busman's holiday and a visit with the Uribe family. After one last cantina session to ask some specific questions, we returned to Santa Fe.

In the spring of 1954, with Alex Krieger and Edward Jelkes and at the invitation of *don* Pablo Martínez del Río and the Instituto Nacional de Antropología e Historia, I went to Torreón, Coahuila, in the Laguna District to visit the excavations in progress at the now-famous Cueva Candelaria and other sites. It was a very instructive outing and gave me a first-hand look at that important but little-known region. By late fall, all the laboratory work on the Coahuila material had been finished, at least as far as I could go at that time. Somewhat later still, all the Coahuila material that I had been studying in Santa Fe was returned to the National Museum in Washington, and our whole family moved, permanently we thought, to Coyoacán, a suburb of Mexico City. I had accepted a professorship at the Escuela Nacional de Antropología e Historia. Soon after settling in, I starting writing the report of the Coahuila Project.

In early 1956, the Dirección de Prehistoria (in which I had been given a research position in addition to my teaching duties in the Escuela) assigned me to direct excavations in Cueva Tetavejo, lying about halfway between Hermosillo and Guaymas in the state of Sonora. I abandoned the writing of the Coahuila report to concentrate on the work there.

In the early spring of 1957, I took our three children for a short vacation to Cuatro Ciénegas. No archaeology was done during this trip, but we did visit Fat Burro Cave (CM24), and camped out close by for one night. That turned out to be my last visit to Cuatro Ciénegas.

In 1958, the Dirección of Prehistoria commissioned me to direct the Mexican part of a joint Mexican-American survey of the land that would be flooded by the construction of the then-called Diablo Dam, now named the Amistad Dam, on the Río Grande north of Ciudad Acuña, Coahuila, and Del Río, Texas. Francisco Gonzalez Rul, a student at the Escuela Nacional, was to do the fieldwork under my direction. We left Mexico City on January 30, and I stayed until February 13, meeting with the American team to coordinate plans and getting Paco Rul started in the field, and then returned to Mexico City. On March 26, after receiving word that the fieldwork had been terminated, I returned to Coahuila to visit sites and to close the project. On March 31, the last day before returning to Mexico City, I hired a Piper Cub and pilot from the Del Río airfield to fly me to the Cuatro Ciénegas basin (Fig. 1-1) to view and photograph from the air some areas that I had previously been unable to reach, particularly the east flank of Sierra de la Fragua southwest of Ciénegas. We sighted several interesting looking caves and rock-shelters as well as a number of burnt-rock middens. We also flew over Frightful Cave (Cueva Espontosa, CM68) and around the head of Cañon Espontosa but could not see any signs of the trail that had been said to lead over the pass into the Contotores basin to the east. Later, Paco Rul wrote a report on the survey for his master's thesis at the Escuela and, during the winter of 1961, while in Mexico City on leave from Southern Illinois University, I used his report as the basis for a joint paper (Taylor and Rul 1961). I also wrote an account of our work for the official progress report on the Diablo Dam project (Taylor 1958).

In 1964, from the end of June until the end of September, I worked out of Sombrerete, Zacatecas, as part of a National Science Foundation–Southern Illinois University project, of which J. Charles Kelley, Pedro Armillas, and I were co-principal investigators. My field crew consisted of two graduate students from the university, Joseph Mountjoy and Richard Pailes; an undergraduate from Beloit College, Michael Whiteford; my youngest son, Natch, age sixteen; and Martín Barajas as cook and camp watcher. The purpose of our part of this project was to obtain information on the culture(s) of the region and their relationships, if any, with the Mesoamerican manifestations to the south and the cave cultures of Coahuila to the north. Essentially, it was to be a test of my ideas as to the possibilities of establishing a cultural continuum running north and south through western Coahuila between the cave cultures of the Greater Southwest

and the Mesoamerican cultures of central Mexico. Overall, the results of this test were inconclusive, although by the end of the season it appeared that we were on the track of some of the evidence we were hoping for.

Once back in Santa Fe, Richard Pailes and I worked from October until almost Christmas organizing the collections and beginning laboratory study. Just as we were shutting down these operations preparatory to returning to the university, we discovered that virtually all of the stone projectile points had disappeared. This was a real disaster because we were counting on them to provide the basis for establishing cultural relationships and relative chronology for our sites. After a bit of detective work, the evidence led us to one of the teenage boys we had hired to help us. He finally admitted stealing the specimens for his collection "of Indian things"; he said he "didn't think they were all that important." The devastating aspect of his theft was that he had taken the points out of the field sacks before they had been marked and cataloged, so that the specimens had lost all provenience and hence all cultural context and chronological significance. The final blow was that he no longer had the points and, we suspected, had probably jettisoned them when our investigation began to get close to him. Thus the field and research part of the Coahuila Project ended on a very sour note.

CHAPTER 2

Coahuila Geography

The state of Coahuila lies between the states of Chihuahua and Nuevo Leon, immediately across the Río Grande from west and southwest Texas (Fig. 2-1). It is the third largest Mexican state, with an area of slightly more than 58,000 mi^2, about the size of Georgia or Michigan. From the standpoint of topography, Coahuila may be divided into three major regions: northeastern or Coastal Plain, central or Mountain, and western or Desert, the last encompassing a southern subregion that may be called Southern Desert (Baker 1956). The Coastal Plain Region lies between the Mountain Region and the Río Grande (Fig. 2-2) and is an area of little topographic relief, varying from approximately 700 to 800 feet in elevation, with horizontally bedded limestone formations eroded into low, rounded hills by the intermittent streams that, when they flow at all, flow eastward into the Río Grande; within its southern portion, east of the town of Sabinas, a number of isolated hills and ridges of low relief break the generally smooth, eastward slope of the land.

The Mountain Region consists of a massive highland chain, with elevations from approximately 9000 to 10,000 feet, that forms the southern extremity of the Rocky Mountains, the great cordillera of western America (Fig. 2-3). It forms a divider between the Coastal Plain, and the Desert and, from just north of the city of Saltillo southward, is usually called the Sierra Madre Oriental. This region begins at the Río Grande in the northernmost part of the state and runs southeastward to the southeastern border with, however, a marked break in its massiveness from the town of Melchor Múzquiz southward almost to Saltillo. Most of the mountains are of Cretaceous limestone, although on the tops of some and in the lowlands between others, particularly in the northwestern part of the state, there are extrusive volcanic formations.

The Desert Region, lying in the west and southwest sectors of the state, is part of the vast Central Mesa of Mexico that extends northward from the latitude of Mexico City to the Río Grande and the international boundary and beyond (Fig. 2-4). It is by far the largest topographic region in Coahuila and is dotted and streaked with a multitude of northwest-southeast trending, mostly limestone block-mountains that reach altitudes of approximately 6000 to 7000 feet. Between these mountains are lowlands of largely interior drainage, rising from 1700 feet at Boquillas on the Río Grande to more than 4000 feet in the south. In the Southern Desert Subregion, between Saltillo on the east and Torreón on the west, the block mountains and the intermontane basins have an atypical east-west orientation. Into this subregion at its western end emerge two rivers that once, before humans appropriated them for their exclusive use, were permanent streams of considerable size. The Aguanaval rises in the state of Zacatecas to the south and the Nazas rises to the west in the state of Durango. They once terminated in two "lakes," Viesca and Mayran, respectively, which early Spanish documents say were permanent bodies of water greatly attractive to the aboriginal people. These lakes (Fig. 2-1) are now dry, their waters controlled and diverted and their sediments farmed to support one of the great agricultural areas of Mexico.

CLIMATE

The climate of Coahuila is arid, except on the higher elevations of the mountains in the southeastern corner of the state. The Coastal Plain receives moisture from the Gulf of Mexico, and an annual precipitation of approximately 20 inches falls near the mountains, with somewhat less rain toward the Río Grande. By the time the easterly winds have passed the mountains, they have lost most of their moisture and the Desert Region receives an average of less than 10 inches, again excepting the very highest elevations, which catch slightly more. On my first trip to Coahuila, in 1937, I was told by a rancher just north of the town of Cuatro Ciénegas that there had been no rainfall on his very large ranch for the previous seven years, but I

have always wondered whether this was a Biblical measure or an actual figure (see also Baker 1956:131). Winds entering Coahuila from the west bring even less moisture: coming the long distance from the Pacific Ocean, they precipitate most of their water over the Sierra Madre Occidental, and what little remains is dropped upon the arid lands of the state of Chihuahua before ever reaching Coahuila. Baker (1956:127, 131) says that "most of the 144 kinds of mammals . . . that live in Coahuila must have the ability to live their entire life spans without the opportunity to drink surface water. . . . Springs and other surface water are either scarce or absent west of the mountains." The highest annual rainfall and the most humid (i.e., the least arid) conditions occur in the high mountains surrounding Saltillo. Where I have traveled in Coahuila, which amounts to over one-half its area, I know of only one run of living water other than those that flow from the northern mountains eastward through the Gulf Coastal Plain into the Río Grande. That one, La Camponada, rises in the Sierra de los Hechiceros in the very northwestern corner of the state, but once outside the shelter of its mountain of origin, it does not last a mile before sinking into the desert sand.

VEGETATION

Biologists who have worked in Coahuila have divided the state in a number of ways. Baker (1956:133) states that "for the study of mammalian distribution. . . . Merriam's life-zones are the most satisfactory major divisions, and Muller's vegetation-types provide the most useful minor divisions." He also says that "climatic and edaphic factors interact to influence the distribution and abundance of vegetation in Coahuila" (1956:132). Following Merriam, then, he continues: "More than three-fourths of the total area of Coahuila is included in the Lower Sonoran Life-zone. . . . This expanse includes areas ranging from less than 800 feet (approx. 245 meters) in the northeast to more than 5000 feet (approx. 1539 meters) in the south and west. Using Muller's floral divisions, two vegetation types are distinguishable: the Tamaulipan Thorn Shrub and the Chihuahuan Desert Shrub" (Baker 1956:134). Because the Coahuila Project was confined to the Lower and Upper Sonoran zones, with only very tentative probes into the Transition and Canadian life zones, description is limited to the two former divisions and only passing reference is made to conditions in the latter two. For the same reason, the area of the Tamaulipan Thorn Shrub has been neglected in favor of more detailed description of the Chihuahuan Desert Shrub vegetation type.

The Chihuahuan Desert Shrub covers the lower elevations in all regions of the state of Coahuila (Figs. 2-5, 2-6), except that of the Coastal Plain. The soils from which it grows are shallow, stony, immature, and often alkaline, characteristics that, together with the climatic aridity, favor the succulents and xeric annuals and perennials found sparsely scattered among low shrubs such as creosote-bush (*Larrea* sp.), tarbush or *ojas* (*Flourensia cernua*), leatherplant (*Jatropha spathulata*), *candelilla* (*Euphorbia antisyphilitica*), and rubberplant or *guayule* (*Parthenium argentatum*).

It is only in restricted places where there happens to be more moisture, such as along watercourses that carry off the occasional rains or in sheltered canyons, that the larger shrubs and low-growing trees can prosper at all: mesquite (*Prosopis* sp.), desert willow (*Chilopsis* sp.), hackberry (*Celtis* sp.), *huisache* (*Acacia farnesiana*) and catclaw (*A. greggii*), walnut (*Juglans* sp.), and pecan (*Carya* sp.) are among the most prominent (Fig. 2-7). In the north and central parts of the state, small areas of grasslands, mostly confined to soils of igneous origin, contrast sharply with the desert shrub that grows on the more widespread limestone soils. The following succulents grow on the stony soils and rocky scales of the limestone hills and canyons: various agaves, including the economically important *Agave lechuguilla* and *A. maguey*; *aguapilla* (*Hechtia* sp.); varieties of yucca, *ocotillo* (*Fouquieria splendens*), and prickly pear (*Opuntia* sp.); and many kinds of *Mammillaria* and *Echinocactus* (Fig. 2-8).

FAUNA

Animal life includes a variety of lizards and snakes that are not, however, very conspicuous; nor are birds, except for quail and doves, hawks and vultures, and a light, temporary concentration of waterfowl on the ponds and streams of the Ciénegas basin during the winter months.

Mammals also are scarce in the Chihuahuan Desert Shrub, although a number were, and still are, of economic importance. Larger mammals, more dependent upon surface water, understandably have greater difficulty in maintaining themselves in such arid country and, at the same time, have had to withstand a considerable amount of hunting pressure, both ancient and modern. Baker lists both the mule deer (*Odocoileus hemionus*) and the white-tailed deer (*O. virginianus*) as residents of the Lower Sonoran zone, but he identifies the latter with the Tamaulipan Thorn Shrub and the former with the Chihuahuan Desert Shrub, noting that the two ranges overlap where the white-tailed deer occurs in sheltered areas that support growths of oak, even at lower elevation (Baker 1956:134–136). In the last statement lies the key to the ranges of the two deer species. The white-tailed deer is associated with oak brush more-or-less wherever it grows; the mule deer is associated with "the desert plains and the rugged terrain of the arid foothills" (Baker 1956:318).

However, it is pertinent to a general discussion of climate and biology to mention the existence of a considerable body of evidence in the archaeological record for a gradual but noticeable desiccation in Coahuila between the time of the first radiocarbon dates, about 7300 B.C., to the time of the last, about A.D. 1000. This evidence consists largely of the remains of animals, typical of more mesic conditions, that decreased markedly or disappeared entirely from the bottom to the top of the cultural deposits in Frightful Cave (CM68) and that are now no longer present in the region of the cave: grizzly bear, *Ursus* "of the planiceps group"; jaguar (*Felis onca*); yellow-haired porcupine (*Erethizon dorsatum epixanthum*); antelope (*Antilocapra americana*); bison (*Bison bison*); and land snail (*Humboldtiana taylori*) (Drake 1951; Gilmore 1947; Metcalf and Riskind 1979). One additional piece of evidence may be of importance here. With the exceptions of one mountain sheep bone in the Top Level and one bison bone in the Bottom Level, no remains of these animals were found in Fat Burro Cave (CM24). Since the earliest date from this site is 3295 B.C. ± 85, this date may serve, at present, as an approximate terminus ante quem for the extinction of those animals and an approximate date for the attainment of the modern, more xeric climate and probably the Lower Sonoran life zone. But it is important to remember that there is no evidence from the archaeological record that the Desert Region of Coahuila has ever been anything but semiarid at best. The desiccation culminating around 3000 B.C. was probably a matter of slowly shifting degree, not one of drastic or sudden change. On the other hand, many sheltered areas of relatively low elevation and a Lower Sonoran vegetation today, such as Cañon Espontosa (Fig. 2-7) and Cañon Piedragosa, may have had an Upper Sonoran type of vegetation during early times, including heavier stands of oak, mescal bean, and buckeye, all of which still grow in both canyons, as well as piñon and juniper, which do not.

Baker (1956:136) says that "less than one-fourth of Coahuila lies within the Upper Sonoran Life-zone. This life-zone encompasses the higher parts of the lesser mountains but is more pronounced in the foothills and the southern exposures of the upper slopes of the higher mountains." The oak, in many forms including the live oaks (*Quercus virginiana*), is the dominant floral type, except in areas of the Grassland Transition and Grassland vegetation types, the latter minimally represented but the former "occurring about the flanks of most of the mountain ranges" of the state (Muller 1947:46). In the Montane vegetation-type flora of the Upper Sonoran, there are also present piñon (*Pinus cembroides*), juniper (*Juniperus pachyphloea*), mescal bean (*Sophora secundiflora*), madroño (*Arbutus xalapensis*), Mexican buckeye (*Ungnadia speciosa*), and in some places, several kinds of grasses such as the gramas (*Bouteloua* spp.). In the grasslands, particularly in the rocky parts, grow sotol (*Dasylirion* sp.), bear grass (*Nolina* sp.), yuccas of several kinds, and an occasional oak (*Quercus* sp.), piñon, or juniper. The mammalian fauna of the Lower and Upper Sonoran life zones is much the same, the differences being mostly a matter of relative quantity. In fact, according to Baker (1956:143-144), the Lower Sonoran has only eight nonflying genera not also found in the Upper Sonoran, while the latter has only four not found in the former—and, of these, several cannot be considered as having significant economic importance to the aborigines of Coahuila, who are said in the archival records to have eaten almost anything that moved of its own free will (see de Leon 1649).

Baker (1956:138–139) observes that "less than one-fifth of Coahuila lies within the Transition Life-zone. The dominant tree is the Arizona pine (*Pinus arizonica*). It may occur in association with large oaks and Douglas fir (*Pseudotsuga taxifolia*)." The Arizona cypress (*Cupressus arizonica*) is also present, and on the tops of higher mountains and remarkably low on some of the eastern highlands, where rainfall comes directly from the Gulf of Mexico, are stands of pine of varying

density and robustness, but Baker (1956:139) says that these rather small enclaves "influence the distribution of mammals only slightly." As far as I am aware, no remains of prehistoric people have been found in this life zone in Coahuila.

The Canadian life zone is present "near the summits of at least four of the highest mountains of Coahuila. Small groves of quaking aspen (*Populus tremuloides*) exist on Sierra del Pino and Sierra del Carmen. No mammals characteristic solely of the Canadian Life-zone are found in these mountains" (Baker 1956:139–140). To my knowledge, no remains of prehistoric people have been found in this zone in Coahuila.

DRAINAGES

The Cuatro Ciénegas basin, where, probably for good culture-ecological reasons, a large majority of our sites were found and in the immediate tributaries of which are located all but two (CM62 and CM79) of the others described in this volume, is a unique and interesting area from many points of view (Figs. 1-1, 2-1). It is a tectonic structure extending about 30 miles east-west and from 10 to 25 miles north-south at maximum reach. Four passes provide base-level routes into and out of the basin: Puerto del Carmen from the Coastal Plain on the east, Puerto San Marcos from the south, Cañon de Jora from the west, and Puerto Ciénegas from the north. As for water, although there may be other, smaller streams of which I am unaware, only three permanent watercourses flow into the basin: one southward out of Puerto Ciénegas, one northward through the commune of La Vega from several large springs that rise in Sierra de la Purisima south of the basin, and one that flows northward from a large spring, called Agua Nueva, in the southeasternmost embayment of the basin. Other than these, the waters that are responsible for the marshes, ponds, and pools that give Cuatro Ciénegas its name (*ciénega*: marsh) and the area its special character rise from the earth within the basin itself: crystal clear, slightly mineralized, and warm. It seems probable that originally (before modern ditching) only one stream, that from Agua Nueva, flowed out of the basin. This stream passes eastward through the Puerto del Carmen at Río Nadadores to be joined by Río Monclova, then northeastward to unite with Río Sabinas to form the Río Salado that eventually enters the Río Grande downstream from Nuevo Laredo, Tamaulipas. This system is, of course, the only through-flowing, permanent watercourse in northern Coahuila—and possibly in the entire state, although I have no data on this subject from the southeast corner near Saltillo. Another unusual feature of the basin is the large expanse of gleaming white gypsum sand dunes that occur in its eastern part and support a specially adapted flora. Also of bioecological interest is the "very high incidence of endemism among freshwater fishes and aquatic reptiles of this basin" (Hubbs, personal communication 1964), which Minckley (personal communication 1965) says "appears to be higher than any other area of its size in North America." This phenomenon suggests that the Ciénegas basin has been biologically isolated for a very long time, possibly since the local orogenic movements at the end of the Pleistocene.

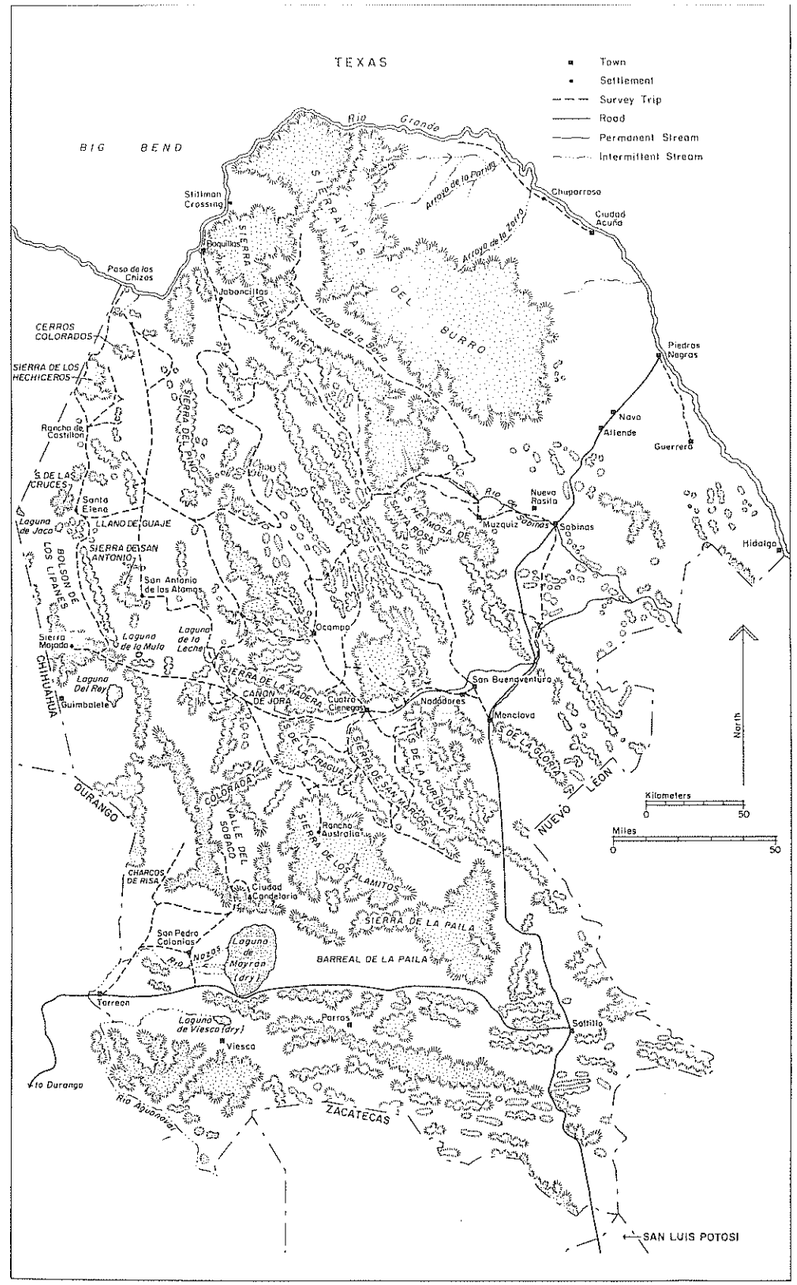


Fig. 2-1
Map of the State of Coahuila

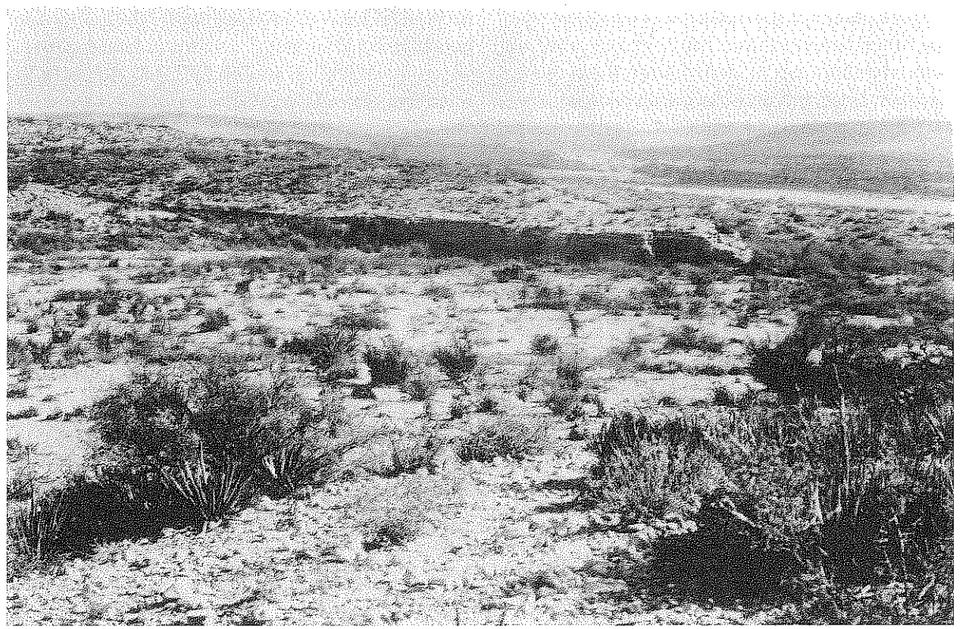


Fig. 2-2
The Gulf Coastal Plain region of northeastern Coahuila, near the Río Grande, upstream from Villa Acuña

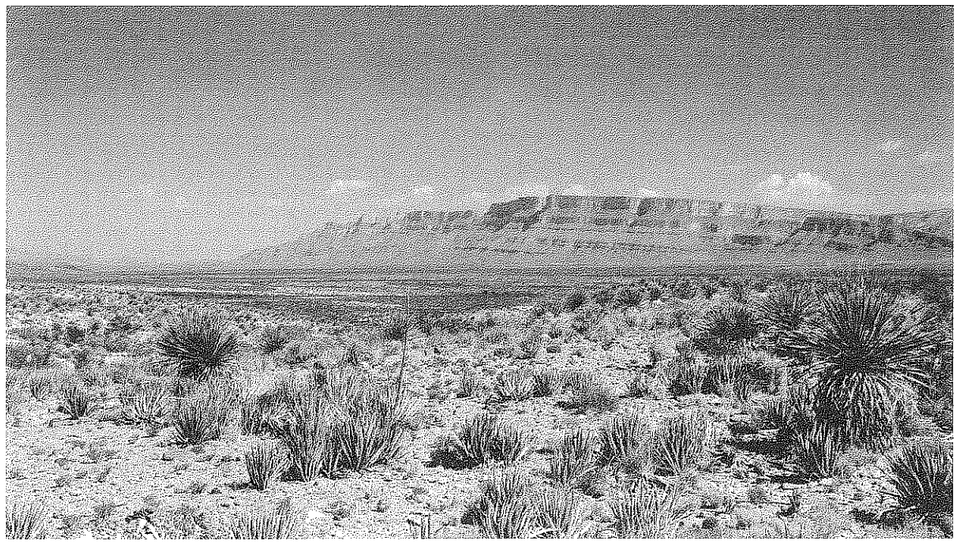


Fig. 2-3
The mountain region of north-central Coahuila. The figure shows the western escarpment of Sierra del Carmen, near Jaboncillas.

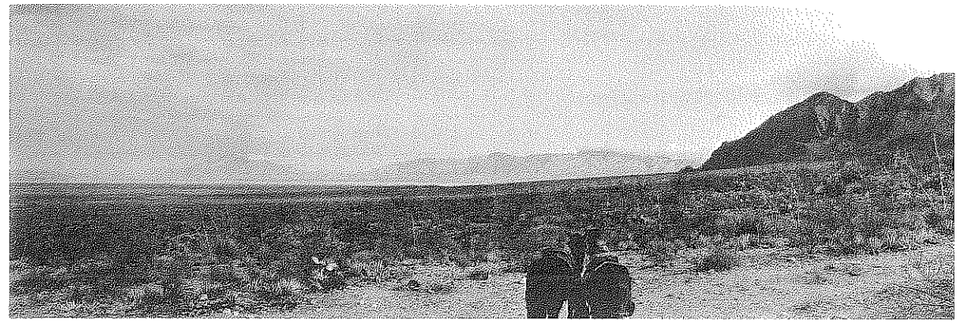


Fig. 2-4
The desert region of Coahuila. Panorama of the eastern part of the Cuatro Ciénegas Basin, looking northwest over the monte of San Vicente from the mouth of Cañon Espontosa. Cuatro Ciénegas lies below the notch to the right of the cloud-topped mountain, left middle ground.

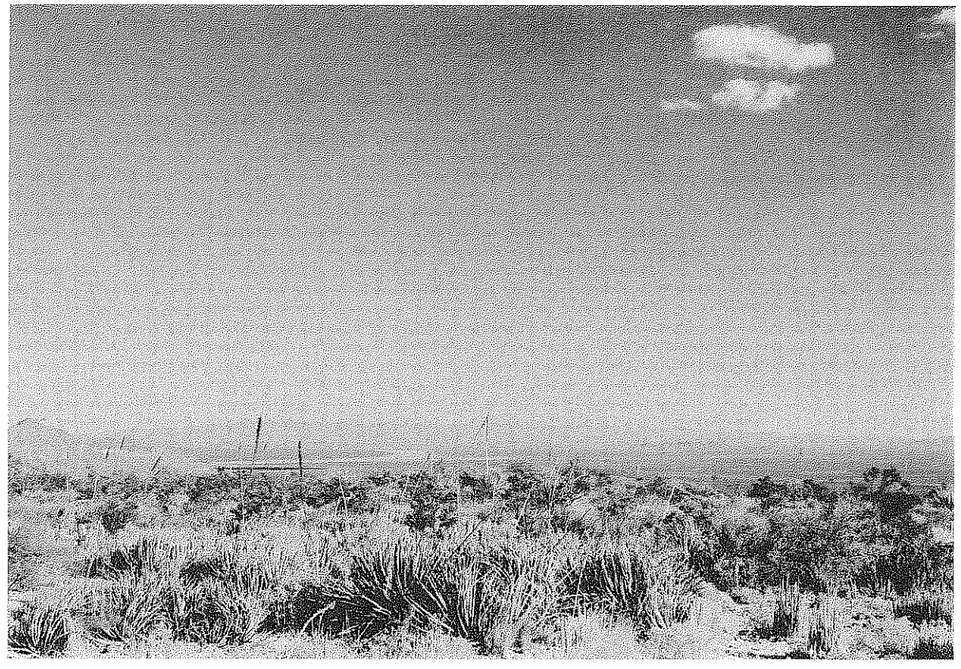


Fig. 2-5
The Chihuahuan Desert Shrub of the Valle de San Marcos near Las Palomas, looking south

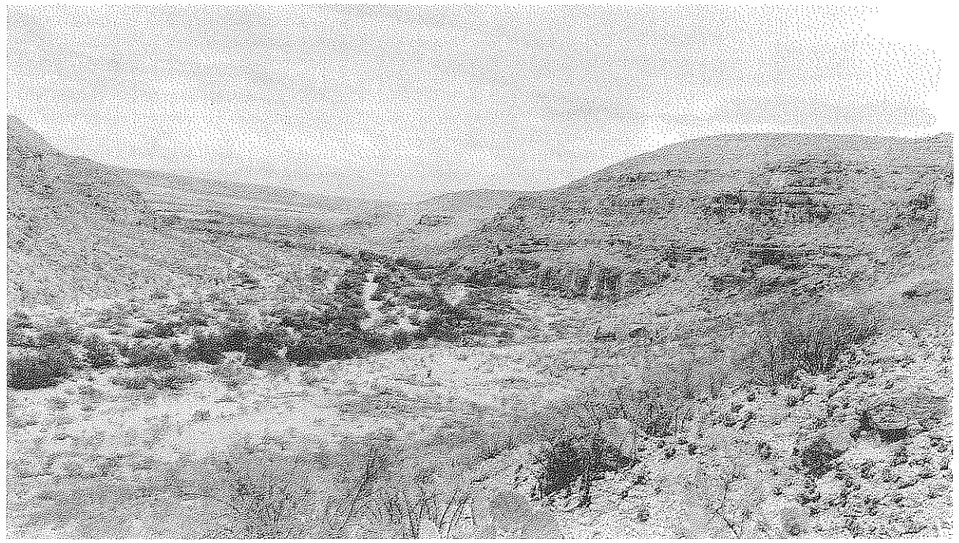


Fig. 2-6
The Chihuahuan Desert Shrub in the east end of Cave Canyon, showing riparian vegetation variety on both sides of the arroyo

Fig. 2-7
Cañon Espontosa with an almost Upper Sonoran flora

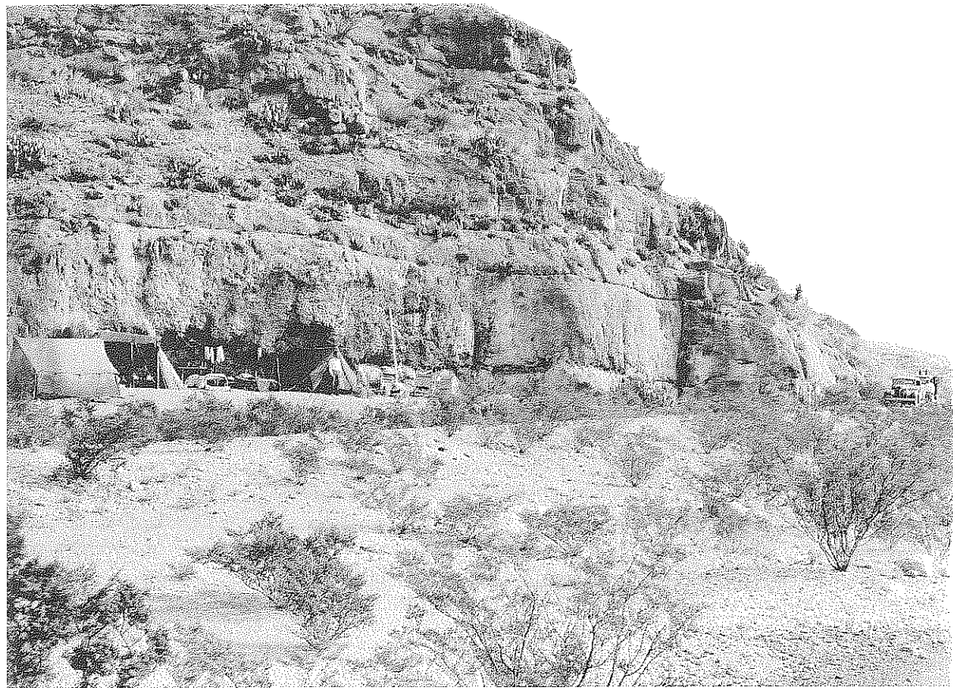


Fig. 2-8
Field camp in Cave Canyon, 1940–1941. This photo shows very well what the Chihuahuan Desert Shrub is like. In the foreground is creosote-bush (*Larrea* sp.). The rocky point in the background supports various succulents.

CHAPTER 3

Sites

There are 120 numbered sites at present in the Coahuila survey. Of these, 12 are multiple, that is, the numbers represent locations, and the letters designate individual sites within that location. A number of sites were found by other American researchers. Dr. Dudley Jackson collected artifacts from one in Cañon de Jora in 1936 and 1941. Edward Palmer in 1880 went to four sites and took away his famous collection, which I examined at the Peabody Museum of Harvard; it should be noted that the locations of these sites as reported by him are confusing and possibly erroneous (Palmer n.d.); I unsuccessfully searched for one of his sites in the Sierra de Oballos, northeast of Monclova, but did find one site probably not mentioned by Palmer. In 1935, Raymond Emerson took a pack trip in northern Coahuila south of Boquillas, on the west flank of the Sierra del Carmen; he reported nine sites, of which I have visited six, and recovered a small collection of material that I have studied intensively (Taylor n.d.). Kirk Bryan in 1941 visited west-central Coahuila on a geological investigation and was taken to eight sites, from which he obtained a small surface collection of lithic artifacts; I have made drawings of these specimens and have visited three of the sites.

Of the "sites" that I have found and numbered, four appear unlikely to have been utilized by aboriginal people, were seen only at a considerable distance, were recorded only on a long chance as an *aide-memoire*, and were not visited. At the time that I was working in Coahuila, there were said to be small, pothunted collections of cave materials in Monclova, but none in Cuatro Ciénegas or other places I visited. It was also reported that rather large collections had been taken across the Río Grande and sold in the United States. I have seen some of this material at various places in the Big Bend area of Texas.

One more point needs clarification before the sites are described. Except for the 1940 and 1941 season, I never worked under a permit that allowed me to excavate. Consequently, the investigation of each survey site consisted merely of viewing and, only very rarely, of digging a small testpit to ascertain the depth and contents of a promising looking deposit. However, many sites had been vandalized, and we could observe to our advantage the spoil piles and profiles of the potholes. Taken as a whole, our records are not complete, even for survey notes, but are sufficient to allow preliminary evaluation. On a number of occasions, however, we did make salvage collections from sites that had been vandalized and in which cultural and osteological material had been left to deteriorate on or near the surface; these sites have been given site-survey numbers and are reported here along with those sites we excavated in 1940 and 1941 (Fig. 3-1).

CM24, FAT BURRO CAVE (CUEVA DE LA BURRA GORDA)

CM24 is a small cave, 6.6 m wide, 3.4 m high at the mouth, and 8 m maximum depth from the drip line to the back. It faces approximately northwest about 10 m above the canyon floor, in the right or south wall of a short, open-ended, flat-bottomed, vertical-sided canyon approximately 1.5 miles in length (Fig. 3-2). The altitude of the canyon floor is 3050 feet at the eastern end and 3125 feet at the western. The canyon forms a chord between two points on the arc of the Cañon de Jora at the northern tip of Sierra de la Fragua, approximately 21 miles west of Cuatro Ciénegas (Fig. 3-1); we named it Cave Canyon to distinguish it from its better-known "parent," Cañon de Jora. The latter often occurs on maps and is famous for being the major pass between the western Desert Region, the Ciénegas basin, and the open country of the Coastal Plain region lying east of the mountains. The vicinity of the cave is in the Lower Sonoran life zone, but to the south the higher elevations of Sierra de la Fragua are in the Upper Sonoran. The vegetation of Cave Canyon is sparse, even for Coahuila, and is typical of the Chihuahuan Desert Shrub, in-

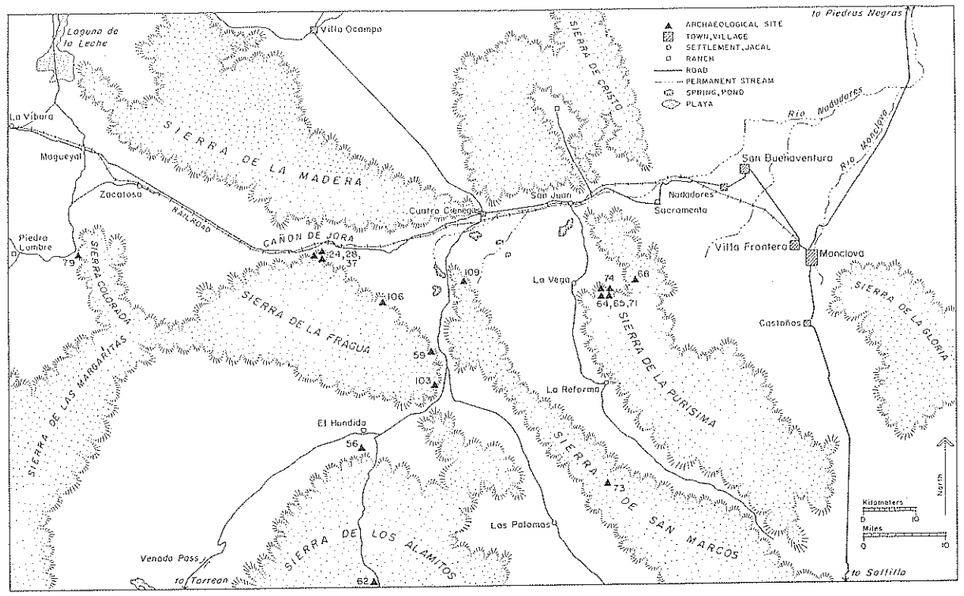


Fig. 3-1
Map of Coahuila Survey area. The numbered archaeological sites are those treated in this publication.

cluding the dominant creosote-bush, alicoche (*Echinocereus* sp.), prickly pear and cholla (*Opuntia* sp.), and other Cactaceae, lechuguilla, ocotillo, only a few yuccas, a little candelilla and leatherplant, and of particular note a scattering of peyote (*Lophophora* sp.) on the north wall, stunted mesquite, desert willow, and catclaw. At present there is no water in the canyon or in its tributaries, although there is plentiful evidence that the arroyo runs from time to time, and sometimes heavily. Bedrock catchment basins called *tinajas*, often used today as transitory water sources in the desert, were not found anywhere in the canyon, although admittedly we did not search every nook and cranny.

Fat Burro Cave (CM24) was the first site excavated during the Coahuila Project and proved to be the second most productive and the second oldest, even though its cultural deposit was only about 0.75 m in maximum depth and in places somewhat less. When I first visited the site in 1939, I noted an irregularly shaped hole dug by vandals to sterile cave spalls along the center of the back wall; several artifacts were found in the spoil pile that surrounded the pothole; these were deposited in the Peabody Museum at Harvard. In 1941, we excavated all the remaining deposits and took a *sondage* at the drip line of the cave to investigate the bedrock and the depth of the sterile cave-spall layer that underlay the cultural debris. A total of 71 quarter-meter blocks (1 x 1 x 0.25 m), amounting to 13.29 m^3 of cultural deposit, were processed (Fig. 3-3). The work occupied 17 full working days, from January 2 to 24, 1941, with a crew of first three and then four workers.

The deposits were not stratigraphically complicated. At the top was approximately 0.5 m of debris containing a considerable amount of fiber. The surface consisted of a fiber floor that was hardpacked, full of both coarse and fine fibers, and had a loose layer of fiber, sand, and dust. Interpreted to be the same as the other fibrous deposits, but compacted by native fauna and by prehistoric and modern humans during occupation, the fiber floor was treated as the surface layer of the site. Beneath it, the 0.5 m of fiber-containing deposit was much looser and mixed with more dust and cave spalls. This stratum was the major culture-bearing deposit and was divided into

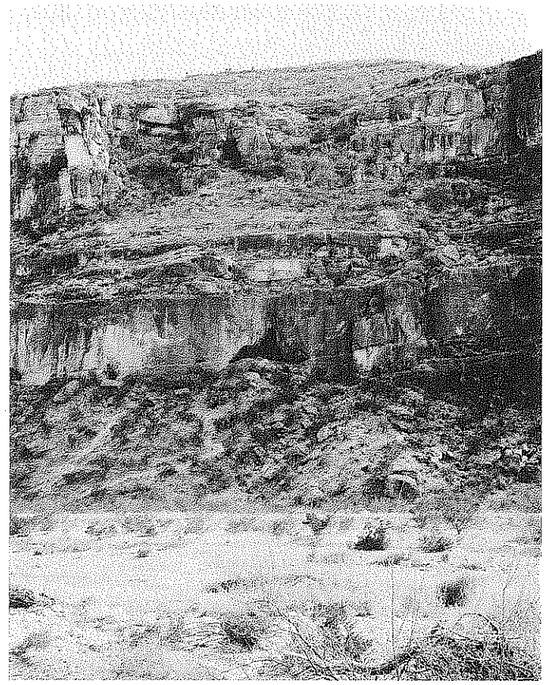


Fig. 3-2
Fat Burro Cave (CM24), the opening in the lower cliff at the center of the photo, as seen from the floor of Cave Canyon

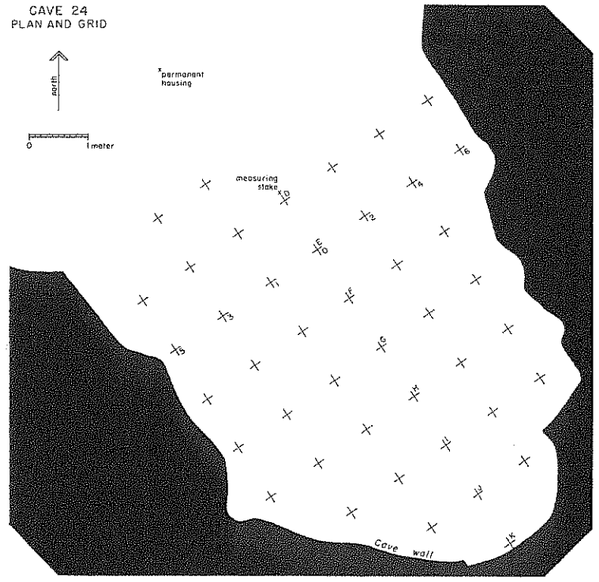


Fig. 3-3
Fat Burro Cave (CM24) plan and grid showing excavated blocks

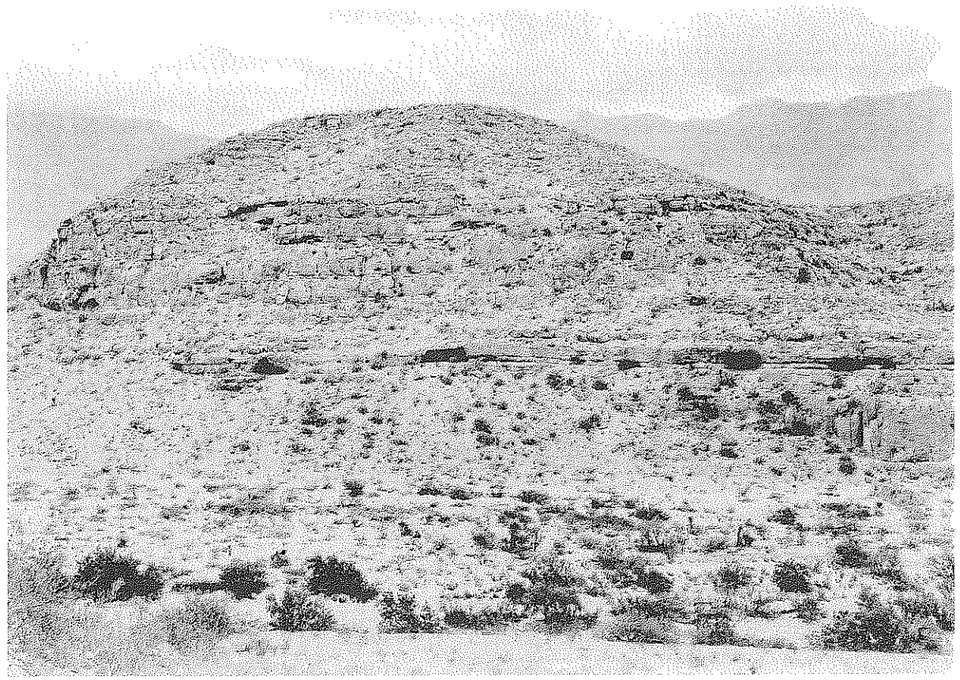


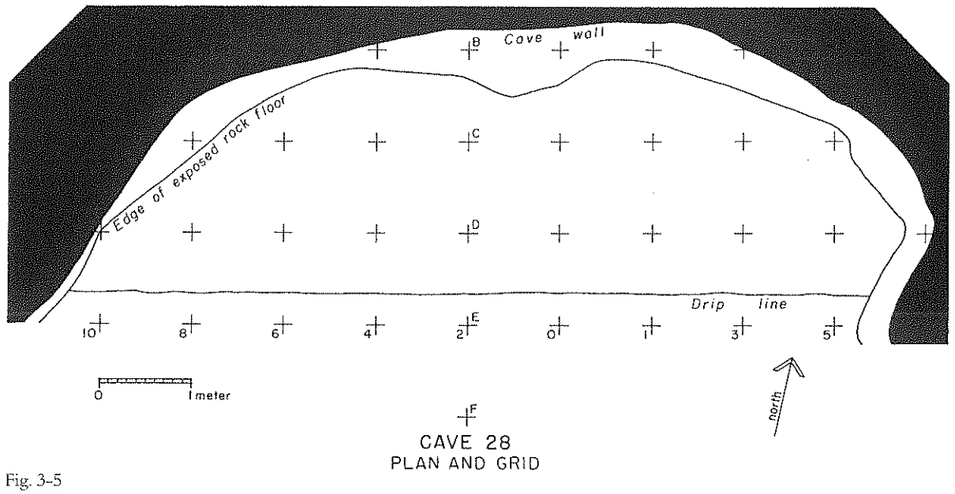
Fig. 3-4
Nopal Shelter (CM28) is in the center of the photograph as one looks north to Sierra de la Madera

two 0.25 m arbitrary levels, the topmost called "Fiber One" and the lower "Fiber Two." Below these levels was the so-called Gray Layer, a stratum about 0.25 m in depth containing some fiber with greater amounts of gray cave dust and spall. The Gray Layer contained cultural materials, including some made of fiber and wood, but in less quantity than in the overlying levels. Below this, lying upon bedrock or cave spalls, was the Yellow Layer. No cultural material could be positively identified as coming from this layer; as far as we could judge, its composition was much like (if not actually identical with) the Gray Layer, except that it contained no fiber and its dust and cave spalls had a yellow tinge. We interpreted the coloration as a result of hydration of iron oxides, which, at some early date when the climate was wetter than at present, had come about through moisture percolating down from above or coming in from the broad mouth of the cave and modifying the ferric oxides contained in the dust and spalls of the native, iron-bearing limestone. We recovered several sacks of samples from both the Gray and the Yellow layers, but they were later lost while awaiting testing in the Geology Department of the U.S. National Museum. We had hoped to produce evidence for an ancient wet period that might equate with the one discovered by Albritton in the Big Bend of Texas (Kelley, Campbell, and Lehmer 1940). It is most unfortunate that those tests were not conducted as we later recovered biological evidence from Frightful Cave of just such a former, more humid climate.

Radiocarbon determinations were run on six samples from Fat Burro Cave. The determinations spanned the period from 1430 ± 50 to 5245 ± 85 B.P. (see Appendix B).

CM28, NOPAL SHELTER (ABRIGO DEL NOPAL)

CM28 is a small, shallow rock-shelter (Fig. 3-4), approximately 8.5 m wide, 2.5 m high at the drip line, with a maximum depth of 2.5 m although the average is somewhat less. It faces slightly south of east about 10 m above the canyon floor in the left or north wall of Cave Canyon, opposite and roughly northeast of Fat Burro Cave (CM24). We chose to excavate Nopal Shelter because it was wide open to the elements and because we hoped it would have little, if any, fiber in its deposits, thus attracting fewer rodents and other burrowing animals that had caused so much disturbance in the dry, fiber-filled debris of Fat Burro Cave. We also had become very interested in the chronological relationships between the two groupings of lithic artifacts found in Fat Burro Cave, and we wished to dig a site in which the two were present and where we could make a test with as few distracting, confusing elements as possible. Nopal Shelter was excavated completely, yielding 47 blocks of 0.20 m each (1 x 1 x 0.20 m), equivalent to 6.62 m^3 of cultural deposit (Fig. 3-5). The excavation occupied six full working days, from February 5 to 14, 1941, with a crew of from two to four men (Fig. 3-6). The cultural deposit attained a maximum depth of 80 cm in just four blocks, with only seven blocks reaching depths of 60 cm. As anticipated, the excavation revealed hardly any loose fiber in the deposits and only four fiber specimens, but the lithic collections were large. We were fortunate in obtaining the stratigraphic information that we had been looking for.



CAVE 28
PLAN AND GRID

Fig. 3-5
Nopal Shelter (CM28) plan and grid of excavated blocks

CM37

"Site" CM37 is a small shelter in the east wall of a narrow canyon that ascends from the floor of Cave Canyon south and across the canyon from Nopal Shelter. A well-worn trail used by collectors of the wax plant, candelilla, to reach the highlands goes up this canyon. When I first saw the site in 1939, there was a pothunter's hole in the center at the back, around which we found prehistoric cultural specimens of fiber, stone, and wood. Excavation was begun at the site on January 28, 1941, after we finished excavating Fat Burro Cave (Fig. 3-7). Work was stopped on February 6 after only one and one-half days of excavation, when two test trenches showed the site to be without any depth of cultural deposit and virtually barren of cultural material. Here again was a usable site that had not been occupied, although it appeared to offer more attractions than many others that actually had been occupied (see Taylor 1964: 197 ff).

CM56

"Site" CM56 is really an area or location-designation that incorporates the whole of Painted Cave Canyon, Cañon de la Cueva Pintada, in which we recorded eight individual sites of what is probably a larger number. The canyon cuts into the north slope of Sierra de los Alamitos (sometimes called Sierra Australia) from the east end of the Barreal del

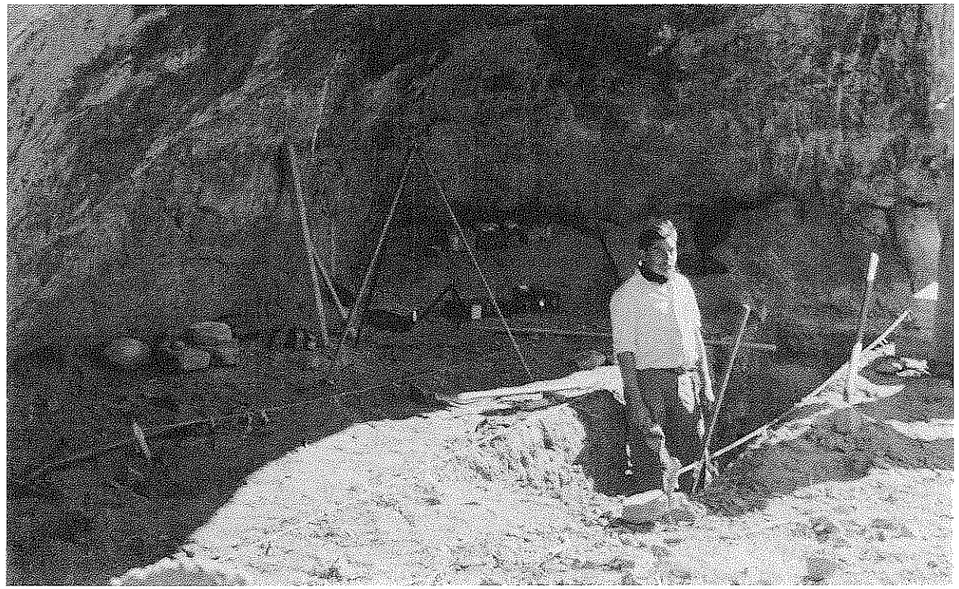


Fig. 3-6
The start of excavation at Nopal Shelter (CM28) in 1941. Manuel Castro stands in the first excavation trench.

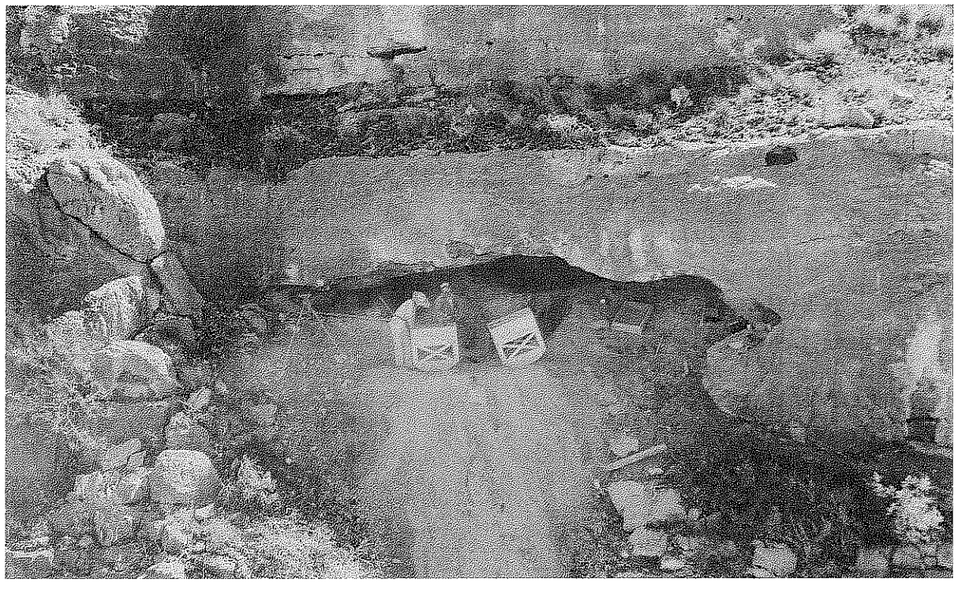


Fig. 3-7
Site CM37 during excavation in 1941. Pedro Gonzalez stands at the left of the screen being filled by Manuel Castro.

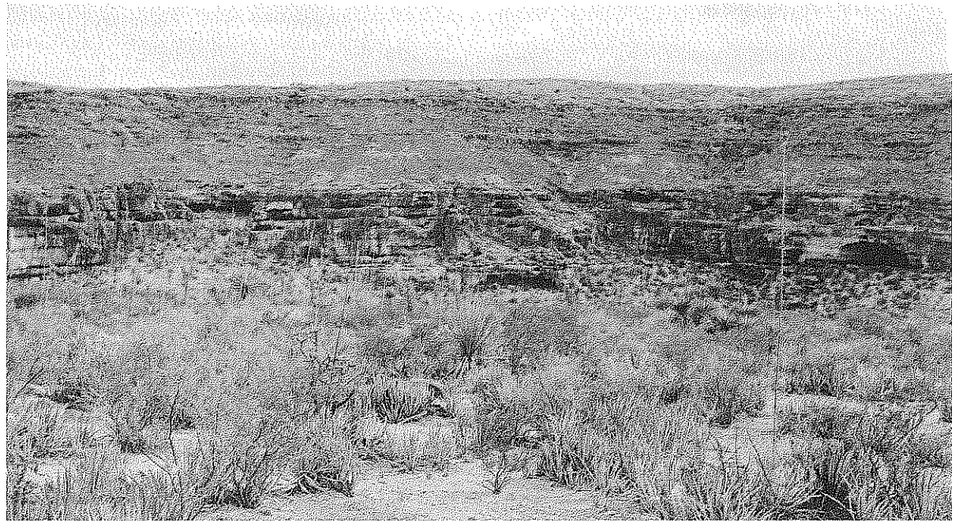


Fig. 3-8
A canyon in the southeast flank of Sierra de la Fragua (CM59). Note the many small shelters or "niches" in the rock wall; these frequently contain human burials. The canyon floor has typical Chihuahuan Desert Shrub with quapilla (*Hechtia scariosa*), lechuguilla (*Agave lechuguilla*), yuccas (*Yucca* sp.), and drago (*Jatropha* sp.).

Hundido and is about 30 miles southwest of Cuatro Ciénegas. The canyon has much the same type of vegetation as Cave Canyon, but it is narrower and has lower but more vertical limestone walls that are riddled with niches, overhangs, shelters, and caves.

Site CM56d is what we have called a "burial niche," about 5.5 m wide, 0.5 m high at the entrance, and 4.5 m deep. It is located at the back (interior) of a larger shelter that was, however, too small for occupation. When I first visited this site in 1939, some human bones and three pieces of plaited matting were exposed. Also projecting from the deposits were a three-grooved club, a notched and pointed stick (digging stick?), a probable firedrill, and half of a pair of wooden fire-rock tongs. These artifacts were described in situ, but the burial was not disturbed and the material was left as I found it; I had no permit to test or excavate. At the end of the 1940 and 1941 season, I again visited the site. The burial had obviously been further disturbed, and so Albert Schroeder and I made a controlled excavation for salvage. Five cuts were made in the horizontal dimension (more or less N-S), first through fiber, dust, and spalls, then through gray dust and spalls, and finally into yellow dust. Thus, here at this small, very dry burial site we had the same sequence as that observed at Fat Burro Cave (CM24), an occupation site.

In the Gray Layer but evidently dug down from the Fiber Layer was an empty grass "nest" or, as we interpreted it, a cache pit. During the course of our excavation, we found coiled basketry, quite a few pieces of plaited matting, the butt end of an arrow, a metate, and many more human bones (but no skull), all in the fiber layer. No artifacts were recovered from the upper levels.

CM59

This is another area designation, representing a broad, flat-bottomed canyon in Sierra de la Fragua on the west side of Puerto San Marcos, about 18 miles slightly west of south of Cuatro Ciénegas (Fig. 3–8). There are many small niches and shelters, some with rather large platforms, in the vertical walls of the canyon for at least 2 miles above its mouth; none of these contained evidence of prehistoric occupation. However, many of the shallow overhangs in the canyon walls retain pictographs painted on their walls, and so-called sharpening grooves can be found on bedrock or large boulders at the entrance of several rock-shelters.

Site CM59a is a rock-shelter about 20 feet above present ground level at the base of the canyon wall on the north side, just at the point where the canyon debouches into the pass. On its surface, we found a considerable number of lithic artifacts and one potsherd, the latter indicative of a relatively late occupation, possibly about A.D. 1000.

Site CM59b contained a multiple burial that included two skulls, a rather unusual find. Desiccated tissues from the bones were determined by William Boyd to have blood types 0 and B, the latter being a very rare occurrence in pre-Columbian American Indians (Taylor and Boyd 1943). Radiocarbon tests from the burial produced two dates: 2100 ± 70 and 1000 ± 45 B.P. Both samples were yucca, so dates have been corrected for isotopic fractionation (see Appendix B).

CM59c held a single burial complete with skull, and had been only slightly disturbed (possibly by rodents). The burial in site CM59d had been disturbed and did not have a skull. Lacking pertinent evidence other than the curious fact that skulls are missing from a surprising number of burial niches, we could come to no other conclusion than that relatively modern vandalism has been responsible. Several informants told us of "caves full of skulls," but we were unable to substantiate or refute these reports.

Site CM59e is a small, shallow rock-shelter on a ledge immediately above CM59d; its burial appeared to be undisturbed, although it did have a rodent's nest in the thoracic region. The burial was covered by a loose pile of rocks, a frequent occurrence in niche burials. All the above sites of CM59 were salvaged in 1941.

CM62

CM62 is a small rock-shelter in a very deep and narrow side-canyon off Cañon de las Tinajas de Chenta on the lands of Rancho Australia, on Sierra los Alamitos, the domain of the family of former Mexican President Francisco I. Madero. The site is about 5 to 6 miles of very rough country from the ranch house, which is now a distillery for making sotol, a tequila-like liquor made from the succulent *Dasylirion wheeleri*. A red pictograph was found on the face of the cliff above the mouth of the rock-shelter. In front of the site was a considerable platform on which we found one potsherd and one projectile point. Inside the shelter, on the surface but beneath some fragments of plaited matting, were a human calvarium and a few long bones. The burial had been disturbed, the bones disarranged, and the stones that had once covered it had been thrown aside; we recovered the calvarium. To the east and west of this grouping were stone piles indicative of other burials, but we did not molest them.

CM64

This "fissure cave" (geologically a solution crack?) in the north wall is about 1 mile up from the mouth of Cañon Piedragoso, a very long, wide, and deep canyon in the east flank of Sierra de la Purisima almost directly opposite and across the valley from the mouth of Cañon Espontosa (the location of Frightful Cave [CM68]). The entrance is very high and narrow, about 9 m deep, and from 0.9 to 1.5 m wide. The floor slopes sharply upward from the entrance and was covered by a layer of broken, dried-out cultural objects and desiccated, smashed, and broken human bones lacking skulls or skull fragments, although some human hair was found (Fig. 3-9). In June of 1941, Albert Schroeder and I salvaged the bones and artifacts. We collected a large amount of plaited matting, netting, coiled basketry, several so-called "burial sticks," grooved clubs, fire tongs, and other wooden objects of undecipherable use. There were also a number of bone beads, some still strung on leather thongs and some beads made from the tubes of what appeared to be marine worms. Such tube beads have been found at a number of sites in the Southwest—the Mogollon Village, Snaketown, caves of the Hueco Tanks, and caves in the Sierra Madre Occidental in Chihuahua, Mexico—and were subsequently identified as *Vermetus* sp. and so published (Haury 1936; 1937; Cosgrove and Cosgrove 1947; Zingg 1940). We sent our Coahuila specimens and samples from other sites (Snaketown and the Mogollon Village, caves in the Sierra Madre Occidental of Chihuahua) to specialist Olga Hartman, of the Oceanographic Museum, La Jolla, California. She reported that she could "see no indications that any of the pieces [were] . . . vermetid" and that they were "strongly reminiscent of serpulid tubes *Protula*" (Hartman, personal communication 1942). It is interesting to note that the known distribution of these animals (as of 1942) is along the Pacific shores of southern California. Hartman had some further interesting remarks: "The biological conditions under which *Protula superba*, or

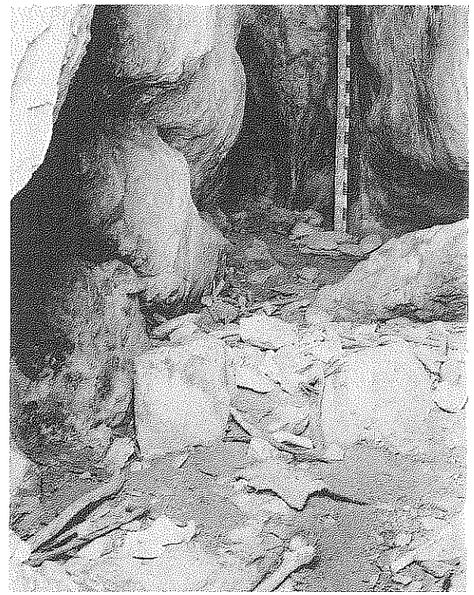


Fig. 3-9
Site CM64. The photograph looks inward from outside the cave. The meter rod is positioned about half way to the back wall. Human bones, matting, and wooden "burial sticks" remain on the inclined floor of the cave, as they were left by vandals.

any serpulid with a straight, regular tube [such as those we sent to her] is able to exist, may be unique. There can be no wave shock or other factors which might disturb the water, or the tube will be irregular, attached for much of its length. This at once places it below intertidal or littoral zones. The question arises how the Indians obtained them" (Hartman, personal communication 1942).

CM65

This cave is in the north wall of Cañon Piedragoso, about 0.3 mile up from site CM64. It is quite large, with a divided entrance and several sections formed by large blocks of fallen rock. The cave had been severely vandalized by guano hunters, but in some of the back sections and possibly also below the level to which the *guaneros* excavated there were still undisturbed deposits. On a sifted spoil pile at the mouth of the cave, we found a number of artifacts, one of which is a twill-pad sandal characteristic of the Ciénegas Complex, the earliest cultural manifestation in our Coahuila sequence dating between 7500 B.C. and 5000 B.C. This Complex has been found in only two other sites, Fat Burro Cave (CM24) and Frightful Cave (CM68). In March of 1941, I collected the cultural material exposed on the surface but did no digging.

CM68, FRIGHTFUL CAVE
(CUEVA ESPONTOSA)

CM68 is a long, relatively narrow cave at the southernmost end of a mountain spur that overlooks the rather steep, wide, V-bottomed east-west Cañon Espontosa (Fig. 3-10). The canyon descends from almost the summit of the range to a broad alluvial valley, called Agua Nueva, which is the southeasternmost embayment of the Ciénegas basin (Fig. 3-1). The altitude of the cave floor is 4100 feet, of the mouth of Cañon Espontosa is 3150 feet, of the Agua Nueva valley floor is 2600 feet. It is obvious from its uncommonly luxuriant vegetation (Fig. 2-7) that the canyon is better watered than any other we saw in the basin, with the possible exception of Cañon Piedragoso on the opposite side of the Agua Nueva Valley. Much of the contributing moisture comes during winter and spring storms from clouds originating over the Gulf of Mexico, driven by the easterly winds to top the divide at the east end of the canyon and to blow down it almost to its mouth. However, at the time we were there, no living water, or even any bedrock potholes (called *tinajas*), could be discovered in the canyon. The floral roster of Cañon Espontosa includes forms from both the Lower and Upper Sonoran life zones: oak,

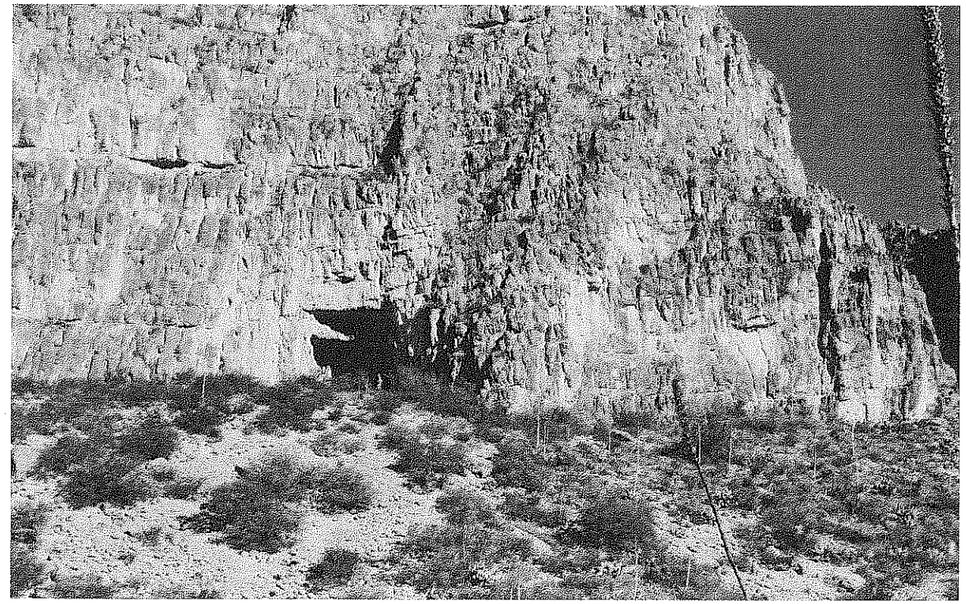


Fig. 3-10
Frightful Cave (CM68) from the south, with figure standing at the right side of the cave mouth

buckeye (*Ungnadia* sp.), coral bean (*Sophora* sp.), mesquite, several species of acacia, sotol, bear grass, lechuguilla, maguey (*Agave* sp.), yucca zamandoque (*Hesperaloe* sp.), candelilla, quapilla (*Hechtia scariosa*), and drago (*Jatropha* sp.). The *monte*, as in most of desert Coahuila, is dominated by the creosote bush, lechuguilla (*Agave lechuguilla*), and to a lesser extent by maguey and prickly pear. Most, if not all, of these plants were of economic importance to the prehistoric inhabitants and remain so today in large measure. The rock in which the cave has been formed consists of limestone, which, however, does not contain the nodular chert (or as much of it) that is so characteristic of the limestone of Cave Canyon.

The mouth of the cave faces 25° east of south (Fig. 3-11). In front of Frightful Cave is a platform on which the sun plays most of the day, although it enters the cave proper only during the winter and then only until early afternoon (Fig. 3-12). The platform appeared to be composed primarily of fire rock and ash with occasional pieces of wood and fiber (although the test that we dug was very limited). A large pothunter's hole had been dug along the west wall near the front of the cave (Fig. 3-13); it was about 1.25 m deep and did not reach the bottom of the cultural deposits. On the spoil pile beside the hole were approximately 15 sandals, fragments of plaited matting, coiled basketry, and fiber quids, the remnants from "chews" of some succulent such as agave or sotol. This evidence was most encouraging, as were the many pictographs on the walls. The surface of the deposits was covered, except at the very front of the cave and in a few places where recent fires had burned it away, by a capping of pulverized and firmly consolidated goat manure some 8 to 10 cm thick. This was another plus for the site as it provided splendid protection against scuffing and other disturbances of the cultural deposits beneath. The platform at the front of the site extended about 2 m south of (i.e., beyond) the drip line. Back of that line, toward the rear of the cave, were 39.15 m of cultural deposits, from 1 to 10 m wide and from 1.5 to 2.5 m deep (Fig. 3-14).

We began the excavation of Frightful Cave on February 21, 1941, and finished on May 23. At first we used quarter-meter blocks measuring 1 x 1 x 0.25 m. After the first trench reached a depth of 2.5 m, it was

Fig. 3-11
The view to the southwest from the mouth of Frightful Cave (CM68). The white patches in the middle distance are fallow fields watered by the springs called Agua Nueva. Sierra de la Purisima is in the background.

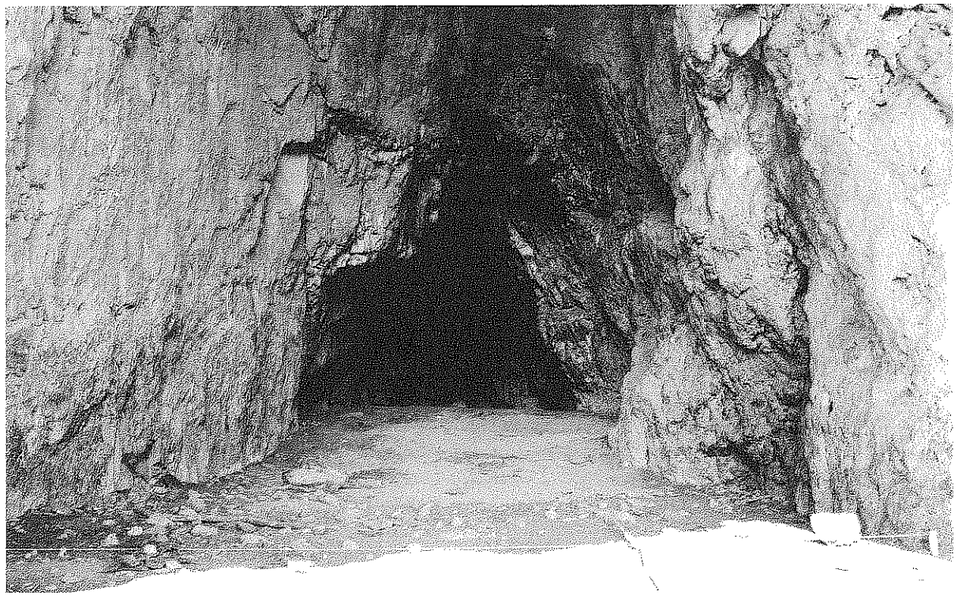


Fig. 3-12
Interior of Frightful Cave before excavation. The string in the foreground marks Line 13 of the grid system (see Fig. 3-13).

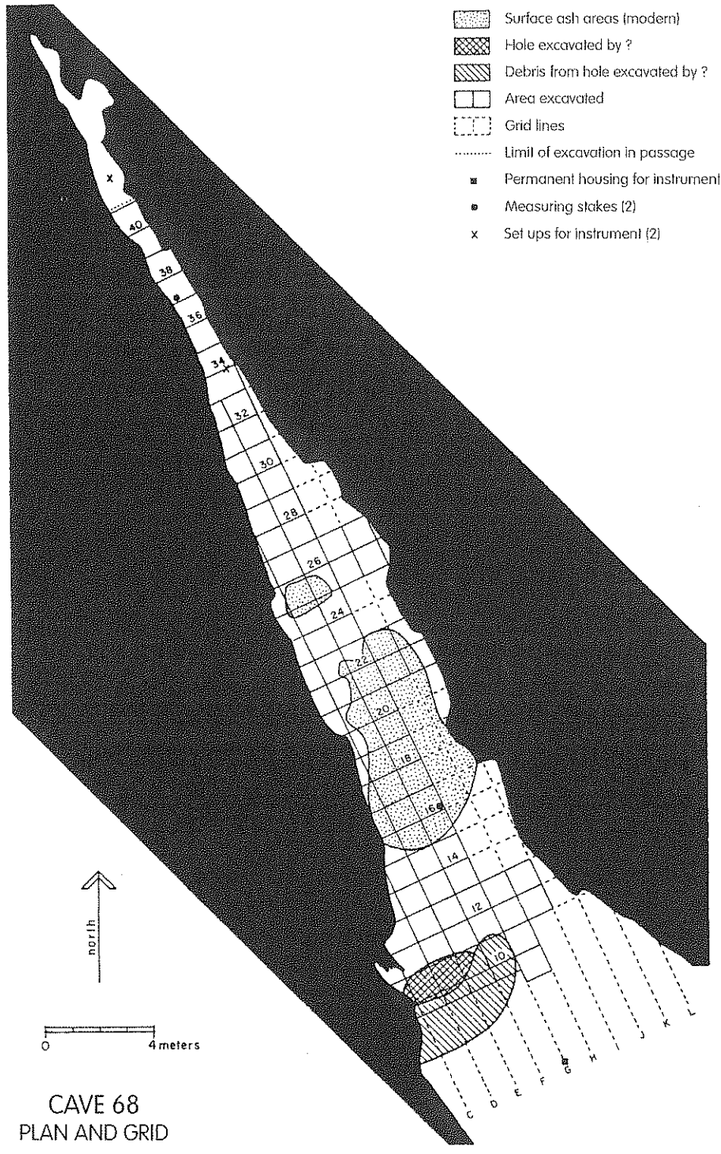


Fig. 3-13
Frightful Cave (CM68) plan and grid of excavated blocks

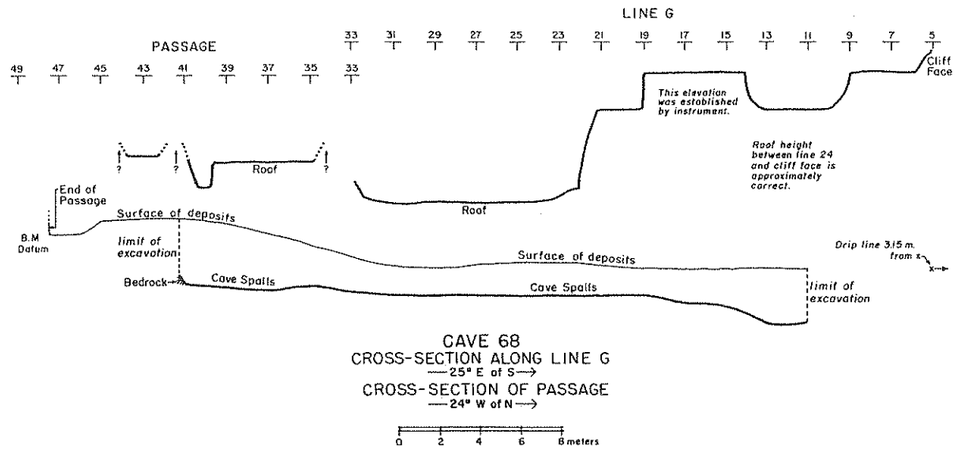


Fig. 3-14
Frightful Cave (CM68) cross section along line G

obvious that, with our small crew of five men (only one of whom was doing the digging, while two moved fill from the work-face to the screens and two men operated the screens) and a very finite amount of money and time, we could not hope to maintain such a small unit of excavation and dig enough to yield a representative test of the site. Following much discussion, we decided to increase the size of the excavation units to 0.5 blocks measuring 1 x 1 x 0.5 m and to excavate only the western half of the deposits. Later we dug three 2-m trenches to the east wall in order to ensure that we were not overlooking a buried city or some other such fabulous archaeological treasure (Figs. 3-15, 3-16). This change represented a stringent compromise, one we grew even more unhappy about when much later we learned the age of the material and that one very significant cultural complex was restricted to the lowest level. If we had maintained the original 25 cm unit, control over the temporal factor of this complex would have been that much more refined. However, we did manage to dig 277 blocks amounting to 130.84 m^3 of cultural deposit.

To convey some idea of the richness of this site, I present here totals of the field catalog numbers for a few of the major, more populous categories, in which at least half of the numbers represent a group of similar artifacts found at a single location, not a single artifact: Fiber, 1401 catalog entries (representing, among other subcategories, 20,600 quids or chews, 1900 pieces of cordage, 958 sandals); Stone, 177; Wood, 573 (representing 883 specimens).

The cultural deposits could be divided into three physically recognizable levels that appeared to have cultural significance and that were very close to the 50 cm arbitrary levels of excavation that were actually used (Fig. 3-17). The lowest of these levels (except in the very front of the excavated deposits) consisted of superposed, water-tamped floors, the middle level of coarse fiber and rocks, and the top level of smaller fiber and much less rock. Of course, throughout was a matrix of cave dust and limestone spalls derived from the walls and ceiling. Grass-lined and unlined pits were found both against and away from the walls, in the form of "nests" of grass and twigs surrounded by and often containing cultural debris. One rock oven and a number of definable hearths of rock were found in the deposits, but the majority of burned rock appeared to be concentrated at the very front of the deposits as constituent parts of the platform. We found only one intact burial: that of an old woman whose desiccated tissue showed her to be of blood group B (Taylor and Boyd 1943). She had been buried from the middle level but lay in a rock and twig "nest" on the preoccupation cave spalls. At burial, she had worn a fiber

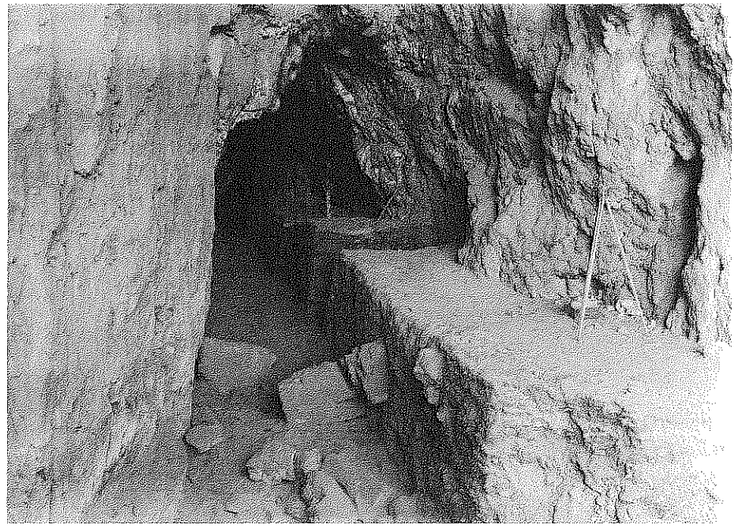


Fig. 3-15
Frightful Cave (CM68) after completion of the 1941 excavation. The top of the stadia rod is projecting from Trench 25-27, one of the major cuts made to the east wall of this site. The rod is at Line H.

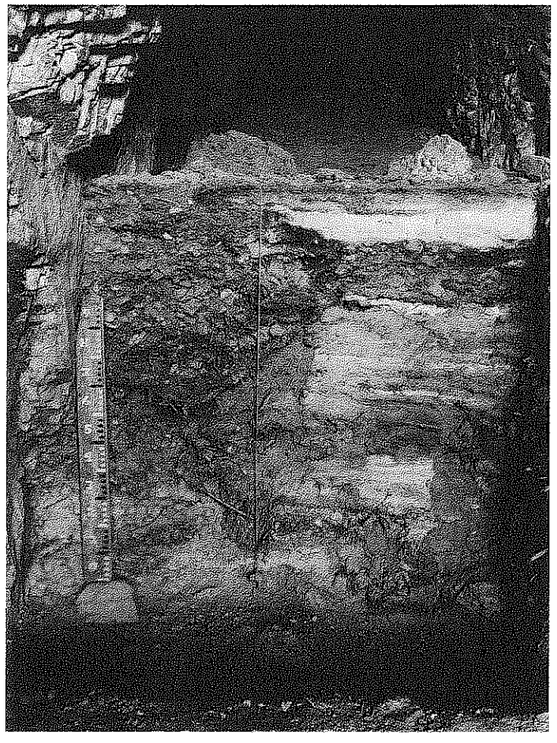


Fig. 3-16
Profile of Line 29, Frightful Cave (CM68), and string marking Line F. The meter rod is on the rock to level it with the original top of the cave roof spall layer, the bottom of the cultural deposits. Note horizontal, water-laid floors at right (white ash lines are burnt floors). Note pit dug from above at left of floors, the cache pit also dug from above starting at the upper left corner of the floors and showing the lining going to the wall at 70 cm (27.6 in) above the cave spalls. Rodent holes are visible at the lower right of the floors.

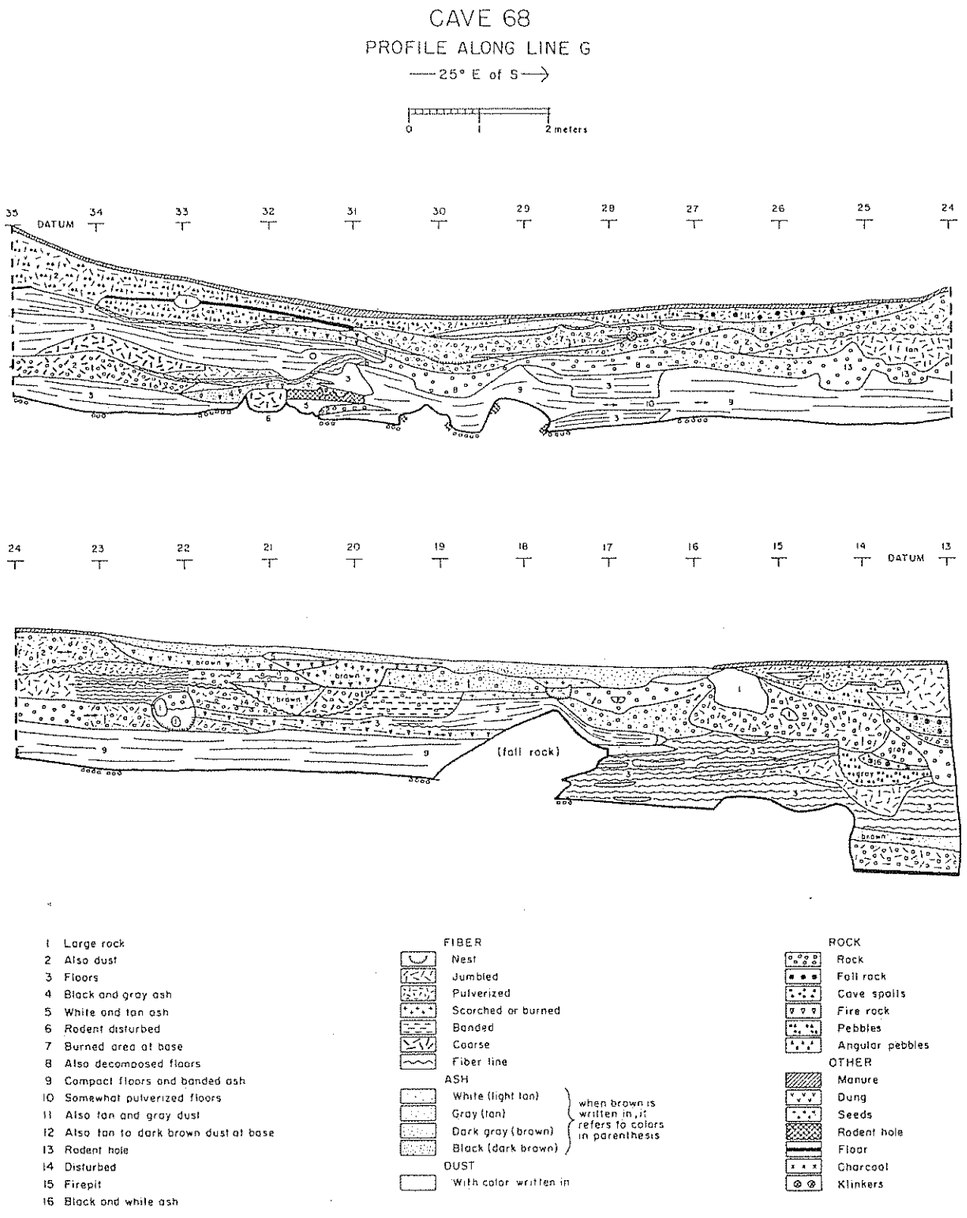


Fig. 3-17
Frightful Cave (CM68) profile along line G showing levels

g-string and had been wrapped in a twined fiber robe and tied in a loosely flexed position by a heavy fiber rope. Prickly pear pads had been plastered over her head, and she was accompanied by a single sandal. The only other find that might be considered a burial was a much-disturbed drift of child's bones, including a calvarium. Other human bones were found scattered sparsely, singly or in small groups, throughout the deposits; they may once have constituted formal burials, but we could produce no evidence for this inference, and called these isolated finds "strewn skeletons." Radiocarbon dates (see Appendix B) have been assigned to each of the three levels: bottom, 7000/5000 B.C.; middle, 5000/3000 B.C.; top, 2000 B.C. to A.D. 200.

CM71, CUEVA TAPADA

CM71 is a long, low, narrow cave measuring about 17 m x 2 m and from 0.5 to 2 m high nearly 5 miles up Cañon Piedragoso from its mouth. It is in a side canyon reached by going over a high ridge or cuesta. At one time, the original deposits at its entrance were cleaned out and the cave was walled up. On its south wall about one-quarter of the way back is painted a red "X," which appears to be aboriginal. A test trench excavated from wall to wall about one-half of the way back revealed human bones beneath some rocks and a piece of metate, all covered by cave dust. Our guide said that after the cave had been discovered and the wall removed, a human skull (adult?) and some long bones, as well as a sandal and matting fragments, were thrown out. When we visited the site, no fiber was seen, water was falling from the walls, and roots were found throughout the deposits.

CM73

This small rock-shelter is located far up a narrow, V-bottomed, major branch of the canyon that contains the well-known guano cave, Cueva Campana or del Rosillo, in the east flank of Sierra San Marcos, opposite La Reforma mine and about 25 miles almost due south of Cuatro Ciénegas. A burial of two or more individuals had been placed under some roof fall in a small niche in the back wall of the shelter. We found the burial disturbed and strewn over the rock floor of the shelter. A reworking of the vandals' spoil pile failed to produce a skull or any evidence of one. A considerable number of cultural objects accompanied the burial: a metate, fragments of plaited matting, knotless netting, coiled basketry, burial sticks, an atlatl, a digging stick, a fire-drilling hearth, and a few unidentified objects of wood. The site was salvaged in June 1941.

CM74

CM74 is a small, open-mouth cave rather high in the point of the rock wall that forms the northern side of the mouth of Cañon Piedragoso. From this site one can look northeast directly into Cañon Espontosa and almost see Frightful Cave. In this cave a burial had been badly disturbed, but a quantity of coarse grass held together by fiber twining suggested that it may have originally rested in a "nest" such as those we found (but without burials except in one instance) throughout the deposits of Frightful Cave. The CM74 deposits apparently contained no cultural material, and what we found on the surface and boulders had been collected by guano hunters from the surface or beneath the usual rock piles. These materials included the skull of a deer with two mandibular rami of deer crossed and tied to the antlers with plied cordage, what probably had been two robes of twined fabric, a number of sandals, pieces of knotted netting, coiled basketry, plaited matting, and a plaited bag containing a quantity of the seeds of monilla (*Ungnadia speciosa*). Generally considered to be poisonous, these seeds were probably consumed either as a food after leaching or as a narcotic; several fiber bags of these seeds were found in Frightful Cave lying in "nests" at varying depths in the deposits.

CM79

CM79 is a burial cave about 2 miles east of the ranch house of Rancho Piedra Lumbre, which is some 15 miles south of the railroad line at Magueyal, about 50 miles west of Cuatro Ciénegas. The cave is in an outcrop of volcanic rock on the eastern margin of a large playa basin that is surrounded by an uncommonly great number of extrusive volcanic hills, mesas, and ridges. Three individual burials were found at the site, two of which had been disturbed and one left in situ by its discoverer, the administrator of the ranch. A coiled basket had been set on edge against a small niche in a corner of the cave, over this a coarse, plaited mat had been placed, and on this the burials. The skull and mandible of the undisturbed burial had been put in a

decorated, coiled-basketry tray. From the clean condition of the associated artifacts, especially the underlying matting, and the absence of many bones, even from the undisturbed burial, it seems reasonable to infer that these were secondary burials. A great number of artifacts were associated with the interments: 39 strings of bone beads on their original cords, 172 loose beads, 42 twill-plaited mats, seven checker-plaited mats or fragments thereof, 14 coiled baskets, one coiled basketry tray, one netting bag, several fragments of netting, nine peyote buttons strung on a cord, and an odd lot of miscellaneous items. Some of the netting is typical of that found in Cueva Candelaria (Aveleyra Arroyo de Anda et al. 1956), with the burials collected by Edward Palmer (Studley 1884), and in the child bundle burial found in Fat Burro Cave (CM24). This kind of netting is a determinant of the Mayran Complex (Aveleyra Arroyo de Anda et. al 1956; Johnson 1977; Taylor 1966: 83f; 1968), one of the late prehistoric cultural complexes in Coahuila, possibly the very latest. Radiocarbon tests produced three dates for this site, 1200 ± 70 to 920 ± 75 B.P., the latest yet for the Coahuila material (see Appendix B).

CM103

CM103 designates a broad, flat-bottomed canyon in the Sierra de la Fragua, the second canyon south of CM59 and the next-to-last before Puerto Duran, slightly more than 20 miles south of Cuatro Ciénegas. Site CM103c is a small niche in which was found a multiple burial covered with rocks. The burial had undergone considerable disturbance, and the skulls had been broken at the sutures. Some human hair was found stuck to a fragment of twill-plaited matting; one sandal was also found. Site CM103d is a larger-than-usual burial niche that could more properly be called a cave; it includes two embayments, both of which contained burials. In addition to four sets of disturbed human bones, there were three other places in the site where there might be undisturbed burials. We did salvage work only and did not disturb the latter. Fragments of several types of plaited matting were found, as were some of what we call "strung matting"; i.e., stems of tule (*Typha* sp.) or members of the Cyperaceae threaded on twisted cordage to form a mat. There was also an unusual type of matting in which the dark brown stems of tule were woven into a twill-plaited textile of light colored fiber to make a design. Although the floor of this cave slopes upward from the mouth, it does not do so enough to have precluded occupation. This condition, together with the niche's large platform and clear view of the pass, would have made it (at least by modern judgment) a serviceable occupation site. However, this site had not been occupied—yet another instance of what we interpret to indicate a lack, or at least a very low level, of population pressure and the resultant high degree of selectivity in sites for occupation (Taylor 1964: 198). Site CM103e is a small niche in which a burial had been placed and covered with a pile of rocks. The burial had been disturbed, and a heap of fragmentary, strung, and plaited matting was found on the site's surface. Human bones, also found on the surface, had evidently been exposed for a long time as they were completely dry, chalky, and much eroded. One toe bone still retained some flesh. One molar tooth and one fragment of a skull were recovered. A surface salvage collection was made in the fall of 1947.

CM106, RUSH CANYON (CAÑON DEL JUNCO)

CM106 is an area designation for a wide and very long, flat-bottomed canyon in the eastern flank of Sierra de la Fragua almost due west across the marshes and playa from the point of Sierra San Marcos. It is south-southwest and about 15 miles from Cuatro Ciénegas and about 10 miles southwest of Cave Canyon (roughly halfway between Cave Canyon and the more southerly sites, CM59 and CM103). Site CM106a is a small burial niche in the south wall where the first side canyon enters the main one. A human skull was found on the surface inside the niche. There is a possibility that more bones, and even some cultural material, were hidden by the cave dust. We could not excavate when we visited the site in 1947 as we did not have excavation permits.

CM109

A rather large burial cave, site CM109 is about 33 feet deep and about 13 feet wide at the mouth, which is approximately 10 feet high. The cave is located in the north, south-facing wall of a short, steep, V-bottomed canyon, locally known as Cañon del Salto or Waterfall Canyon, which cuts into the eastern flank of Sierra San Marcos immediately west of a ranch house named Orosco, across the basin south of Cuatro

Fig. 3-18
Site CM109, Burial 3 wrapped in a simple plaited mat. Although the burial is not in situ here, the burial and associated matting are shown just as they were found.

Ciénegas. At the very back of the cave were three superimposed child burials, the topmost completely disturbed and the lower two less so, possibly unintentionally due to the movement of the upper one. The order and details of the burials, as nearly as could be worked out, are as follows: first, several plaited mats were laid on the cave floor; then Burial 3, wrapped with a woven band around the thighs and waist and tied (?) with black, human-hair (2 x) x (2 x) cord, was laid on the mats. The bones from Burial 3 were articulated and stains, no doubt from the decaying body, were found in the band and on the upper mat indicating that at least part of the body had been fleshed when interred (Fig. 3-18). Burial 2 had been placed over Burial 3 in the following sequence: first a fragment of checker-plaited matting was laid over Burial 3, followed by a complete checker mat, then a twill-plaited mat, followed by the body, unwrapped, but lying on an unpadded, wooden cradle frame, to which a fragment of woven band was stuck by what were probably body juices. Burial 2 was in a loosely flexed position on its left side; under the pelvis was a mass of still-sticky matter, probably body juices. Between Burials 2 and 3, but not definitely associated with either, was a shell pendant. On top of Burial 2 was a second twill-plaited mat and over all was a third twill mat. Burial 1 had been laid on the third mat, but because of the vandalism the details of this burial could not be determined, except that over the whole pile a strung mat of tule tied between two parallel poles had been laid and a cairn of rocks piled on top of all. This site was salvaged, not excavated, in 1947.

CHAPTER 4

Field Recording Techniques and Analytical Methods

It is expedient to briefly describe four devices that were used during the fieldwork and analysis basic to this report. The viability of many of the conclusions in this volume depend on the validity and applicability of these devices. They were developed and used, at least in their present form, for the first time in the course of this work in northern Mexico.

DAILY NOTEBOOKS

The first notebook is called merely "Diary" and consists of a daily entry on matters other than those having to do strictly with the excavations: weather, personnel, camp activities, trips and activities away from camp, visitors at camp, evaluations of present conditions, archaeological and otherwise, plans for the future, and, at first, financial matters, which were later recorded in a separate ledger. The second notebook is called the "Day Book" and consists of synoptic, itemized, numbered, and sequentially ordered descriptions of daily archaeological activities performed at the excavation. Taken together, these notebooks have been of inestimable benefit as a means of recording and evaluating the details of archaeological fieldwork, of its theory and method, and of the nature of its supporting logistics. They also served as the means of cross-checking one another and the three card systems.

CARD SYSTEMS

Card systems consist of pairs of "cards" duplicated using carbon paper that contain entries made on a "field original" onto a "field carbon" copy. They served to record fieldnotes during excavations.

All cards were of common 4 x 6 inch size. The top one of each pair was not really a card but something like a 60-pound box paper that would stand up in a file but be light enough to pass a good impression through to the carbon paper. The carbon paper was cut to the same size as the cards, hard enough to make a clear, not-easily-smudgeable impression, and durable enough to last an appreciable time under harsh treatment. The bottom unit was a rather stiff card that would take a good impression from the carbon paper and endure much handling, erasing, and rewriting: it was the most used component of the three.

At the close of each working day, the cards were brought to camp. At the end of the week, they were taken to the town laboratory where they were copied on a typewriter, again on paper-and-card pairs, and the field originals were returned to the field for future reference; the other three sets were stored at the lab in town.

Block Cards

Block Cards carry the basic archaeological field-notes and were written by the digger immediately after the completion of each unit of excavation. At the site, the cards and carbon papers were kept in a top-hinged engineer's notebook, which served as a writing desk and temporary storage file.

Feature Cards

At the first notice that excavation had come upon something special, the digger would reveal the find and take notes on a Feature Card. Feature Cards included burials, cache nests, prepared floors, fire pits, definite associations of artifacts, and other finds. Such features were not common in the deposits, but they did provide some significant information and important cultural implications.

Specimen Cards

Each working day, the archaeologist remaining in camp as guardian removed the artifacts from the sacks in which they had been brought to camp from the cave and did as much cataloging as possible before sleep overtook him. This consisted merely of catalogue number (also put on the specimen), provenience, author, date, and a minimal description of the artifact. The Specimen Cards were the repository of all meas-

urements, detailed descriptions, identifications of materials and other characteristics from correspondence and our own labs, extemporaneous sketches by laboratory personnel, and (although done too rarely) references to personal communications, literature, and photography.

Periodically, sets of Block, Feature, and Specimen Cards were forwarded to Clyde Kluckhohn at the Peabody Museum, Harvard, and to Frank Setzler at the U. S. National Museum. In this way, we hoped to preserve at least one full copy in the dire event that any sets were lost. Remaining sets accompanied the final collections inspection at Mexico City and one was shipped with the specimens by sea to Washington, D.C. Eventually, all four sets were brought together for study at the U.S. National Museum.

EMPIRICAL TABLES

The empirical tables compile, by sequential catalogue numbers, the descriptive data for each specimen abstracted from the Specimen Cards. Their purpose is to present the quantity and empirical specifications, including provenience, recognized by the archaeologist. It also provides the reader with a means of evaluating the laboratory work and helps him identify objective and subjective conclusions. Possibly most important of all, it enables the reader to make his own analyses of the data.

Table 4.1 presents a small section of the Empirical Tables for Frightful Cave, CM68, covering five fiber specimens that fall within four categories. The explanatory legends for those categories are also given in a somewhat abridged form.

It is intended that all the Empirical Tables and their accompanying Legends be published in a full archaeological report. Some years ago, I calculated that the entire collection of the Coahuila Project would require no more than 35 printed pages.

The Empirical Tables can be used to set up computer analysis. In fact, a considerable number of years ago, we transferred data to computer work sheets and then passed these to the computer laboratory to be punched into cards. We then realized how much better it would have been to construct Empirical Tables first and then pass them to a computer laboratory. Unfortunately, when the 27 boxes of cards came back and were checked, they had so many errors in punching that they were useless.

In spite of the breadth and depth of these studies, it is very possible, even probable, that my primary analyses and syntheses will not serve the purposes of other archaeologists. Some future archaeologist may wish to use the raw data of the Empirical Tables in ways not employed or even envisaged by the original archaeologist.

MASTER MAXIMUM METHOD

Master Maximum Method (MMM) is the second major research device that was developed during the work in northern Mexico and was certainly the most useful. It had not been conceived at the time of the excavations in Coahuila but was first used during the laboratory phase of our study of the materials from Frightful Cave, CM68. By late 1956 I was ready to give the MMM a field trial during the excavation of Cueva Tetavejo, in Sonora, Mexico, a small rockshelter that contained only a very shallow cultural deposit. It was not the best place for an initial test. However, we did find that the MMM aided our interpretations even there, and with its considerable success in Coahuila, it looks as if we may have fallen upon something of value, but further tests will be necessary.

The MMM establishes parameters of expected frequency for categories (classes, types, sub-types, etc.) of specimens excavated from archaeological sites. It compares the actual frequencies and their deviations from expectancy within and between sites and excavation units of sites. The word "master" signalized the fact that the basic reference and control is a schematic chart, the Master Maximum chart (MMc, Fig. 4-1), depicting the total (hence "maximum") cubic content of cultural deposit (artifacts and their matrix) from each of the units of excavation and from the aggregate of all such units in a site as a whole (again "maximum"). From these figures, a Master Maximum percentage (MM%) is calculated for each excavation unit: the percentage that the amount of its total excavated cultural deposit represents of the total cultural deposit excavated from the site. This is a parameter of expectancy for that particular unit of excavation and the basis from which minus deviations (MM-d) and plus deviations (MM+d) are calculated by comparing the actual percentages of frequency: the percentage that the actual frequency of a category excavated from a unit represents of the total frequency of that category from the site as a whole.

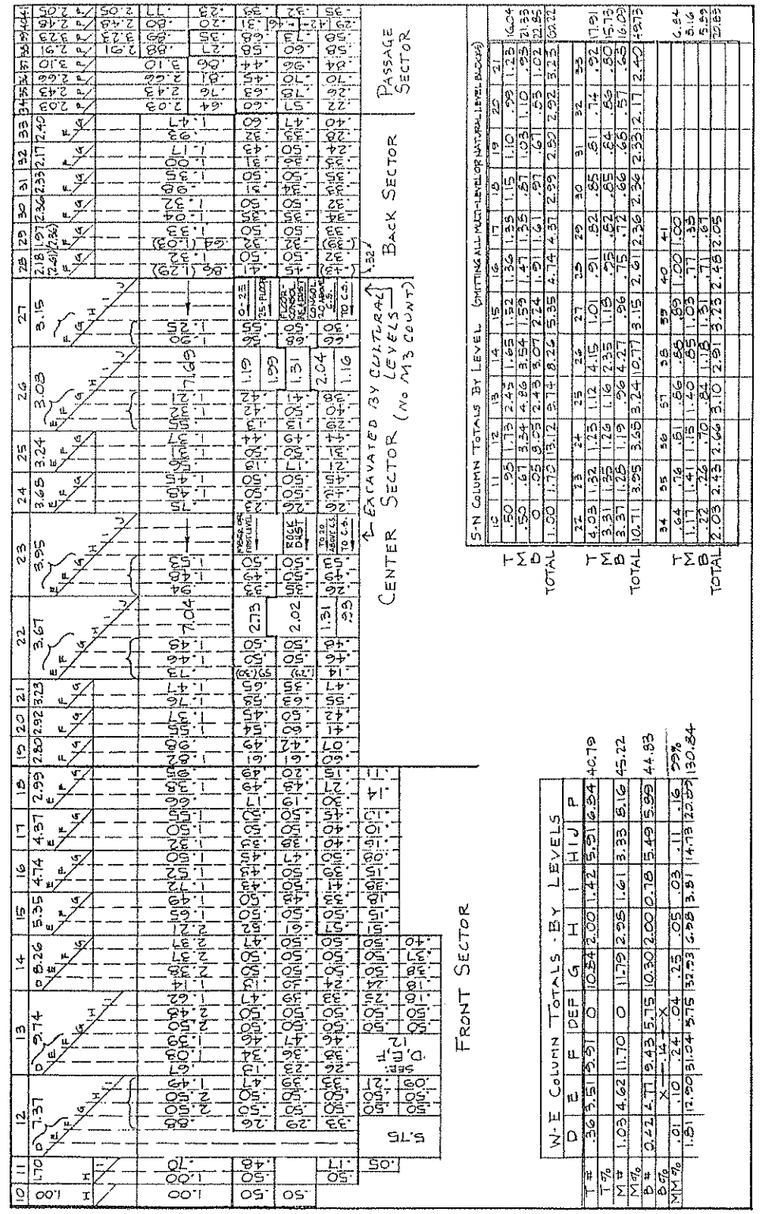


Fig. 4-1
Master Maximum Chart (MMc), showing the volume of deposit excavated from Frightful Cave (CM68)

Table 4-1. A small section of the Empirical Tables for Frightful Cave (CM68), covering five fiber specimens that fall within the rubric fiber (F).

1	2*	3	4	5	6	7	8	9	10	11	12	13	14	15
F445	1b	D14-B	209F	141	LT/H	S/#	190	95	-	2/z	?	A/A	A	No
F446	6b	D14-B	2z(3-7)	/R	5-7	8	68	63	2	6	13	-	-	F
F447	2	D14-B	-	-	-	-	-	3?	?	S	-	-		
F448a	1a	F16-T	155F	95F	H/H	H/H	M	BTC	-	LF	L?	C		
F448b	1ai	F16-T	88F	99F	H/H	H/H	M	BTC	T	BF	L	-		

* Column two indicates the Class, Type, (and sub-Type, if applicable) to which a particular artifact has been assigned. This in turn determines which Legend should be employed in reading the subsequent Column entries for that artifact. For example, the first artifact (F445) is Class 1, Type b. Consequently, one would use Legend 2. F1b, twill-pad sandals, to determine the meaning of the rest of the column entries for that specimen.

Legend 1. Type F1a, plaited sandals

Column
1. Catalogue number:
2. Class, Type, and sub-Type:
3. Provenience: letter = W-E horizontal, number = S-N horizontal, B = bottom level, T = top level
4. Length: maximums in millimeters, F = fragmentary
5. Width: maximum in millimeters, F = fragmentary
6. Materials: warp/weft, H = *Hesperaloe*
7. Materials: ties/padding, H = *Hesperaloe*
8. Breaks: T = toe, I = instep, H = heel, M = middle (of length), K = broken out
9. Wear: B = bottom, T = top, C = compressed
10. Depressions: T = toe, G = great toe, LT = small toe, B = ball-of-foot, H = heel
11. Padding: L = longitudinal, D = diagonal, B = both, F = fragmentary, M = moderate, F = full, N = thin
12. Foot: R = right, L = left
13. Convergence of warps at heel: C = converge, CS = converges slightly

Legend 2. Type F1b, twill-pad sandals

Column
1. Catalogue number:
2. Class and Type:
3. Provenience: same as Legend 1
4. Length: maximum in millimeters
5. Width: maximum in millimeters
6. Depressions: L or LT = left, R = right, H = heel
7. Selvage: # = formula recorded (see text), D = doubled under at T = Toe, H = heel, S = side(s), F = faggoting at selvage
8. Length of pad: in millimeters
9. Width of pad: in millimeters
10.
11. Ties: ply/twist, C = crude cordage
12. Foot: R = right, L = left
13. Materials of sole/pad: A = *Agave*
14. Materials of ties: A = *Agave*
15. Heel reinforcing: R = rear, NO = none

Legend 3. Type F2, scuffer sandals

Column
1. Catalogue number:
2. Class:
3. Provenience: see Legend 1
4. Length: maximum in millimeters
5. Length: front (toe) to start of heel wear
6. Width: in millimeters at front (toe)
7. Wear:
8. Depressions:
9. Number of strands in body:
10. Number of cross strands:
11. Type of knot in toe-tie:
12. Type of knot in cross element:
13. Type of knot in rear strand, if there are two:

Legend 4. Type F6b, knotless netting

Column
1. Catalogue number:
2. Class and Type:
3. Provenience: see Legend 1
4. Cordage: ply/twist, number of turns per cm
5. Cordage: diameter in mm/material, R = hard, S = soft
6. Netting: gauge in mm
7. Netting: distance between "levels" in mm
8. Longest dimensions: in mm
9. Longest dimension perpendicular to that of Column 8
10. Number of twists in weave:
11. Number of "levels":
12. Number of "diamonds":
13.
14.
15. Condition of Specimen: F = fragmentary

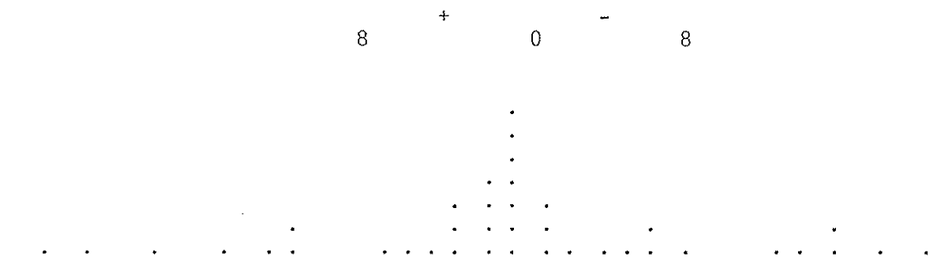


Fig. 4-2
Master Maximum (MM) deviations of artifact categories (shell, nacre, stone artifacts, stone flakes and chips, and ceramics) from Cueva Tetavejo, Sonora, Mexico

The major premise of the MMM is that, with random distribution, an equal percentage of the total frequency of a cultural category can be expected from a like percentage of the total cultural deposit excavated from the site and that any deviation from this expectancy can be attributed to nonrandom causes, either cultural or natural or both, and presents a problem of cause to the archaeologist. Thus, in essence, the MMM can be regarded as a kind of Chi-square test, and the null hypothesis is that the volume of excavated cultural deposit, and the volume alone, is the efficient cause of the quantitative representation of cultural material within the excavated cultural deposits of archaeological sites.

The use of volume as a constant is not a new technique in archaeology; the "average frequency" per some unit of excavation is one of the common uses. But the MMM exploits the concepts of frequency, expectancy, and deviation in somewhat more expanded and precise ways and in doing so provides, among other things, a mathematical scaling of the magnitude of deviation and of comparative difference. For example, in Cueva Tetavejo the first or top level amounts to 9.19 m^3 or 47% of all cultural deposits excavated from the site. Therefore, according to the null hypothesis, if the distribution were random, we would expect the top level to contain 47% of any cultural category, whereas the actual frequency of the category All Ceramics in the top level is 78%, while only 43% of All Stone Artifacts is found there. Thus the former category has a rather large plus-deviation of +31 that calls for explanation other than randomness. All Stone Artifacts, however, has a small minus deviation of -04, that is so close to expectancy as to suggest that it might represent merely a "random," "normal," nonsignificant variation. But possibly the most important aspect of this example is that the two parameters are mathematically and directly comparable and give us a precise quantitative expression of the difference between the two distributions—and would do so even if the example had derived from two or more sites rather than one.

Another problem arises: Which deviations from expectancy are so small as to be considered "normal?" That is to say, historically nonsignificant, the results merely of sampling or other nonsignificant difference, too small to void the null hypothesis or to require any explanation other than randomness. One approach to this problem would certainly be to apply the Chi-square test to an observed frequency distribution. But under certain circumstances those manipulations are inappropriate, even unqualified, and the MMM has been specially developed to avoid them and their inherent problems of small frequencies and dependence upon strictly formulated probability distributions that would beg a host of questions that archaeology has yet to put to the test and find acceptable.

Therefore, in applying the MMM, the determination of what are to be considered "normal" ranges of deviation from expectancy has been done largely by constructing and analyzing histograms of frequency distributions. These particular ones taken from the Specimen Cards of Cueva Tetavejo, have been constructed for the most inclusive and populous categories (ceramics, stone, shell, and nacre) and for all the larger spatial units into which the site had been divided for study (blocks, columns, trenches, quadrants, sectors, areas) on the assumption that percentages derived from larger excavation units and most populous categories will provide more realistic data than those

Table 4-2. Frightful Cave (CM68): Sub-Type F1ai, Two-Warp Plaited Sandals, Vertical and Horizontal Distributions (frequencies, percentages of total universes, master maximum percentages, and master maximum deviations).

	#	%	MM%	MMd
Level				
Top	231	42	31	+11
Middle	235	42	35	+07
Bottom	89	16	34	-18
Total	555	100	100	
Sector				
Front	101	18	39	-21
Center	173	31	34	-03
Back	84	15	11	+04
Passage	197	35	16	+19
Total	555	99	100	

from smaller units and less populous categories. Figure 4-2 shows that most deviations fall within a range of ± 8 from the zero line and that on either side of this range there is a considerable gap in recorded deviations, making the range ± 8 stand out as a unit from the others. Thus, beyond this parameter, on both the plus and minus sides, the deviations are to be considered nonrandom, the null hypothesis void, and some nonrandom cause is to be sought.

Raw frequencies and even percentages are often misleading unless one uses some form of noncultural control such as the MMd. Table 4-2 presents data in an actual case from our study of Frightful Cave material. For the present, the two most significant sets of figures are those for the Top and Middle Levels and the Center and Back Sectors. In the former, although the raw frequencies and percentages are essentially the same, there is a significant plus-deviation in the Top Level and a smaller and nonsignificant one in the Middle Level. In the lower part of the Table, these sandals show a Center-Sector frequency over twice as large as for the Back Sector, but the deviations for these areas are virtually identical and both are nonsignificant. Of course, these differences are due to the differential amounts of cultural deposit excavated from the units, but this is precisely what the MMM is designed to bring out, because it does make significant interpretive difference whether a given number of specimens was recovered from 100 m^3 or from 10 m^3 of cultural deposit. The MMds have been the most commonly used and productive parameters of comparison in our laboratory studies. Often they were the first indication that "something is rotten (or merely interestingly different from expectancy) in the state of Denmark" and that there is some situation that demands attention and, hopefully, explanation.

I believe that I should mention that when, at the end of June, 1974, I retired from Southern Illinois University and to all intents and purposes left the field of archaeology, Robert Lafferty, one of my graduate students, and I were working together with great hopes for the future of the MMM—but still with several pressing problems pending. One of the pressing problems that was abandoned in 1974 was the effect that size, the cubic meterage of cultural deposit of excavation units, has upon the cultural meaning and significance of relative deviations. Also, the physical sizes of the specimens themselves affect such parameters.

CATEGORICAL ACCOUNTING

The specimens recovered from sites recorded by the Coahuila Project, whether excavated or collected from the surface, have been cataloged according to the materials from which they were made, such as fiber, stone, wood, or by cultural interpretation (inferred), or by substance of origin, such as animal remains, vegetal residue, debitage; as well as by other convenient names. There is also, as is usual and most useful, a category called "miscellaneous."

In this volume, I present a complete listing of one rubric of the Categorical Accounting (All Fiber, Table 4-3). This illustrates one of the tools that we have found

of service in keeping precise inventory of each of our many specimens and categories. In doing so, I must point out that what is offered here lists only those specimens that had been recovered by the end of the 1940 and 1941 season.

FIBER SANDALS

There were several reasons for choosing fiber sandals for presentation in this volume. First, the manuscript on this topic was fairly well along and, together with the research involved, it brought to light a number of significant cultural and chronological insights. Second, the many sandals produced in stratigraphic order by the excavation of Frightful Cave (CM68) gave hope to the prospect that information obtained under good control and in sufficient quantity would permit sound conclusions. Third, sandals are relatively complex and culture-sensitive artifacts, the number and specificity of whose characteristics make them possibly the most useful cultural category available to the archaeologist fortunate enough to be working in sheltered sites in the area of arid America. At the same time, sandals are probably more closely connected with people as biological beings than any other cultural category that we have at our disposal in north Mexican archaeology—certainly more so than many that are more commonly used for fundamental archaeological studies, say ceramics, lithic artifacts, even basketry. Fourth, fiber sandals are also intimately connected with the local environment and contain, within the materials of their manufacture and the imprint upon them of the human factor, much information on aspects of cultural and natural ecology that could be of great interest to the archaeologist as interpreter and student of cultural and natural contexts.

These incentives led me to study fiber sandals in more detail than I had examined any other category of the Coahuila material, except possibly that of lithic artifacts. The choice between sandals and lithic materials for presentation here was made on the basis of the relative sizes of the respective manuscripts: that of the latter being three or four times as long as the present one on sandals—and the anticipated time of final preparation proportionately greater. Even in the sandal paper, it has been impossible, because of lack of space, regularly to include descriptions and discussions of the many variations, often found on a single specimen, that would have provided a fuller, more properly weighted, more vital picture of true conditions within the cultural realm of sandals. It has been one of the tenets of the Conjunctive Approach that such data on variation are important and should be provided as an integral, not an incidental, part of an archaeological report (Taylor 1983: 195ff). Recognizing this, I have given some examples of variation but to have done a complete job would have increased the size of this volume beyond permitted limits.

Table 4-4 presents the quantitative and vertical distributional data, by types, on all sandals from Frightful Cave with the exception of those noted in the legend. Type F1a, plaited sandals, are treated in Chapter 5, while the remaining types are the subject of Chapter 6. The sections in Chapters 5 and 6 are arranged in what may seem to be reverse order, i.e., the "Discussion" often precedes the description of the data discussed, the conclusive cart often comes before the substantive horse. It is recognized that this is sometimes repetitious, but the disadvantage is outweighed by the advantage to the reader who wants to get an overall picture, to get at the gist of the matter, without having to wade through pages of measurements and specifications.

Table 4-3. Categorical Accounting: Fiber.

Category	Number of Artifacts/Site Number	Total # of artifacts/ Total # of sites
1. Sandal:	71/CM24, 1/CM56d, 14/CM65, 958/CM68, 4/CM74	1048/5
a. Plain plaited:	38/CM24, 13/CM65, 884/CM68, 4/CM74	939/4
i. 2 warp:	9/CM24, 13/CM65, 570/CM68, 4/CM74	596/4
ii. 3 warp:	1/CM24, 36/CM68	37/2
b. Twill pad:	28/CM24, 1/CM65, 42/CM68	71/3
c. Checker pad:	7/CM68	7/1
d. Sewed:	4/CM24, 18/CM68	22/2
e. Braided:	1/CM24, 5/CM68	6/2
f. Residual	1/CM56d, 2/CM68	3/2
2. Scuffer sandal ("agave scuffer")	2/CM24, 44/CM68	46/2
3. Cordage	210/CM24, 7/CM37, 12/CM56d, 2/CM59d, 1/CM59e, 160/CM64, 5/CM65, 1900/CM68, 39/CM79	2336/9
a. Yarn	151/CM24, 5/CM37, 11/CM56d, 2/CM59d, 1/CM59e, 160/CM64, 5/CM65, 1195/CM68, 39/CM79	1569/9
i. Z-twist	133/CM24, 2/CM37, 9/CM56d, 2/CM59d, 160/CM64, 2/CM65, 1060/CM68, 36/CM79	1404/8
A. Single yarn	14/CM24, 1/CM37, 66/CM68, 1/CM79	82/4
B. 2 ply	113/CM24, 1/CM37, 9/CM56d, 2/CM59d, 1/CM59e, 123/CM64, 1/CM65, 946/CM68, 28/CM79	1224/9
1. Re-plied	15/CM24, 2/CM56d, 1/CM59d, 1/CM59e, 19/CM64, 161/CM68, 3/CM79	202/7
C. 3 ply	2/CM24, 37/CM64, 1/CM65, 27/CM68, 4/CM79	71/5
1. Re-plied	2/CM24, 15/CM64, 1/CM65, 20/CM68, 4/CM79	42/5
D. 4 ply	4/CM24, 7/CM68, 1/CM79	12/3

Table 4–3 cont.

Category	Number of Artifacts/Site Number	Total # of artifacts/ Total # of sites
1. Re-plied	4/CM24, 4/CM68, 1/CM79	9/3
E. 5 ply	1/CM68, 2/CM79	3/2
1. Re-plied	1/CM68, 2/CM79	3/2
F. 6 ply	1/CM79	1/1
G. Residual	13/CM68	13/1
ii. S-twist	18/CM24, 3/CM37, 2/CM56d, 9/CM59e, 3/CM65, 127/CM68, 2/CM79	164/7
A. Single yarn	6/CM24, 3/CM37, 2/CM56d, 19/CM68	30/4
B. 2 ply	12/CM24, 9/CM59e, 97/CM68, 2/CM79	120/4
1. Re-plied	2/CM24, 5/CM68	7/2
C. 3 ply	3/CM65, 9/CM68	12/2
1. Re-plied	3/CM65	3/1
D. 4 ply	1/CM68	1/1
E. Residual	1/CM68	1/1
iii. Residual	8/CM68	8/1
A. Zero twist, single yarn	5/CM68	5/1
b. Crude cordage	59/CM24, 2/CM37, 1/CM56d, 705/CM68	767/4
4. Coiled basketry	49/CM24 (1 frag. not typed), 1/CM28, 1/CM56d 6/CM59b, 1/CM59e, 21/CM64, 2/CM65, 101/CM68 2/CM73, 1/CM74, 14/CM79	199/11
a. Bundle foundation	37/CM24, 1/CM28, 1/CM56d, 6/CM59b, 1/CM59e, 21/CM64, 30/CM68, 2/CM73, 1/CM74, 14/CM79	114/10
b. 1/2 rod foundation	7/CM24, 2/CM65, 65/CM68	74/3
c. Rod foundation	4/CM24, 6/CM68	10/2

Table 4–3 cont.

Category	Number of Artifacts/Site Number	Total # of artifacts/ Total # of sites
5. Plaited matting	25/CM24, 2/CM28, 3/CM37, 15/CM56d, 2/CM59b, 4/CM59d, 2/CM59e, 3/CM62, 96/CM64, 2/CM65, 142/CM68, 7/CM73, 3/CM74, 49/CM79	355/14
a. Twill	16/CM-24, 1/CM28, 3/CM37, 9/CM56d, 1/CM59b, 3/CM59d, 83/CM64, 1/CM65, 94/CM68, 4/CM73, 1/CM74, 43/CM79	259/12
b. Checker	9/CM24, 3/CM27, 1/CM28, 6/CM56d, 1/CM59b, 1/CM59d, 2/CM59e, 3/CM62, 13/CM64, 1/CM65, 48/CM68, 3/CM73 2/CM74, 6/CM79	99/14
6. Netting	7/CM24, 2/CM56d, 1/CM59d, 33/CM64, 1/CM65, 140/CM68, 1/CM73, 1/CM74, 3/CM79	189/9
a. Knotted	1/CM24, 2/CM64, 14/CM68, 1/CM74	18/4
b. Knotless	6/CM24, 2/CM56d, 1/CM59d, 31/CM64, 1/CM65 126/CM68, 1/CM73, 3/CM79	171/8
7. Twined matting	17/CM24, 72/CM68, 2/CM74	91/3
a. Hard	12/CM24, 47/CM68, 1/CM74	60/3
b. Soft	5/CM24, 25/CM68, 1/CM74	31/3
8. Strung matting	3/CM24, 1/CM59E, 12/CM64, 2/CM68	18/4
9. Rosette	1/CM37, 87/CM68	88/2
10. Stripped leaf	14/CM68	14/1
11. Spiralled leaf or pod	9/CM68	9/1
12. Wrapped fiber wad	10/CM68	10/1
13. Nopal artifact	1/CM68, 25/CM68	26/2
14. Agave needle	37/CM68	37/1

Table 4-3 cont.

Category	Number of Artifacts/Site Number	Total # of artifacts/ Total # of sites
15. Fiber ring	3/CM24, 2/CM65, 73/CM68	78/3
a. Single strand	14/CM68	14/1
b. Several strand	1/CM24, 1/CM65, 6/CM68	8/3
c. Multiple strand	25/CM68	25/1
d. Small	13/CM68	13/1
e. Fat, high	2/CM24, 1/CM65, 12/CM68	15/3
f. Aberrant	3/CM68	3/1
16. Roll of fiber	2/CM24, 18/CM68	20/2
17. Fiber fringe	6/CM68	6/1
18. Knotted band	12/CM68	12/1
19. Ladder	1/CM37, 1/CM56d, 50/CM68	52/3
a. Like sandal foundation	1/CM56d, 36/CM68 (including 2 not typed)	37/2
i. No padding, sotol	1/CM56d, 7/CM68	8/2
ii. No padding, zamandoque	10/CM68	10/1
iii. No padding, yucca (?)	1/CM68	1/1
iv. Padding, sotol	4/CM68	4/1
v. Padding, zamandoque	7/CM68	7/1
vi. Zamandoque	5/CM68	5/1
b. Unlike sandal foundation	1/CM37 (not subtyped), 9/CM68	10/2
i. Looped both ends	2/CM68	2/1

Table 4-3 cont.

Category	Number of Artifacts/Site Number	Total # of artifacts/ Total # of sites
ii. Weft parallels other warp	2/CM68	3/1
iii. Narrow, elongated, flat	3/CM68	3/1
iv. Narrow, elongated, round	2/CM68	2/1
c. 3 warp	3/CM68	3/1
d. Residual (fragmentary)	3/CM68	3/1
20. Small, plaited artifact	5/CM64, 51/CM68	56/2
a. Braid	1/CM24, 35/CM68	36/2
b. Rectangle	3/CM24, 9/CM68	12/2
i. Diagonal	3/CM24, 8/CM68	11/2
ii. Right angle	1/CM68	1/1
c. "Pad"	4/CM68	4/1
d. Selvage (?)	1/CM24, 1/CM68	2/2
e. "Lanyard"	2/CM68	2/1
21. Noose	5/CM68	5/1
22. Fiber cross	11/CM68	11/1
23. Scarifier	1/CM24, 8/CM68	9/2
24. Wrapped fiber	19/CM68	19/1
25. Hank of fiber	2/CM24, 30/CM68	32/2
26. Residual	16/CM24, 1/CM59d, 2/CM64, 30/CM68, 1/CM74, 1/CM79	51/6

Table 4-4. All Sandals (Class F1)* from Frightful Cave (CM68).

	F1a																		
	F1a			F1aii			F1b			F1c			F1d			F1e			
Level	#	%	MMd	#	%	MMd	#	%	MMd	#	%	MMd	#	%	MMd	#	%	MMd	Total
Top	231	42	+11	29	85	+54	2	5	-26	0	-	-31	5	28	-03	5	100	+69	272
Middle	235	42	+07	3	9	-26	1	2	-33	4	57	+22	11	61	+26	0	-	-35	254
Bottom	89	16	-18	2	6	-28	39	93	+59	3	43	+09	2	11	-23	0	-	-34	135
Total	555			34			42			7			18			5			661

*Not included here, but included below, are 2 specimens in the residual category, 278 specimens too fragmentary to type, and 17 specimens not in situ.

Total Accounting for Class F1: All fiber sandals 958

F1a: Plaited sandals			
F1ai: Two-warp			
not in situ	15		
in situ	555		
	570	570	
F1aii: Three-warp			
not in situ	2		
in situ	34		
	36	36	
Not typed (too fragmentary)	278	278	
Total: Plaited sandals		884	884
F1b: Twill pad			42
F1c: Checker pad			7
F1d: Sewed			18
F1e: Braided			5
F1f: Residual			2
			958

CHAPTER 5

Plaited Sandals

TYPE F1a, PLAITED SANDALS

Description of the Type

This type of footgear (Figs. 5-1, 5-2, 5-3) was constructed of coarse fibers that served as lateral warps and were bent inward and crossed at the toe-end, then plaited in figure eights over-and-under, under-and-over the lateral warp-frame back toward the heel to form the wefts (Fig. 5-1a). These wefts were tucked under, not knotted, and ended at various places in the body of the sandal. Padding was added both longitudinally and transversely to form the foot-pad, and ties were installed to complete the construction.

Distribution of plaited sandals

38/CM24, 13/CM65, 884/CM68, 4/CM74 = 939/4

Discussion: This category includes a greater number of specimens than any other in the Coahuila collections, with the exception of cordage. However, the vast majority came from Frightful Cave (CM68), and the type was recovered from only three other sites, only one of which was excavated. Nevertheless, it has been possible to derive a considerable amount of information and a goodly number of inferences from these specimens, which, thus, have come to be one of our most productive bodies of information.

Plaited sandals were the most common form of footgear when the occupation of Frightful Cave began (see Table 4-4, this volume), possibly as early as 7000 B.C. We found them in the Bottom Level localized in the rear areas (the Back and Passage Sectors), which served at that time as a dumping ground. By Middle Level Times, beginning possibly as early as 5000 B.C., there was a marked increase in the numbers of these sandals abandoned, and presumably used, by the people occupying Frightful Cave. The Back Sector had ceased to be a major dumping place and had become primarily a living area; the Passage continued to receive much trash but was probably too narrow for occupation.

From the deposits of the Top Level, starting about 2000 B.C., although there was approximately the same number of these sandals recovered, the Master Maximum deviations (MMd) show that actually they had increased considerably and that their area of concentration had shifted from the rear to the forward areas.

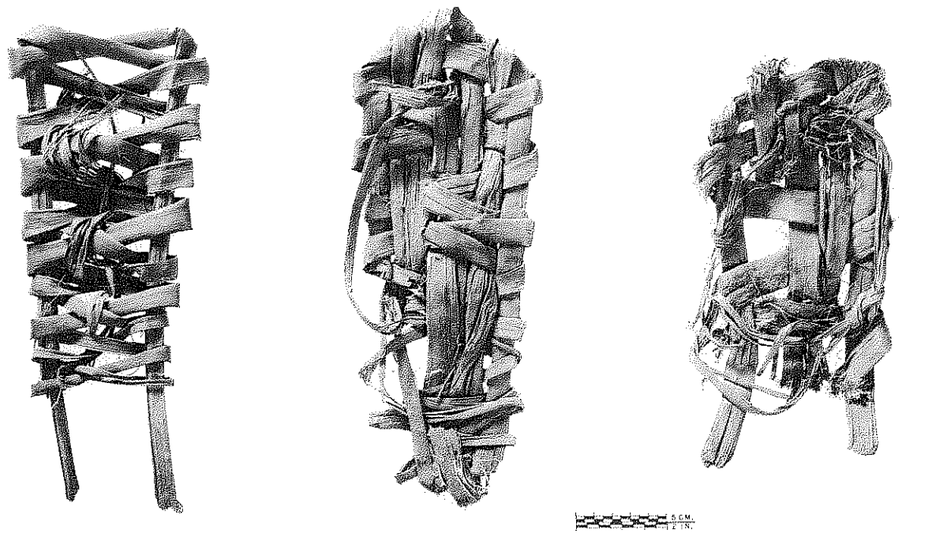
When this chronological sequence is compared with that from Fat Burro Cave (CM24), the best fit between the two bodies of data seems to be as shown in Table 5-1. This correspondence is supported by radiocarbon dates, coiled basketry, and chipped stone artifacts, particularly projectile points. There are a few contradictions, however, as for instance the presence of twill-pad sandals in the Middle Level of Fat Burro Cave, while in Frightful Cave the level of correspondence is the Bottom Level. There is reason to believe that this discrepancy may be due to the shallowness of the deposits of Fat Burro Cave and the consequent compression of the stratigraphic column.

Analysis of the complete lengths of plaited sandals reveals a definite modality and a unidirectional shift in size through time. On the assumption that these relationships, seen in the total collection, will reflect in general the relationships of foot lengths of the separate groups of people that occupied the cave, the sandal lengths have been converted into foot sizes, and these in turn have been interpreted in terms of the age and sex of the persons using those sandals. The application of Student's *t*-test to these data indicated that there is less than 1 chance in 1000 that the sandal samples from the Top and Middle Levels of Frightful Cave derive from the same population, but for the Middle and Bottom Levels there is more than 1 chance in 10 that the sandals come from one population. In other words, we are getting substantial evidence of a

break in the cultural continuity of the site between the Middle and Top Levels, which may very possibly be indicative of a physical change in the people who occupied the site—and at the same time as other breaks have been noticed in other aspects of culture.

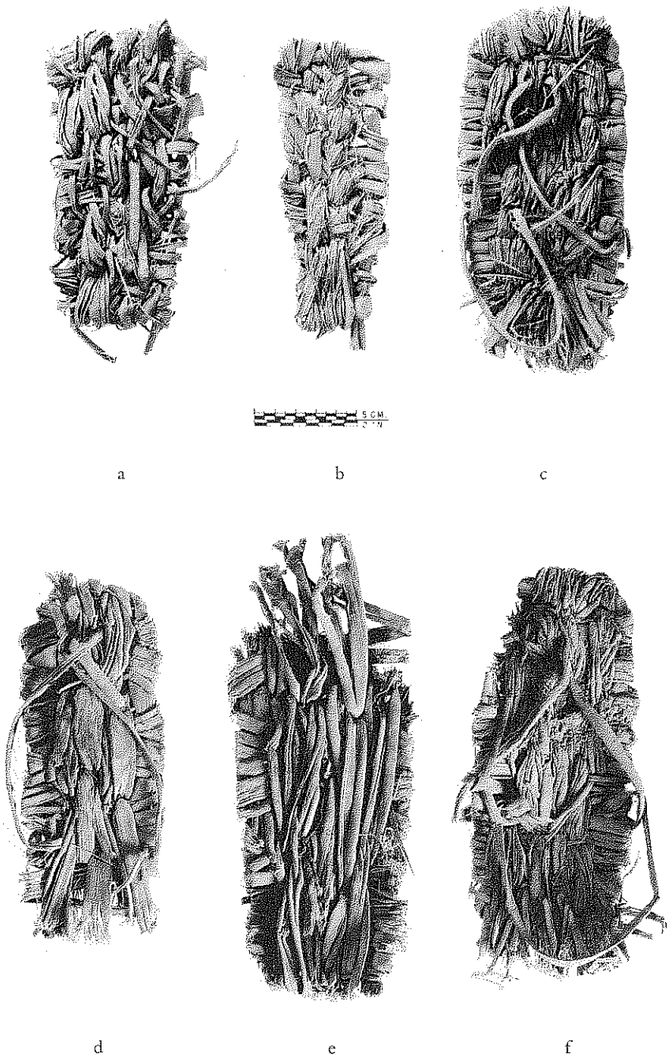
For some reason, apparently other than chance, more right sandals than lefts were worn out and abandoned in Frightful Cave, while the reverse is the case in Fat Burro Cave. Although an attempt was made to explain this on the basis of handedness, the results are inconclusive and unsatisfactory. Although this line of inquiry still remains viable, more conjunctive and collateral evidence will have to be found and adduced before we can hope for a solution to the problem. Other investigations have been made on the very apparent results of sandal use, for example the rank order of the various locations exhibiting depressions and breaks. But although certain regularities and correlations were discovered, there is not enough comparable information in our collections or in the literature to encourage a more detailed study at the present time. The same can be said of our analysis of the reuse of sandals and what this might mean for other aspects of the lifeways of the ancient people. For the present we have made a start but have come to the end of our endeavors without the more conclusive results to which we had aspired.

We found that the use of lechuguilla in the manufacture of these sandals was an early trait that was given up in later times when zamandoque became almost the only material used. But one fact stands out above all: the basic materials and the technique of making plaited sandals remained identically the same for more than 7000 years, from sometime before 7000 B.C. to



a b c

Fig. 5-1
Plaited sandals (F1a) from Frightful Cave: a) CM68,F-432, foundation for two-warp plaited sandal (F1ai), of zamandoque (*Hesperaloe funifera*), only two strands of padding and no ties inserted; b) CM68,F-559c, two-warp plaited sandal (F1ai), of zamandoque, padding minimal and longitudinal between warps, toe ties in place but broken off, slightly worn on bottom (i.e., used); c) CM68,F-692d, three-warp plaited sandal (F1aiii), of zamandoque, padding minimal, ties of Type G in position and worn, bottom well worn (i.e., sandal was used in its present condition).



a b c

d e f

Fig. 5-2
Two-warp plaited sandals (F1ai) from Frightful Cave: a) CM68,F-502d, of zamandoque, padding mostly longitudinal and full, no depressions or breaks or wear, no ties (i.e., not used); b) CM68,F-803c, of zamandoque, padding longitudinal and moderate, one strand on right is looped over top weft and then twill-twined through other wefts to heel, no wear and no ties (i.e., no use); c) CM68,F-1342e, of zamandoque, padding longitudinal and moderate, no depressions and no breaks but bottom slightly worn and heel worn especially at left (i.e., moderate use); d) CM68,F-1138d, of zamandoque (except two padding strands of lechuguilla [*Agave lechuguilla*]), padding longitudinal and full, ties of Type E, heel worn off evenly across, bottom worn; e) CM68,F-1220d, of zamandoque, padding longitudinal and full, both warps broken and missing at toe-end, right toe broken out, bottom worn; f) CM68,F-775f, of zamandoque, padding longitudinal and moderate, ties of Type A terminating on inside, heel worn and pressed out on right, bottom well worn, right foot.

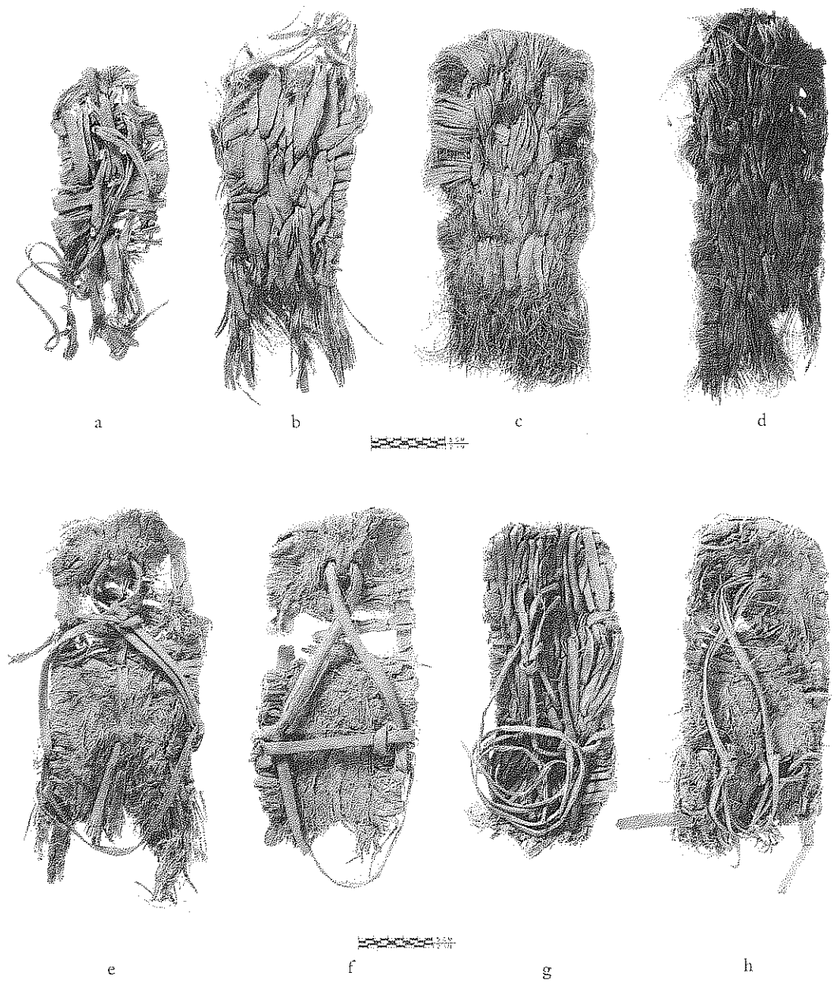


Fig. 5-3
Plaited sandals (F1a) from Frightful Cave: a) CM68,F-280a, two-warp plaited sandal (F1ai), of lechuguilla (except ties, which are of zamandoque), padding longitudinal and scanty, bottom well worn, right side of heel worn off, right foot?; b) CM68,F-1228, plaited sandal (F1a), of lechuguilla, well padded longitudinally, bottom well worn, both toe and heel broken out; c) CM68,F-785b, two-warp plaited sandal (F1ai), of lechuguilla, well padded mostly longitudinally, left side of heel the most worn; d) CM68,F-472a, plaited sandal (F1a), of lechuguilla, padding longitudinal and full, bottom worn, heel worn especially right; e) CM68,F-538e, two-warp plaited sandal (F1ai), of zamandoque, padding longitudinal and full, ball-of-foot area broken out, big toe depression right, heel worn through left, tie Type F, left foot; f) CM68,F-1301f, two-warp plaited sandal (F1ai), of zamandoque, padding moderate and longitudinal, ball-of-foot area worn/broken on left, big/middle/small toe depressions, bottom much worn, heel worn off center, tie Type F, left foot; g) CM68,F-811a, two-warp plaited sandal (F1ai), of zamandoque, padding longitudinal and full, big (right) and small (left) toe depressions, heel depression (center), bottom worn, tie Type B, right foot; h) CM68,F-688b, two-warp plaited sandal (F1ai), of zamandoque, padding longitudinal and transverse and full, bottom worn also top, big toe depression left, small toe depression right, heel worn through right, tie Type G, right foot.

Table 5-1. Correspondence of Levels in Frightful (CM68) and Fat Burro (CM24) Caves, Based on the Closest Correspondence of the Master Maximum Deviations of Plaited Sandals (F1a [sub-Types F1ai and F1aii]).

	Frightful Cave N=589*	Fat Burro Cave N=36	
		-31	Top Level ± A.D. 1
Top Level ± 1900 B.C.	+13	+37	Middle Level ± 2800 B.C.
Middle Level ± 5000 B.C.	+05	-06	Bottom Level ± 3300 B.C.
Bottom Level ±7000 B.C.	-18		

Note: Dates are generalized approximations abstracted from radiocarbon dates (Appendix B); they represent possible starting dates of levels.

*555 F1ai and 34 F1aii (certain identifications)

at least the first centuries of the Christian era and probably later. Many other categories of artifacts also remained more or less the same or changed very little, but there were none, as far as we could discover, that showed such consistency as did the plaited sandals. This consistency appeared most unusual to us because artifacts of general use, made by individuals for their own wear in large quantities over long periods of time, are commonly the ones that exhibit the most variation and, in many instances, a definite "drift" along certain lines of change. It would be interesting to know whether this contrary condition did indeed exist in Coahuila and, if so, why such a reversal of custom occurred.

Before leaving this general discussion of sandals and the potentially profitable, but at present rather inconclusive, results that some of our lines of investigations have produced, I should like to enter a few remarks into the record. It is obvious that one of the major causes of this inconclusiveness has been the lack of comparable information from other sites and other areas. Such information could have helped to refine our inquiries, to factor out irrelevancies and eliminate patent "just-not-so's," to add supportive or contradictive evidence, in short to help in the winnowing process so necessary in coming to substantial and acceptable conclusions. But as things now stand, we have not been able to fill out and substantiate (or disqualify) our equations with other data. We have been unable to make full use of the comparative method.

At the same time, our material is said to be isolated, not fully in accord with current practices or interests in archaeology. Several archaeologists have thought it esoteric and questioned its value because they cannot find anything in the literature with which to compare it. In reply, I simply point out that our work is not at fault because it has been shown to be unsound, but instead that it is considered dubious because it has not been tested. Nor can it ever be tested until comparable data are collected and subjected to comparable analysis. This also can never be unless a start is made. The first archaeologists to try will have, as we have had, only a very small field to till and some hard rows to hoe, but if they persist, we expect that there will gradually be built a body of evidence that should suffice the task.

SUB-TYPE F1ai, TWO-WARP PLAITED SANDALS

Description of the Sub-Type

The warp frame of this type is made of two elements laid parallel to form the lateral margins and to support the wefts (Fig. 5-1). Each warp element is turned inward to the opposite side at the toe-end and, as a new role as a weft, is turned around the warps ("plaited") in figure eights back toward the heel, form-

ing the wefts. Ties and padding were added to complete the construction.

Distribution of Two-Warp Plaited Sandals

9/CM24, 13/CM65, 570/CM68, 4/CM74 = 596/4

Discussion: Since only those sandals about whose warp construction we can be sure are included in this category and since all sites where they were found, except Frightful Cave, produced such small quantities, any conclusions drawn or inferences made about these artifacts, for any site other than Frightful Cave, must be regarded as provisional. Furthermore, in as much as only two of the four sites that produced this type of sandal were excavated (Fat Burro Cave [CM24] and Frightful Cave [CM68]), only they can be used for situal distributional and quantitative analyses—and the former site has a frequency of only nine. Therefore, detailed intersite comparative studies, particularly outside of northern Coahuila, would appear to be highly contingent. The reader will note that what generalizing and comparative work is reported here is placed in the Discussion section of Class F1a, plaited sandals as a whole. There, any significant differences are noted in passing.

Two-Warp Plaited Sandals from CM24 (Fat Burro Cave)

See Table 5-2 for distributional data.

Discussion: From this site, there are only 9 sandals that we can certainly identify as two-warp, and there are only 36 plaited sandals of any kind. Given the amount of occupational debris recovered, this scarcity is puzzling, especially when compared with the very large number found in Frightful Cave. It is possible that the difference is due to a variation in lifestyle at the two sites, Fat Burro Cave being a relatively short-term, stopover place, while Frightful Cave, particularly in its early occupation(s), was certainly a more permanent habitation. The relative lengths of time spent in the two sites would account for the loss or abandonment of more sandals in the latter than in the former. There is, of course, also the possibility that differential preservation may have been responsible, since Fat Burro Cave retains relatively shallow deposits in its relatively shallow front-to-back depth and hence is more exposed to the deteriorating effects of weather. But this does not seem likely, because the poor condition of the sandals from Fat Burro Cave appears to be due more to aboriginal wear than to natural deterioration, as is suggested by the localization of the majority of destroyed areas in the pattern of foot use, i.e., heel, ball, and toe.

Because of this scarcity, few conclusions of significance have been reached from a study of the sandals from Fat Burro Cave. Certain facts, however, are worth noting, if only to have them on record for future reference. First and possibly the most suggestive is that all specimens are made of lechuguilla, the use of which in Frightful Cave is characteristic of the earliest times, possibly even before Fat Burro Cave was occupied. Then, also, sandal F-198, from the surface of Block H6 in the Center/East Wall Sector, is the nearest thing we have in the Coahuila collections to a "fishtail" sandal, a type characteristic of sites in Trans-Pecos Texas and the Upper Gila River area of New Mexico, that were probably occupied in later times. It is noteworthy that in Sandal F-198 the warps do not cross as they do in the northern sites, but only converge very strongly. There were no sandals having complete lengths, but the eight measurable widths have a range of 70 to 122 mm, a mean of 97.6 mm, and both the mode (two specimens) and the median are at 99 mm. Only one sandal retains its ties in good enough condition for the type to be recognized: specimen F-187, from the Bottom Level of the Rear Wall Sector, has ties of Type D/B (see Chapter 7).

Two-Warp Plaited Sandals from CM65

Before we entered it, this cave had been vandalized by guano collectors. The cultural materials we recorded were salvaged from the spoil pile of the screens used by the vandals to sift the deposits. Thirteen sure two-warp sandals were recovered. Only one of these retains a complete length, 265 mm. All had complete widths: range, 84 to 125 mm; mean, 94 mm; mode, 84? and 125? mm; median, 100 mm. Nine are made entirely of zamandoque, one of which has a few strands of lechuguilla padding; two are predominantly of zamandoque but have ties and some padding of lechuguilla; two are entirely of agave, one of which is identified as "lechuguilla" and the other as "maguey." (The ratio of these is quite different from that of Frightful Cave, being 1:3:8 for all lechuguilla, mostly zamandoque with some lechuguilla, all zamandoque; from Frightful Cave: mostly

Table 5-2. Summary Table for Two-Warp Plaited Sandals (F1ai) from Fat Burro Cave (CM24).

Level	MMd	Sector	MMd	Wall	MMd
Top	-26	Front	+08	East	-12
Middle	+17	Center	+17	North	-07
Bottom	+08	Rear	-25	West	+05
				Rear	+13

F-9,52,72,73,153,160,161,187,188/9

avg. per m^3 ...0.68
avg. per blk ...1.29

This table is an abstraction from and a simplification of the corresponding complete Master Maximum chart (MMc) of this type at this site (as an example, a complete MMc of the type F1ai, two-warp plaited sandals from Frightful Cave [CM68], is presented in Figure 5-4). The designation "avg. per m^3" means the average number of specimens per cubic meter of cultural deposit and matrix excavated from the site as a whole; it is a measure of relative quantity. "Avg. per blk" means the average number of specimens found in one block or other excavation unit and is obtained by dividing the total number of specimens into the total number of blocks in which any specimen of the category was found; it is a measure of concentration. "Level" refers to a vertically superposed cultural stratum based on the arbitrary and/or cultural levels by which the site was excavated. "Sector" is a unit of more or less culturally associated and defined "columns," which are units of excavation defined in two directions by the horizontal grid system. "MMd" refers to the Master Maximum deviations, either plus or minus (see Chapter 4), which give the amount and direction of deviation from the Master Maximum expectancy. The "wall" association is a unit of columns with inferred cultural implications but descriptively defined by association with the bedrock walls of the cave.

zamandoque with some lechuguilla 1, all lechuguilla 1.94, all zamandoque 44.23). At CM65 we recovered two sure left sandals, one sure right, four probable lefts, one probable right, five possible lefts. This is in sharp contrast with the finding at Frightful Cave, where most sandals were for the right foot.

Two-Warp Plaited Sandals from CM68 (Frightful Cave)

In Table 5-3 no catalog numbers have been included, as they were (for the sake of example) in Table 5-2 for Fat Burro Cave. To have done so in the absence of the Empirical Tables (see Chapter 4) would have been merely to take up space with an exceedingly long list of quite meaningless figures and to advance the reader's knowledge and understanding little, if any. We hope the purpose and advantage of both the Empirical Tables and such a reference list of categorized specimens by site will have been recognized by the reader. For the present, the matter can be left to rest as an example of method, not as a source of empirical information.

At this point it is expedient, however, to provide another example of the methods/techniques that we have used in studying the material from Coahuila. Figure 5-4 is the Master Maximum chart (MMc) of two-warp plaited sandals, Type F1ai, from Frightful Cave. It contains the quantitative and distributional data for this type at this site and is to be used in conjunction with other such charts (for other categories of cultural and noncultural specimens and attributes) in contextual and comparative studies. Together with the descriptive records of field and laboratory, these MMc's comprise our basic data. For the sake of clarity, one caution is necessary: it is most important to distinguish between the MMc of a site (that which contains the quantities and percentages of all excavated cultural debris [Fig. 4-1]) and the MMc of some category or attribute at the site. The former is "master maximum" in terms of a site, the latter in terms of one particular cultural or natural phenomenon at a site. In practice, the MMcs are very easy to work with, not only at the time of construction but also later during study and comparative work. From our field notes and survey plats, a two-dimensional analogue of the three-dimensional cultural deposits of the site was composed and mimeographed in quantity.

When we began to study an artifact or an attribute, one of the first things we did was to construct an MMc: of two-warp sandals, of square knots, of cache pits, of

Table 5-3. Quantitative and Distributional Data for Two-Warp Plaited Sandals (F1ai), Frightful Cave (CM68).

By Level

Level	Sector	f*	% By Site %of N	% By Site MM% Site	% By Site MMd Site	% By Level %of f	% By Level MM% Level	% By Level MMd Level
Top	Front	36	6	10	-04	16	31	-15
f=231	Center	137	25	12	+13	59	40	+19
%=42	Back	28	5	4	+01	12	12	00
MMd +11	Passage	30	5	5	00	13	17	-04
Middle	Front	61	11	14	-03	26	40	-14
f=235	Center	31	6	10	-04	13	30	-17
%=42	Back	29	5	4	+01	12	11	+01
MMd +07	Passage	114	21	6	+15	49	18	+31
Bottom	Front	4	1	16	-15	4	45	-41
f=89	Center	5	1	11	-10	6	32	-26
%=16	Back	27	5	3	+02	30	9	+21
MMd -18	Passage	53	10	5	+05	60	13	+47

By Sector

Sector	Level	f*	% By Site %of N	% By Site MM% Site	% By Site MMd Site	% By Sector %of f	% By Sector MM% Sector	% By Sector MMd Sector
Front								
f=101	Top	36	6	10	-04	36	25	+11
%=18	Middle	61	11	14	-03	60	36	+24
MMd -21	Bottom	4	1	16	-15	4	40	-36
Center								
f=173	Top	137	25	12	+13	79	36	+43
%=31	Middle	31	6	10	-04	18	31	-13
MMd -03	Bottom	5	1	11	-10	3	33	-30
Back								
f=84	Top	28	5	4	+01	33	35	-02
%=15	Middle	29	5	4	+01	35	36	-01
MMd +04	Bottom	27	5	3	+02	32	29	+03
Passage								
f=197	Top	30	5	5	00	15	33	-18
%=36	Middle	114	21	6	+15	58	39	+19
MMd +24	Bottom	53	10	5	+05	27	28	-01

Deviations by Level (Synchronic)

	Front	Center	Back	Passage
Top	-15	+19	00	-04
Middle	-14	-17	+01	+31
Bottom	-41	-26	+21	+47

Deviations by Sector (Diachronic)

	Top	Middle	Bottom
Front	+11	+24	-36
Center	+43	-13	-30
Back	-02	-01	+03
Passage	-18	+19	-01

* N=555

fire hearths, of round, self-pointed atlatl foreshafts, of 2/2 twill plaiting, etc. For this work, we used the so-called catalog cards. These contained the provenience data as well as the descriptive information on each recovered specimen. Had we had been fortunate enough to have our data computerized, the analysis would have been vastly facilitated and our task greatly lightened. We now know that the system is viable, only its implementation is deficient. It is probably superfluous to point out that a visual image such as Figure 5-4 is much more easily remembered and understood than any lettered list of hundreds of specimens, provenience, and quantities.

As for Figure 5-4, some explanation is in order. The numbers at the top represent one set of grid lines; they identify what we call "trenches," because it was along these lines that our east-west excavation trenches were dug. Within the space of each trench are the alphabetic symbols for north-south grid lines perpendicular to the numbered ones. When the numbered lines are combined with the lettered lines, the result is called a "column"; thus, Column 10-H is the designation for the westernmost excavation unit, i.e., column, in Frightful Cave (see Fig. 3-13). The vertical units of excavation have been termed "levels" (e.g., "1st level," "2d level"), and, when certain excavation levels have been combined as the result of decisions made through cultural analysis, they have been designated as "Top Level," "Middle Level," and "Bottom Level." (The reasons behind these decisions are too contingent and involved and need not be presented here.) When horizontal units, i.e., trenches and columns, have been combined they have been called "sectors": Front, Center, Back, and Passage. Thus, when all three of these systematics are combined as they are in Figure 5-4, the result is a two-dimensional representation of a three-dimensional form. Finally, numerical summaries of the table are to be found below the table itself. "Avg. per m²" and "avg. per blk" have been explained earlier, in the summary table (Table 5-2) for Fat Burro Cave. In the table at the right are the vertical and horizontal summations, plus the MMd's for each.

Discussion: This is the most abundant category of sandal from Frightful Cave. It represents 59% of all sandals and 64% of all plaited sandals and occurs throughout the deposits, but with notable concentrations in the Top Level and Passage Sector. Table 5-3 is a more detailed presentation of the data, giving the frequencies, the unit percentages, and the MMds for each Level-Sector permutation calculated on the basis of the cubic meterage excavated from each level and sector (not from the whole site). Table 5-4 is a recapitulation of Table 5-3, in simpler form, for the purpose of pointing up the implications of the quantitative/distributional data.

Before analyzing Tables 5-3 and 5-4, the nature of the Passage Sector and its deposits should be described. The passage lies at the farthest inward end of the cave. It is a very narrow fissure or solution crack, in most places less than a meter wide, sinuous and angular, extending back from the open part of the cave for more than 10 m into the mountain. It starts over 35 m from the mouth of the cave and receives virtually no sunlight, and because of these conditions, it could never have been a place of habitation (see Figs. 3-13 and 3-14). During its excavation we recovered no unequivocal evidence that it ever was occupied, although several features that we identified as hearths and as cache nests were found but were discounted as anything but evidence for transient use. In the Bottom Level, lying directly upon preoccupation cave-spall, the deposits were much like those of the adjacent, somewhat wider and better-lit Back Sector: errant cave spalls, cave dust, small amounts of bat and rat dung, a little much-used and shattered fire rock, an occasional cache "nest," a few hearths, and an atypically large number of fragmentary, worn out, no longer serviceable artifacts. The problem, of course, is how and why these cultural objects (apart from the caches and hearths) got to a presumably nonresidential area such as the passage. The "collected" aspect of the material seems to eliminate from consideration as efficient cause all but Man and pack rats, and the latter do not appear to be acceptable suspects because there were no burrows or rats' nests in the deposits. Indeed, it would have been impossible for rodents to dig or maintain such structures in so friable and unstable a matrix as the bat guano and rat dung that made up an increasingly large proportion of the deposits as they grew upward through time. All present evidence points to humans as the depositors and to the strong probability that they used the area as a more or less recognized dumping ground and repository for little-used or abandoned artifacts while living in other parts of the cave.

Now let us turn to Table 5-4. The upper part contains signs pertaining to the MMds calculated by using

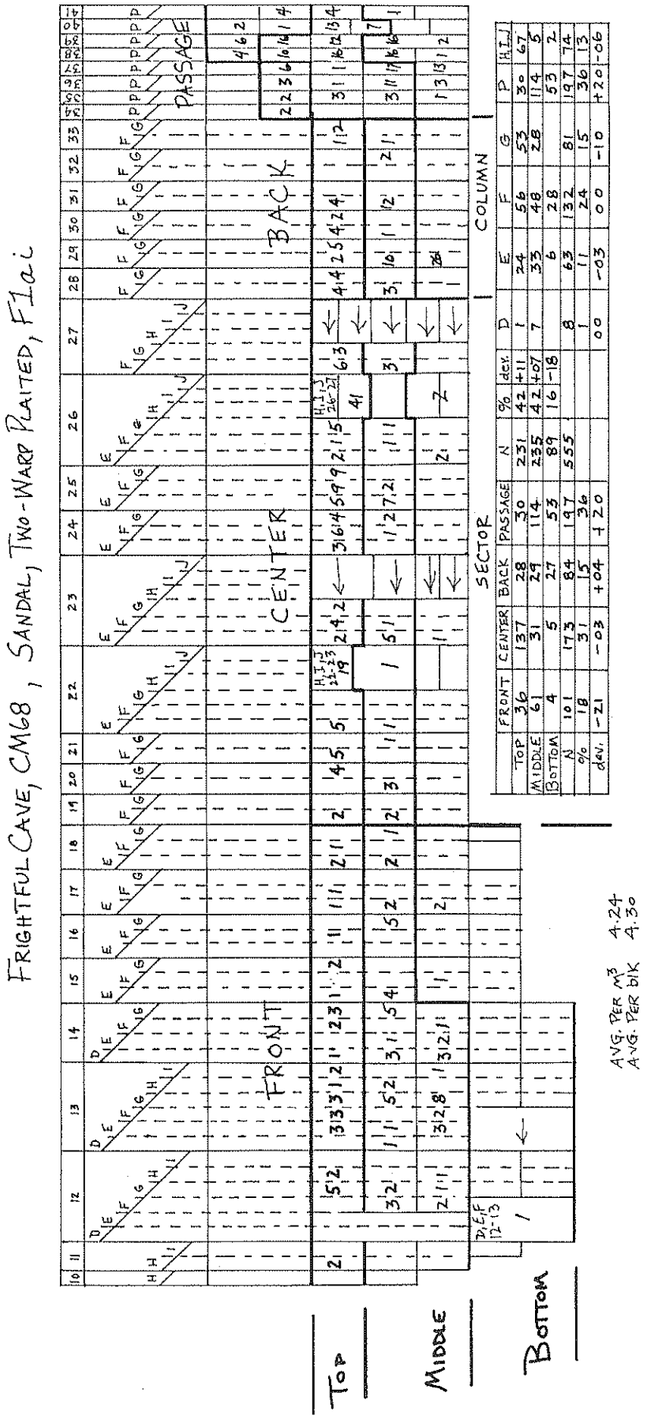


Fig. 5-4
Master Maximum Chart (MMc) of two-warp plaited sandals (F1ai) from Frightful Cave (CM68)

Table 5-4. Recapitulation of Table 5-3, Showing Only the Signs of the MM Deviations for Two-Warp Plaited Sandals (F1ai) from Frightful Cave (CM68).

	Front	Center	Back	Passage
By Level				
Top (+11)	-	+	00	-0
Middle (+07)	-	-	+0	+
Bottom (-18)	-	-	+	+

	Top	Middle	Bottom
By Sector			
Front (-21)	+	+	-
Center (-03)	+	-	-
Back (+04)	-0	-0	+0
Passage (+20)	-	+	-0

- = significant minus deviation
-0 = Nonsignificant minus deviation
00 = No deviation, i.e., precise expectancy
+0 = Nonsignificant plus deviation
\+ = Significant plus deviation
> ±8 = Significance level

the cubic meterage excavated from each of the three stratigraphic levels. The information means "what happened throughout the cave during the stated, single time-level"; it is thus synchronic. In the bottom part of the table, the figures have been calculated according to sector and mean "what happened within limits of the stated Sector through time"; it is thus diachronic. In both parts, we note the unidirectionality and regularity of trends (with only one exception in the diachronic view of the Passage). When we examine the more detailed expressions of Table 5-3, we see that the detailed figures emphasize this orderliness. Our conclusion is that the data and the manner of presentation of Table 5-4 are internally consistent and probably present a valid picture. Therefore, we have the makings of a significant culture-historical problem.

At this time, it might be well to state two premises that are basic to the following discussion. (1) That the presence of sandals, all other things being equal, is indicative of human occupation and the more sandals, the more concentrated, populous, or "intense" the occupation. (2) That, unless there is evidence to the contrary, the find-spot of the sandals must be considered to be the approximate place of their original deposition and subsequent residence, thus indicating the living area of the people who made, used, and/or possessed those sandals. Of course, a longer span of residence by a small population could equally account for more sandals, overall or in any one locus, and thus make erroneous an inference of a more populous occupation. But since all our individual cataloging units (and virtually all of our excavation units) are of the same size, i.e., one-half cubic meter (1 x 1 x 0.5 m deep), we make the further assumption (contingent upon evidence to the contrary) that they represent more or less the same time-span.

Returning again to Table 5-4, top part, we see that in Bottom-Level times the concentration of two-warp sandals was in the Back and Passage sectors, while the actual frequency of such sandals in the Front and Center sectors was very low and the minus deviations very high (see Table 5-3). Since the Passage appears undoubtedly to have been used for dumping and possibly storage, the stated assumptions of the preceding paragraph leave only the Back Sector as the place where the people lived in those early times. But

the Back Sector is very small, only about 12m², and would have accommodated at the most only a very small group of people. It appears that we must look among our other data in order to explain this situation and modify the hypothesis.

Throughout the excavated portion of the site, the Bottom Level was comprised of a series of stacked, water-consolidated dirt and fiber floors of a uniquely formal nature. These are surely indicative of human occupation—and one of an unusually stable, continual if not continuous, relatively well-organized kind (see Fig. 3-16, this volume). These floors were best defined in the forward areas of the cave, but they did extend into the Back and even the Passage Sectors, where they broke down and gradually lost definition when they did not actually cease to exist. All these conjunctive data (and others not appropriate to this abbreviated account) lead to an inference that the Back Sector could not have been the only area of occupation, or possibly even a living area at all, and that it probably was used primarily as a dumping area combined with what little, if any, domestic activity went on there. This would account for the cache nests and hearths and for the high plus-deviation of two-warp sandals, while at the same time explaining the absence of evidence for a more intensive and diversified domestic use.

Then what about the scarcity of sandals in the Front and Center Sectors, where the floors give conclusive evidence of intensive human occupation? How does this jibe with the premise that sandals are indicative of a human living area? To help resolve these questions, we looked about for conjunctive evidence in the Bottom Level deposits in the area of floors. Immediately noticeable was the rather large number of cache pits (early in our field notes we called them "nests" or "cache nests," when we were uncertain about their human origin) and the generally uncluttered condition of the surfaces of the floors themselves. These and other data suggest that the scarcity of sandals in the area of floors may have been due, at least in part, to a relative formality and order, even a relative cleanliness, in the general culture, including traits that might have encouraged the construction of formal floors and cache pits, the maintenance of the living area in relatively "shipshape" condition, and the "bunching" of abandoned artifacts and other "trash" in a recognized, accepted, and commonly used "dump," such as the Passage. These cultural characteristics are in opposition to those of the culture(s) of the people who used Frightful Cave in later times and may constitute one of the major differences that appear in our archaeological record between the cultural manifestations at this site.

Returning yet again to Table 5-4, top part (synchronic), the distribution of two-warp sandals in the Middle Level is seen to be essentially the same as that in the Bottom Level. Looking over the more detailed presentation of Table 5-3, especially the rank order of sectors according to their deviations within levels, we note that the Passage and Back sectors are the same, and the only difference we find is that the Front and Center sectors have exchanged places, the former moving in the Middle Level 27 points toward expectancy and assuming third place in the order, while the latter moved by 9 and slipped into last place—but only by 3 points. These data appear to indicate that, while the Back and Passage sectors remained predominantly dumping and storage areas, both the Center and Front areas continued to be intensively occupied and, at the same time, the amount of abandoned artifacts, human fecal matter, scattered fire rock, and other "trash" increased in the living areas, but the number of along-the-wall caches diminished.

Although the above data and other evidence suggest that the start of a breakdown of the older, more stable and integrated culture of the Ciénegas Basin may have started by the end of Bottom-Level times (or at least during Middle-Level times), possibly as the result of increasing geographic and cultural pressures triggered by the beginning of a climatic change (Taylor 1966: 65f), these changes become strongly apparent only at the beginning of the Top Level. By Top-Level times, the Center Sector had become the one major living area and the two rear areas had lost much of their function as loci for dumping and storage. The Front Sector, possibly because of an enlargement and consequent encroachment of the rock ovens that had existed on the platform and very front of the cave since early times, suffered a reduction of "living space" and a loss of over 40% in its two-warp sandal population.

These changes in the Top Level, constituting as they do a rather definite break in the continuity that had existed since earliest times, provide additional evidence for significant cultural difference between the people who lived in Frightful Cave during its first

two epochs of occupation and those of the group(s) who used the site during its last years as a living place, i.e., from about 2000 B.C. to the Christian era and probably later. Perhaps if this were the only evidence of such a break, we would not be justified in making such an inference, but in view of the considerable amount of other supporting and conjunctive evidence, from both Frightful Cave and Fat Burro Cave (see below and Gilmore 1947), the inference would indeed appear to be reasonable, at least as a working hypothesis and basis for further investigation.

The gist of the evidence is that the major locus of occupation, from first to last, was always in the Center Sector, though with more or less intensive extensions into the Front and Back Sectors. The Passage, until the bats and rats took over in Top-Level times, had always been a dumping and storage area, as had been its neighbor the Back Sector when it was not used to live in. This inference is based on evidence that our first impression, gained from the data of Table 5-3, was probably in error and that the differential distribution of two-warp sandals in the Bottom and Middle Levels was due, not to differences in occupation areas, but to cultural variations having to do with the early construction and later abandonment of living floors and a more ordered, regulated, integrated, possibly more "sophisticated" culture during earliest times.

When we come to study the parts of Tables 5-3 and 5-4 where the orientation is from the viewpoint of Sector through time, i.e., diachronic, we get a different perspective but are led to much the same conclusions (or derivative inferences). The Passage yielded the most two-warp sandals of any Sector, but their distribution attains expectancy or above in only one of its three Levels. This is to say that, although the Passage contained a majority of two-warp sandals found in the Bottom Level throughout the site, the majority did not really represent a very large number of sandals when we consider the Passage sequence alone: only 27% of the total. In other words, when considered as a unit by itself, the Passage Sector had its greatest concentration of two-warp sandals, not in the Bottom, but in the Middle Level. By the time the deposits had built up to the Top Level, the Passage had minus-deviations both by Sector and by Level.

Before using these data to make an interpretation of culture history in Frightful Cave, information contained in the two-warp sandal distribution in the other Sectors is developed. The Back Sector remained remarkably constant in its two-warp sandal population throughout the occupation of the cave and was very close to expectancy the whole time. The Center Sector started with a sizeable minus-deviation and built up, by Top-Level times, a large plus-deviation, in fact the second largest in the distribution of two-warp sandals in the site and the very largest from the viewpoint of "deviations-by-Sector." The Front Sector started very slowly, with a very large minus-deviation, but by its Middle Level had a large plus-deviation, even larger than that of the Passage at the same time; however, by the Top Level, its distribution was down again, still plus but significantly lower.

When we combine these two bodies of data, the distributions of two-warp sandals by Level and Sector, it seems justified to make an interpretation or working hypothesis that will explain the facts as cogently as presently possible and give us a "hand up" to an understanding of the data and the construction of a cultural context for Frightful Cave. At the time of the first occupation of Frightful Cave, people built living floors on the original cave spalls and around the fall rocks from Front to Passage in the site. They lived largely in the Front and Center Sectors, and, to a lesser degree, in the Back. They threw their trash, including abandoned sandals, in the Passage for the most part but also in the Back Sector, and throughout the site they made small cache "nests" for storing sandals and other things. The floors were kept notably free of refuse, waste, and litter. At that time, plaited sandals were apparently just coming into vogue, contemporaneous with twill-pad sandals but gradually, by the end of Bottom-Level times, becoming the most numerous kind.

During Middle-Level times, the more stable culture of the earlier occupation began to break down. Much less attention was paid to order in the living area, and the floors were not kept up. The Passage still received much trash and many sandals while the Front Sector became more of a repository of sandals, either as storage or as locus of abandonment. This may have been a consequence of the growing importance of the rock ovens as activity and trash disposal centers. As the ovens were moved inside the cave from the platform, they encroached on what had been living space. The deposits of the Top Level show that the floors were no longer being made and that the cache nests

were much reduced in number. Trash and waste, including a tremendous amount of human fecal waste, were being strewn all over the living area—Front, Center, and Back—although in the Front there appear to be fewer sandals and less refuse, possibly because of a continued encroachment of the rock ovens. The details of these problems have yet to be worked out.

At this point one might present some other examples of inference and hypothesis developing out of the data on sandal distribution and context, especially examples that involve ideas (culture traits) that may have been entertained by the ancient people(s) who lived in Frightful Cave. But because only part of the pertinent data can be presented in this paper, nothing like a full analysis is possible. Nevertheless, I shall give two very abbreviated accounts in order to intimate some of the lines of our reflection upon this material.

First, let us consider an apparent dilemma. If it is true that the Passage was used as a dump and that unserviceable artifacts were abandoned there, then the people must have had some idea or ideas by which they defined a category of "trash" that was selected for disposal, and they must have had an idea of "bunching" that trash to put it out of the way and keep it out of their general living area. Furthermore, since this practice of dumping trash in the Passage endured for a very long time, and became a matter of archaeological record, so widespread was its acceptance, it reflects an order and regulation of cultural activities not apparent in other aspects of culture among the aborigines of Coahuila, particularly in the later epochs. And here is the dilemma: it does not seem possible that they had the same, or even closely comparable ideas concerning their own biological trash or, as we might say, their own "waste products." This is evidenced by the truly astounding amount of human fecal and human cadaveric matter that we found scattered haphazardly and in quantity throughout the deposits of the cave, even within the major living areas. The present paper is no place to attempt to resolve this problem, but one possible line of investigation would be to look for other instances in which the inhabitants of Frightful Cave or other (Coahuila) sites did or did not make distinction between cultural waste and biological waste, i.e., between what today we consider to be varieties of the same category of objects.

A second topic of reflection concerns the matrix of bat and rat excreta in which sandals were found in the Passage Sector. It was very noticeable during our excavation that the amount and proportion of bat guano, when compared to other materials including the cultural, increased greatly from bottom to top: in the Bottom Level there was very little more than in other areas of the site, but by Top-Level times it was estimated to comprise well over one-half of the deposits and the cultural material had all but disappeared. Conjunctive with these data, it gradually came to our attention after we had been working the site for a while, that the bats, numerous and pestiferous when we first arrived, had departed and not come back.

Based on both of the observations above, we may formulate a working hypothesis: The increase in the amount and exclusiveness of the bat guano (and possibly rat dung as well?) from bottom to top in the Passage was due to a gradually more intermittent, less continuous human occupation of the cave; this in turn may have been due to the increase in nomadism of the human population, a condition attested by several other lines of evidence (e.g., Taylor 1964, especially p. 198). Put in another way, this is to say that in Bottom-Level times, human occupation of Frightful Cave was relatively continuous, enough so as to encourage the building of formal floors, and the culture was relatively stable and well integrated as suggested, among other things, by the small amount of variation in artifact design, a greater concern with craftsmanship and aesthetics, the very restricted geographic range of the early cultural assemblage (the Ciénegas Complex, see Taylor 1966: 62f). By the beginning of Middle-Level times, the formal floors were no longer being made and many other indications of the old culture had gone, while there developed a notable increase in evidence suggesting a more nomadic way of life and a more variable culture influenced by outside cultural contacts.

Two of these indications are mentioned here by way of illustration. (1) Artifactual design and techniques of manufacture had proliferated. Chipped stone artifacts, especially projectile points, in early times had been made in only a few shapes into which all specimens could be placed with relative ease and assurance. Later, in Middle-Level times, there came to be a very large number of shapes, whose interrelationships, if any, are not at all clear, so that categorizing them has generally been very difficult and more than usually dubious; the number of specimens in each category

was very much reduced. On the other hand it seems apparent that many of these new designs have counterparts in regions surrounding Coahuila, specifically in Chihuahua, west Texas, and northeastern Mexico, and thus may represent intrusive "foreign" ideas and possibly objects. In regard to sandals and coiled basketry, the number of techniques of manufacture increased, some of which are so unusual as to be easily and surely identified and have been found in collections from surrounding areas, again suggesting "foreign" intrusion.

(2) The second indicator of a more nomadic life is that by Top-Level times, possibly around 1900 B.C., there had evidently come a change in climatic conditions as shown by the extinction of certain mesic animal forms and a shift of human diet and basic materials of manufacture from more mesic to more xeric components (Gilmore 1947; Taylor 1966: 66f). At approximately the same time, the archaeological sequence records a disruption and diffusion of culture, a very possible change in the population, increased evidence of nomadism, the acquisition of definitely "foreign" cultural objects and probably culture ideas. It seems hardly possible that this concatenation of events and conditions did not have some interrelationships and reciprocal effects.

Having dealt with the distribution of two-warp sandals, we may now turn to an examination of the sandals themselves, their form and construction. Figure 5-5 provides data on the length of complete two-warp plaited sandals. The distribution has been compartmentalized, making four groupings, one around each of the modes. The logic of the division of a column having an uneven number of instances and lying between two modes has been to award the larger (i.e., odd number) of cases to the adjacent mode that has the larger number of "its own" occurrences. It should be mentioned here in passing that a like analysis of the length measurement of all two-warp sandals that were recorded as being either complete (i.e., those of Fig. 5-5) or "nearly complete" (those additional ones that have been estimated to be within 10 or 15 mm of complete length), numbering a total of 245 specimens, gave results that are virtually identical to those in Figure 5-5. Thus it seems that we are dealing with essentially one universe, and therefore we can use either or both sets of data in our analyses.

At this point it is necessary to say something about the relationship between sandal dimensions and foot dimensions. In observing the modern, sandal-wearing Mexicans, both in Coahuila and in other parts of Mexico, it was apparent that in most cases, the sandal is both longer and wider than the foot. It is assumed that this is to provide a kind of "bumper" or "fender" against hurting or harming the foot on rocks, spines, and other hazards of foot travel. Our field notes (based on observation, not measurement) say that this fender is most commonly about one-half inch wide (approximately 12–13 mm) around the full circumference of the sandal. When the two-warp sandals from Frightful Cave were examined, it was noticed that a number retained very distinct depressions marking areas compressed by the toes, heel, and ball-of-the-foot and that these occurred at some distance in from the edges of the sandals. Measurements were made of sandals on which the depressions were clear enough to provide an unquestionable dimension, with the following results:

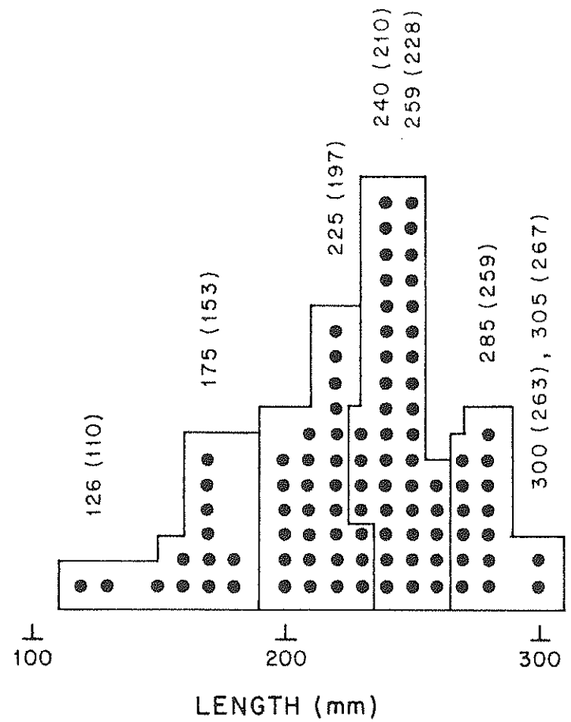
Distance from the end of the big-toe depression to front end of sandal:

N=24
range: 6–30 mm
mean: 15.42 mm
mode: 10 mm
median: 13–14 mm

Distance from end of heel depression to back end of sandal:

N=6
range: 0–25 mm
mean: 14.17 mm
mode: none
median: 12–17 mm

If some allowance is made for the roll of both big toe and heel in walking, such as the fact that depressions usually delimit an area a little larger than the true "static length" of the foot, and if we also recognize the imposed imprecision of measurement, the above mean figures can be taken as not significantly different from our observational estimation of 12 to 13 mm. When distances, adjudged to be "certain," between the lateral edges of the sandals and the depressions attribut-



N = 96
Class interval = 10 mm
range = 126 - 305 mm (110 - 267 corrected)
mean = 235 mm (206 corrected)
mode = 240 - 259 mm, 32 specimens (210 - 228 corrected)
median = 243 mm (212 corrected)

Fig. 5-5
Lengths of complete two-warp plaited sandals (F1ai)

able to the big toe, the ball of the foot, and/or the heel are abstracted from the descriptive data, the following results were obtained:

N=50
range: 0–38 mm
mean: big toe 10.9
ball 12.6
heel 12.93
avg. 12.14
mode: 8, 10, 12, 15 mm (5 specimens each)
median: 12–14 mm

Since the above-noted differences between length and width measurements are so small as to be negligible for our present concerns, 30 mm (15 mm each for big toe and heel and the same for each lateral margin of the sandal) are subtracted from all measurements to provide a "corrected" measure of the "actual" length and width of the foot that wore the sandal and made the depressions. However, since the majority (54%) of the lengths of the sandals from which depression measurements were derived falls above the mean-mode-median point of all the complete sandal lengths, it was felt that merely subtracting a constant 30 mm from each, whether the sandal is long or short, might significantly warp the results. Therefore, it has been assumed that a reduction by a percentage would yield more realistic results; and so, in arriving at an estimate of foot-length from sandal-length, we calculated the percentage that 30 mm represents of the three measures of central tendency (mean, mode, and median) of all complete sandals. These parameters proved to be 12.8, 12.0, and 12.3, respectively, with a mean of 12.4. The "corrected" measurements of foot-length were thus obtained by applying a reduction of 12.4% to complete sandal length and width. These measurements make possible a comparison with foot size and modern shoe size.

Using field notes obtained in 1973 from shoe stores in Carbondale, Illinois, we found that the range of aboriginal foot sizes is from about a child's size 3 to just over an adult male size 8, with the mean close to an adult male size 1.

Foot Lengths (in inches)		Shoe Sizes
4.33	min.	3+ child's
10.51	max.	8+ man's
8.11	mean	1+ man's

The modes of Figure 5-5 from smallest to largest are: child 8+, between a child 13 and an adult male 1, almost an adult male 2 to about an adult male 4, and an adult male 6½. These are small sizes, suggestive of a small, gracile population. Interpretation of these data in terms of their meaning for the age/sex composition of the population is obviously not certain, but some probabilities can be stated with reasonable confidence. The modality at 175 mm (corrected: 153 mm), equivalent to a modern child's size 8, surely reflects the youngest sandal-wearing population; today, a child's size 7 is usually worn by children between the ages of 4 and 7 years, and so, allowing for the general smallness of aboriginal Coahuila feet, we can say that a modern child's size 8 might have been suitable for aboriginal children from 4 to 10 years old. But if modern Mexican practice is any guide, it may have been the aboriginal custom not to put on footgear at all until late childhood and early adolescence—even though most movement would have been over rugged terrain full of rocks and spines and not, as is the modern way for the most part, over village streets and less inimical country. The modality at 225 mm (corrected: 197 mm) is perhaps indicative of the large adolescent and (small?) adult female population, while the extended modality from 240 to 259 mm (corrected: 210 to 228 mm) probably reflects the numerical dominance of adult males and (?) females. The mode at 285 mm (corrected: 259 mm) undoubtedly stands for a relatively large-footed adult male population, as do the two sandals at the upper extreme of the total range.

One sandal in particular requires comment. From the Top Level of Block G25 in the Center Sector there is a "complete" sandal (within no more than 5 mm of being so), whose length is only 80 mm (70 mm as corrected). This sandal was tried on my infant son, age five weeks, and it was entirely too short. My notes say that it would probably have been too short for him at birth. Its warp and weft and padding are all of lechuguilla, a material not usual in Top-Level sandals, and the notes say that the heel is broken and worn through, and that the right warp is broken. In other sandals, this has usually been attributed to the stress developed at the big toe and interior ball of the foot in walking, but on a sandal too small for a five-week-old baby, how do the heel and instep become broken and worn? Could the sandal have been a toy or a model or a practice exercise? If so, then why is it broken and worn? Only one thing is certain: This sandal skews, if only slightly, the distribution curve of two-warp plaited sandals!

One of the major reasons for recording sandal length was to obtain data from which to estimate foot size, and from foot size to infer the age and sex of the individuals for whom they had been made and, presumably, by whom they had been worn and discarded. We built a graph of the length of sub-Type F1ai sandals from Frightful Cave and hope that it shows modalities in the measurements indicative of the age and sex composition of that total universe. We proceed from the basic assumption that the modalities of a total universe reflect, within only a nonsignificant

range of variation, the modalities of its separate constituent groups. Thus we estimate the "average" age and sex composition of the groups or "bands" that occupied Frightful Cave (Figs. 5-5, 5-6). Using these data and assumptions, Table 5-5 has been constructed but it cannot be considered a definitive statement on the age/sex composition of aboriginal Coahuila bands: basic assumptions need further analysis, and comparative data, in both the archaeological and ethnographical literature, should be examined and brought into the picture. The approach must remain for the present merely a preview of an untested technique illustrative of a particular viewpoint and approach, which I have called the Conjunctive Approach (Taylor 1983).

However, in view of the fact that the above sandal data represent a time span of some seven thousand years, analysis of subsamples from shorter periods of time might provide more realistic insights. With this in mind, the total universe was broken up into three chronological subsamples according to the three culturally determined levels within the cave. The results are seen in Figure 5-6. It is apparent that the curves for sandals in the Bottom and Middle Levels are noticeably alike, while that in the Top Level is distinctly different, more flattened and more extended, making the central tendency less pronounced. Such differences can have had their origin in three spheres, the people, their products, or both. This is to say that there could have been changes in the physical characteristics of the people, in cultural aspects of their manufactured products, namely sandals, or in both of these areas. Since we do not have the data that would tell us of physical changes in the people (skeletal remains), we are forced to make inference back from products to people. This procedure is far from satisfactory, being circular, but it is all we have.

There has obviously been a consistent, unidirectional shift in sandal length through time, and the Bottom- and Middle-Level collections are more alike than either is like that from the Top Level (see Table 5-6). Also notable is the covariant increase in range and the decrease of the mean, mode, and median of each of the temporal units, except the mean of Middle-Level times (1 mm only!). Several potentially significant questions arise from these data. First, can the increase in range be a function of an increase in population? On the working hypothesis that the earlier occupations of the cave were more sedentary, less nomadic, than the later ones, (see Taylor 1964; 1966) is it likely that such an increase in population occurred during an increase in nomadism? Might it not fit the data better to infer that it was the formally patterned sandal manufacture in the earliest times that led to a more restricted range of variation than later obtained when footgear was apparently made with close regard for technique of manufacture but less regard for, or in the absence of, any formal, generally accepted canon of foot-length/sandal-length relation? Second, there is a perceptible increase in small sandals (below 200 mm) in the Top Level (25% of the sample, against only 8% and 7%, respectively, for the Middle and Bottom Levels) and a decrease in the numbers of large sandals (above 269 mm) from the Middle to the Top Level (13% to 1%, respectively). There was apparently a change in the human associations of footgear, and some possible explanations may be suggested: a decrease in the physical size of the population (due to a deterioration of their subsistence economy as a result of the climatic change and an increase in nomadism?), an increase in the numbers of children and young adolescents (this would probably be in conflict with the inference of a more nomadic and presumably more rigorous life but in accordance with a postulation of better child care as time passed), an earlier age for putting on sandals and more wear and tear on all sandals because of more travel outside the cave (both due to a more nomadic life?).

In order to obtain a simpler and clearer way of expressing and pointing up these differences, a Student's *t*-test was run on the three stratigraphic samples. Using a class interval of 2 mm (rather than the 10 mm as used in Figure 5-6), the following values for *t* were obtained and are presented in Table 5-6. These figures mean that for the Top and Middle Levels there is less than 1 chance in 1000 that the samples derive from the same population; for the Top and Bottom Levels there is less than 1 chance in a 100; but for the Middle and Bottom Levels there is more than 1 chance in 10 that they do come from one population. The conclusions reached by observation of Figure 5-6 are supported: there is strong evidence that there was some kind of break between the Middle and the Top Levels, which had an impact upon the making, wearing, and/or discarding of sandals; whether this break was physical or cultural or both cannot be determined at this time but, since the pattern and manufacturing tech-

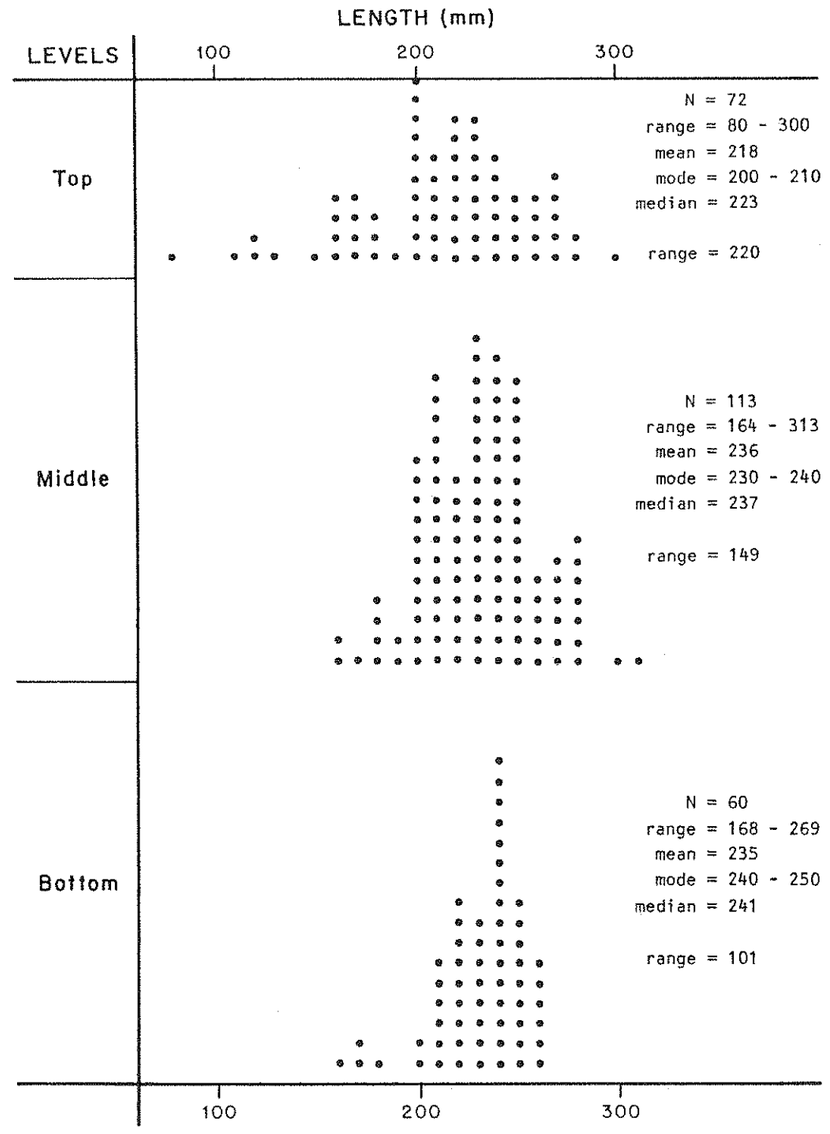


Fig. 5-6
Lengths of complete and nearly complete two-warp plaited sandals (F1ai) from Frightful Cave (CM68), arranged according to levels from which they were recovered

Table 5-5. Estimates of Group Composition Based on Sandal Length (Figs. 5-5, 5-6) for Two-Warp Plaited Sandals (F1ai) from Frightful Cave (CM68).

Age/Sex Group	Complete Sandals: At Modes Only #	%	Complete Sandals: Total Universe #	%	If Number of Individuals in Group Was . . . 10	20	30	40	50
Children 4–10 years	6	11	13	14	1(1)*	2(3)	4(4)	4(6)	6(6)
Adolescents, small adult females	11	20	27	28	2(3)	4(5)	6(8)	8(10)	10(14)
Adult males and females	32	57	38	40	7(6)**	14(12)	20(18)	28(24)	34(30)
Large adult males	7	13	18	19					
Total	56		96						

*First number is based on the length of complete sandals. Number in parentheses is based on data for complete and nearly complete sandals combined.
** Combined estimate of "adult males and females" and "large adult males" categories.

Table 5-6. Results of Student's t-test for Two-Warp Plaited Sandals (F1ai) by Stratigraphic Levels at Frightful Cave (CM68).

	Top	Middle	Bottom
Top N = 72	—	Dist. of Mean T = -1.762	Dist. of Mean T = -1.492
Middle N = 113	t = 3.523 df = 183	—	Dist. of Mean M = -0.013
Bottom N = 60	t = 2.984 df = 130	t = 0.025 df = 171	—

df = degrees of freedom
Class interval = 2 mm

nique of two-warp sandals did not change from Bottom to Top Level, a matter of some 7000 years, there is a justifiable supposition that the change was physical rather than strictly cultural. As a final exploration of this topic, a one-tailed analysis of the t-test was performed in order to arrive at an idea as to the amount of the change that occurred in the distribution of the three means. The results are included in Table 5-6, and show a small and probably nonsignificant drift toward small sandals (i.e., a small minus distribution of the mean) between the Bottom and Middle Levels and a much larger and definitely significant drift in the same direction between each of the two lower levels and the Top Level. This appears to be further evidence of a meaningful difference between the Top Level and the two lower levels, as has been indicated in other areas of the data from our archaeological collections.

Concerning the width of footgear, inquiry in shoe stores in Carbondale, Illinois, revealed that the letter designations for widths of modern shoes do not represent absolute measurements but are relative to accompanying lengths. Thus a width of, say, 100 mm falls between an E and a Double E in a size 5 adult male shoe, where it is a C in size 10 and a Double A in a size 15. Therefore, in order to obtain a modern view as to the widths of aboriginal feet in Coahuila, it has been necessary to associate each width with its accompanying length. This had been done, and the data are presented in Figure 5-7.

It will be noted that the regression is remarkably regular but that there is a gap starting at 160 mm of length, and there seems to be no comparable gap in width. No explanation for this gap has been suggested other than the possibilities either (1) that it represents the dividing line between the immature and the mature foot (in which case, then why so few "immature?") or (2) that it is due merely to chance distribution in a sample with a rather large range and a relatively small frequency. A histogram of complete and "nearly" complete sandal widths (within approximately 10 mm) was made but seemed not to be informative and will not be presented here; its "corrected" figures are as follows:

N = 542
range: 29–134 mm
mean: 85 mm
mode: 87–89 mm*
median: 85 mm
*(69 specimens based on 2 mm class interval)

One sandal retains such distinct big-toe and ball-of-the-foot depressions that very accurate measurement of actual foot width can be made. It is 84 mm, while the full width of the sandal is 105 mm, a difference of 20% which is somewhat larger than the figure calculated and subsequently used above.

The materials of manufacture of these sandals show a remarkable consistency, especially when the length of time over which they were made is taken into ac-

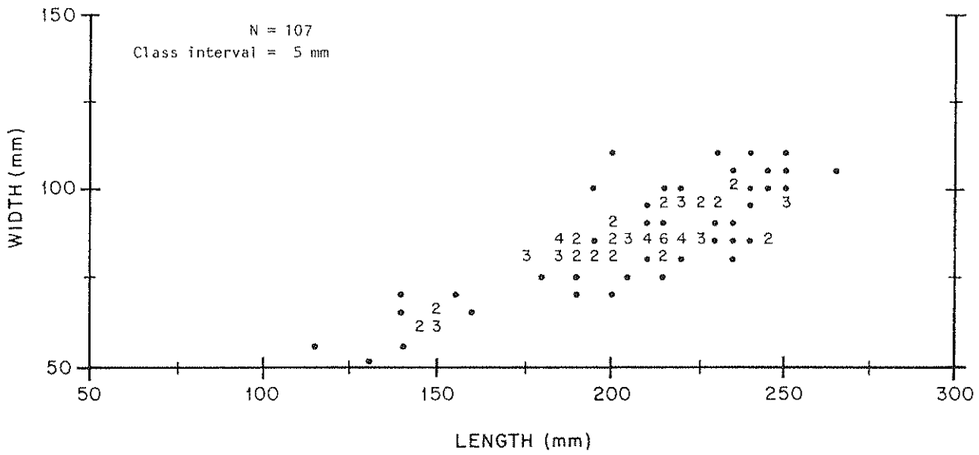


Fig. 5-7
Lengths and widths of plaited sandals (F1a) from Frightful Cave (CM68)

count. Zamandoque is by far the most common material throughout the occupation of the cave, and lechuguilla is a distant second. Together these data suggest that at the first appearance of plaited sandals, in the very bottom of the Bottom Level of Frightful Cave, there had been enough time for testing materials and selecting those that were best suited for the manufacture of footgear. If this inference is as true as it is probable, then we have a strong indication that both the Ciénegas and the Coahuila Complexes had been in existence, in desert environments in Coahuila or elsewhere, for a considerable time prior to our currently known earliest date of about 7500 B.C. Some potentially interesting, additional data on this matter might be had by delineating the boundaries of the present natural range of zamandoque and lechuguilla and conducting investigations in those areas, assuming that the origin of the earliest form of Coahuila Cave Culture, with due allowance for shift of vegetation zones, will be found within those boundaries. Relatively few sandals were found to have been made from fibers of more than one species of plant. We made no attempt to make counts of these aberrancies, if they can rightly be called such, because to produce meaningful results it would have been necessary to make a complete examination and fiber count of each specimen—and to do this would have meant destroying a large majority, if not all, of the plaited sandals in our collection.

When this problem came up in the laboratory, we did not think that the potential results would justify the loss, but we did take the investigation as far as we were able through nondestructive examination of each sandal. The results are presented in Table 5-7. Sandals made entirely or predominantly of zamandoque comprise so large a proportion (93%) of all plaited sandals, Type F1a, that their distribution is not significantly different from that of the Type as a whole (see Table 5-3). On the other hand, although they constitute only 5% of all two-warp sandals, those made entirely or predominantly of lechuguilla are also very little different in their distribution. What difference there is shows that the latter are slightly more prevalent in the Bottom Level. This trend, minimal as it is, takes on significance when it is realized that the twill-pad sandals, Type F1b (see Chapter 6), associated virtually 100% with the Bottom Level, are also made mostly of lechuguilla. These facts are conjunctive support of the conclusion that lechuguilla was most popular as a material for sandal making during and/or before the earliest occupation of the cave, a time when both twill-pad and two-warp sandals were being made contemporaneously. As time went on, twill-pad sandals disappeared, plaited sandals

Table 5-7. Materials of Manufacture for All Plaited Sandals (F1a) from Frightful Cave (CM68).

Material of Manufacture	Number of Sandals*
All zamandoque	796
Mostly zamandoque + lechuguilla	18
Mostly zamandoque + other materials: sotol, maguey, lechuguilla, and sotol	4
Zamandoque approximately equal to lechuguilla	4
All lechuguilla	44
Mostly lechuguilla + zamandoque	12
Mostly lechuguilla + sotol	1
All sotol	2
Mostly sotol + zamandoque	1
Unknown	2
Total	884

*These counts must be accepted with caution for a number of reasons (e.g., many specimens are fragmentary and it might be that the missing factions would have contained materials not contained in the surviving fraction; proportions are virtually impossible to assess; identification of fibers, especially those that are worn and decorticated, is not always sure).

increased greatly, the use of lechuguilla was greatly reduced, and zamandoque became virtually the sole material of sandal manufacture.

The manufacture of two-warp sandals was a relatively simple process, although as might be expected, a considerable number of variations on the basic technique do occur. During the course of analysis an attempt was made to derive significance from the frequencies and distributions of these variations, but no recognizable pattern developed and the results of the investigations are not reported here. The first step in the making of a two-warp sandal was to lay two heavy fibers (usually whole or filleted zamandoque) parallel to one another along the long axis; these served as warps and their spacing determined the width of the sandal. These warps were cut considerably longer than the proposed length of the sandal because they were to be folded inward and across one another at the toe end and then woven ("plaited") back toward the heel to form the weft of the fabric (Fig. 5-1a). Some specimens have wefts that do not reach the heel end of the warps and, since some of these show wear, it seems that warps which projected beyond the body of wefts and padding were of no concern. Although it was not usual practice to do so, in some instances additional weft elements were introduced, evidently to make the fabric firmer or to provide a more solid base for the padding that was to be inserted later; in others, some wefts end between the warps and new ones are started there. One more aspect of the two-warp sandal foundation construction should be mentioned, if only for comparative purposes. One of the characteristic sandals found in the Big Bend of Texas immediately north of Coahuila and in the Upper Gila region of southwestern New Mexico is what has been called the "fish-tail." In it, the warps are drawn together and often crossed at the heel end of the fabric in such a fashion and with such regularity as to indicate without much doubt that it was an intentional aspect of sandal design. Although not a few sandals in our Coahuila collection have converging warps (see Table 5-8), it can be stated that, with the possible but unlikely ex-

Table 5-8. Quantitative Analysis of the Details of Warp and Padding Construction for Two-Warp Plaited Sandals (F1ai) from Frightful Cave (CM68).

	Number	Percent
Warps		
Converge	150	89
Do not converge[1]	19	11
Total	169	100
Padding[2]		
Longitudinal[3]	536	76
Transverse[4]	127	18
Diagonal[4]	36	5
Around toe[5]	6	-
Total	705	99

[1] This quantity is probably misleading because, during analyses, inspection was made for convergence, and when it was not found nothing was reported in most cases; thus the "converge line" is probably accurate, but the "do not converge" line probably should show a complementary quantity based on the total number of two-warp plaited sandals (Type F1ai, N=570)
[2] The quantities represent numbers of occurrences, not numbers of sandals, because padding was installed in more than one direction on some sandals
[3] longitudinal = paralleling the warps
[4] transverse and diagonal are also in reference to warp direction
[5] around toe means around the toe end from bottom to top or vice versa

ception of three specimens, no sandal excavated by us in Coahuila can be considered within the range of "true" fish-tail sandals. What warp convergence there is seems to be due merely to manufacturing abnormalities: an increase in lateral compression of the warps caused by exerting greater and greater lateral pressure as the wefts were woven around them back toward the heel.

The next step in the typical manufacturing procedure was to attach the sandal ties. That this was most commonly done before the padding was added is plain from the fact that, in the majority of cases, the toe ties were originally covered by the padding on the bottom of the sandal and became exposed only later by wear. On the other hand, there are other specimens for which it is clear beyond doubt that the (existing) ties had been installed after the padding and some on which no ties had yet been installed although the padding was fully in place. On one specimen, the tie is a continuation of a padding element, leaving no doubt that the tie was made at the same time as the padding or, at least, that it was "stubbed out" at the same time to be completed later. It is pertinent here to note that one twill-pad sandal also has as its toe tie a continuation of a sinistral element of its pad. Usually, there are two ties at the toe end of the sandal, made of a single strand of so-called "crude" cordage (not decorticated or twisted). According to our present interpretation, this strand was looped to make two moving ends which were then threaded upward from the bottom of the sandal, before the padding was installed, at some distance from the toe end and from one another and made to come out on the top through two holes, although occasionally through only one. On some specimens the ties are of two strands, each secured on the bottom of the sandal by an overhand stopper-knot; sometimes it is evident that this double tie was installed after an original (single strand?) tie had been worn through or otherwise broken. In all cases, the two toe ties were brought back and, in various ways, anchored near the ankle, from where in all specimens at least one strand

Table 5-9. Distribution of Two-Warp Plaited Sandals (F1ai), with "Around the Toe" Padding (N=6), Frightful Cave (CM68).

	Frequency	MMd
By Level		
Top	2	+02
Middle	3	+15
Bottom	1	-17
By Sector		
Front	3	+11
Center	3	+16
Back	0	-11
Passage	0	-16

was continued backward to form the heel tie (see Chapter 7).

Padding was plaited over and under (and sometimes sewed through) the wefts in such a way as to appear on both top and bottom of the sandal, acting as both sole and what might be called an "insole" (see Table 5-8). The direction of the padding did not show any consistent or significant associations, and the data are given in Table 5-8 only for the record. However, one bit of negative evidence should be mentioned. The last line in the padding section shows that there were six instances of padding being inserted in such a way as to go "around the toe," i.e., from the bottom around the toe end of the sandal to the top and/or vice versa. Since this is the way padding was installed in the twill-pad sandals (Type F1b, see Chapter 6), which is one of the diagnostic traits of the very earliest culture complex in Frightful Cave, it was thought possible that the two-warp sandals exhibiting this trait would also be early and thus provide conjunctive evidence. This was not the case, however, as Table 5-9 shows. Because there were so few sandals with this feature, the significance of the data of Table 5-9 is certainly not established. As far as the data go, however, there are definite trends, such as significant plus-deviations in the Middle Level and the Front and Center Sectors. It might be well to keep them in mind for incorporation into future analyses. The fullness of the padding varies, not only in its estimated original state but also at present due to amount of aboriginal wear. A rough assessment of the amount of wear yields the results shown in Table 5-10.

It is probable that being "worn" on the top indicates that the sandal has been reversed, as discussed below, because it does not seem possible that what has been defined as "wear" can have been due to the human foot alone. An abrasive surface is definitely indicated, and a human foot, however horny and rough (from going barefoot), could not, in my estimation, ever become abrasive enough to wear through, shred, or destroy undecorticated zamandoque fiber. Table 5-10 notes that the largest percentage of sandal bottoms are "well worn" and the smallest are "slightly worn," while for the sandal tops just the reverse is true: the largest percentage are "compressed," for example, not worn at all, and only the smallest percentage can be considered "well worn." This means that the largest percentage of sandals found in Frightful Cave had both well-worn bottoms and compressed or "well-compressed" tops. This suggests that most of these sandals had been discarded, not lost, and this was probably so because their serviceability had been impaired by use—and to such a degree as to make replacement necessary or at least more expedient than continued use with or without repair. Of course, it is also possible that some of the sandals that we found, particularly those showing only slight wear on the bottom, were neither lost nor abandoned, but were merely cached awaiting further use which, for some reason, was never made.

As functions of use and wear, breaks and depressions appear on the top surface (and often through to the bottom surface) of virtually all sandals, except the few that evidently were never used or used very little.

Table 5-10. Amount and Area of Wear Based on Observation of Two-Warp Plaited Sandals (F1ai) from Frightful Cave (CM68).

Area of Wear	Amount of Wear			Total
	+	o	-	
	well worn	worn, worn and compressed	compressed well compressed	
Top of Sandal	# = 42 % = 9	# = 87 % = 19	# = 324 % = 72	453
	well worn	worn	slightly worn	
Bottom of Sandal	# = 310 % = 56	# = 205 % = 37	# = 35 % = 6	550

Worn means that fibers are frayed and/or broken by fraying.
Compressed means that the fibers are merely pressed down and/or pressed together.

These marks appear at places where there was continual pressure, and evidence indicates that depressions were made first, by compression, and then the breaks developed when the compacted fibers were eventually shredded and gave way. It seems from our evidence that zamandoque fibers tend to compact and only in extreme cases to shred, while lechuguilla does not compact very much and tends to be decorticated and shredded by use much more readily. The marks also provide clues to the foot on which the sandal had been (mostly?) used and to the manner of using the feet. Table 5-11 presents the basic data.

From the raw data of Table 5-11, in order to make its contribution clearer, Table 5-12 below has been abstracted. The internal consistency of both parts of Table 5-12 would appear to lend credence to the data and the analyses—and potentially to the inferences derived. It is seen that in the lower part the order of frequency of the locations of depressions is the same for Total Universe, Right Sandal, and Left Sandal: Big Toe-Ball-Heel-Small Toe. In the upper part, with one exception, the sequence of break locations is also internally consistent, although the quantitative differences between rights and lefts is larger than it was for depressions, and the frequency order of locations is different: Heel-Ball-Arch-Toe. The exception is that in left sandals the order of the two least-represented locations is reversed—but when both rights and lefts are combined, the "usual" order is restored, meaning that the orderliness of right sandals is enough to compensate for the slight aberrancy of the left ones. It should also be noted that in both the lower and the upper parts of the "Questioned identification" column of Table 5-11 the sequences are nothing like what they are in the "Certain Identification" columns. This would seem to indicate that the identifications are indeed questionable but that the technique of analysis is credible, the findings consistent, and the results probably acceptable.

Deriving biological/cultural inferences from Tables 5-11 and 5-12 above has not been an easy task, and what inferences have been drawn cannot be said to be startling or very conclusive. They are presented here to add to the corpus of data that, at some later time, can be brought together from this and other sources to further cultural studies of archaeological cave materials. First of all, the question arises: if breaks did indeed develop from depressions, why are breaks more common at the heel, while depressions occur most often at the big toe? In other words and in general, why are the two sequences different? When we examine these sequences more carefully, however,

Table 5-11. Breaks and Depressions in the Fabric of Two-Warp Plaited Sandals (F1ai) from Frightful Cave (CM68).

		Certain Identifications							Questioned Identifications	
		Right + Left		Right		Left		Ratio		
	N	#	% of N	#	% of R+L	#	% of R+L	R:L	#	% of N
Breaks										
Heel	264	214	81	125	58	89	42	1.40:1	50	19
Toe	87	63	72	33	52	30	48	1.10:1	24	28
Ball	156	91	58	48	53	43	47	1.12:1	65	42
Arch	121	67	56	44	66	23	34	1.91:1	54	44
Depressions										
Heel	54	49	91	31	63	18	37	1.72:1	5	9
Big Toe	79	77	97	39	51	38	49	1.03:1	2	3
Small Toe	35	35	100	18	51	17	49	1.06:1	0	0
Ball	66	58	88	32	55	26	45	1.23:1	8	12

Note: The quantities in this table do not represent individual sandals, because a considerable number of sandals have more than one break or depression; thus the various subsamples record instances of wear, not the number of sandals having wear. In spite of the fact that many sandals have been identified as right or left on the basis of their breaks and depressions, the interdependence and circularity of these data and derived inferences are considered minimal because of the cumulative evidence of the above-mentioned multiple marks—in any case not sufficient to impair credibility.

Table 5-12. Order of Magnitude of Numbers of Specimens with Breaks and Depressions in Stated Locations on Two-Warp Plaited Sandals (F1ai) from Frightful Cave (CM68).

	Order of Magnitude
Breaks	
Total	Heel > Ball > Arch > Toes
Right Foot	Heel > Ball > Arch > Toes
Left Foot	Heel > Ball > Toes > Arch
Foot Uncertain	Ball > Arch > Heel > Toes
Depressions	
Total	Big Toe > Ball > Heel > Small Toes
Right Foot	Big Toe > Ball > Heel > Small Toes
Left Foot	Big Toe > Ball > Heel > Small Toes
Foot Uncertain	Ball > Heel > BigToe > Small Toes

Note: Raw data are located in Table 5-11 above. If percentages had been used rather than quantities to order the magnitudes, the consistency of this table disappears. Thus what this table expresses is the order of magnitude of breaks and depressions within each stated locus, not within the total universe of either breaks or depressions. To paraphrase, it means: "Of the 214 surely determined right and left heel breaks, 58% are on right sandals and 42% are on left."

it is noticed that perhaps they are not so different after all: the rank-order of the ball-of-the-foot area is the same in all sequences, with the one exception in the breaks data, as already mentioned above, where the arch area in left sandals is the least represented, there is a toe area in last place in all sequences. Thus the problem is reduced to: why is the heel the most common location of breaks, while for depressions it is the big toe, why are the ball and toe areas so constant as second and last respectively, why are breaks in the arch area relatively uncommon, and why are the frequencies of depressions in the big- and small-toe areas so much alike? I can imagine very little, and see even less, of anything having to do with culture that will explain these facts. The answers seem to lie largely in the realm of physical anthropology, specifically in the mechanics of the use of the human foot. It is possible that the low frequency of breaks in the area of the arch is due to the effect of two things. First, the sandal ties, in that they hold the sandal relatively steady against the foot and thus might reduce (but certainly not eliminate) bending in the area of the arch, which would tend to affect the fibers. Second, the arch is the area of the foot that has the least pressure exerted upon it either from the foot or the ground and thus would suffer the least amount of compression or friction either in walking, running, squatting, or standing, the four human actions that act as efficient causes of wear on footgear such as fiber sandals. On the other hand, in walking and in running (jogging), the foot usually hits the ground with the heel and pushes off the ground with the big toe, which explains both compression and friction in these areas. The small toes play little part in kinetic foot use, except to form a wider and more stable platform, and it is obvious that appreciably less pressure and friction are exerted there.

There are 366 sandals for which right/left designations are either certain or very probably so. Table 5-13 presents the data. Many sandals exhibit breaks and depressions that give clues to the foot on which they have been worn. Sandals are designated right or left on the following assumptions: (1) that heel wear and heel breaks occur on the outside of the foot; thus a right sandal would show such signs on its right edge; (2) that breaks at the ball of the foot are on the inside; thus a right sandal would have such signs on its left edge; (3) that the big-toe depression is on the inside, so that a right sandal would have it on its left; the case for the small toe(s) depression is the reverse. In cases of conflict, when one set of tokens indicates one side and another the opposite, big-toe depressions have been given precedence, because in a large majority of

Table 5-13. Identified Right and Left Sandals, Both "Certain" and "Very Probable" Identifications for Two-Warp Plaited Sandals (F1ai) from Frightful Cave (CM68).

	Total	Right #	Right %	Left #	Left %	Ratio R:L
All sandals identified	366	208	57	158	43	1.32:1
Certain	96	55	57	41	43	1.34:1
Very probable	270	153	57	117	43	1.31:1

instances they are the most easily identified and the least ambiguous, followed by heel breaks and depressions; small-toe and ball-of-the-foot depressions are the least decisive. When the percentages and ratios for the total sample and the two subsamples are compared (see Table 5-13), it is seen that all three are virtually identical in regard to the numbers of rights and lefts. This is an astonishing similarity and is strong support for the credibility of the identifications and suggests that in other such manipulations the total universe, not merely the "certain" subsample, may be used in analyses. Accepting these figures, then, the question immediately arises as to why more right than left sandals were lost and/or abandoned in Frightful Cave.

It is our assumption that loss was most probably a matter of chance and therefore not in need of further explanation. As to why more rights might have been abandoned, we may start with two assumptions that this was because there were more of them to lose, i.e., that for some reason there was greater need and production of rights than lefts and that no less value was placed on rights than on lefts so as to induce more careless handling and consequent loss. One of our first positive ideas was that, for right-handed people, the right foot is the base of stability and power and thus the locus of most pressure and friction and that this would cause right footgear to wear faster and more drastically than left. If we could accept this reasoning, we would have evidence of the predominantly right handedness of the ancient inhabitants of Frightful Cave. However, inquiries of local shoe merchants in Carbondale, Illinois, threw some doubt on this argument because, in their opinion (which, however, did not appear to be based on anything but a sudden thought in response to our question), right handedness does not, at least under modern conditions and today's footgear, lead to above-average wear on the right shoe. They thought that compensatory pressures would tend to even out wear on the two sides. However, I know from personal experience that even slight favoring of one foot over the other will definitely and noticeably cause more wear on the nonfavored side. Also in a TV broadcast of World Series baseball, I saw that right-handed pitchers pitch off the right foot all the time.

In the absence of further testing, I am of the opinion that the evidence we now have indicates that the right sandals of ancient Coahuilans suffered more wear and tear than the lefts and that there is a very good possibility that this was due to use of the right foot as the push-off foot, suggesting that the people were predominantly right handed. Examination of the handles of atlatls, the bevels of stone projectile points, and the manufacture of textiles that were made by unidirectional techniques (e.g., plaited matting) might throw light on this problem, but only preliminary, cursory studies have been made on such materials with this question in mind, and the findings are not ready for publication.

Evidence of reuse of sandals is found in several sets of data. It has been the inference that the usual signs of use on a sandal consist of "wear" on the bottom, by which is meant the fibers are decorticated, frayed, and broken, while on top the fibers are not worn but compressed and often caked with dust, soil, sand, and/or mud through some wetting agency such as sweat, dew, or surface water, a condition that could not endure on the bottom of a sandal in use. Therefore, when it is seen that a sandal has a top that is "worn," we conclude that it has been reversed and

assume that the reason for this reversal was to prolong its useful life. In Table 5-10, it is shown that a total of 129 specimens (28% of all two-warp sandals on which such observations have been made) show at least some wear on their tops. This is not to say that every one of these has been reversed and reused, but that the number is probably more or less of that order. Of those 129 specimens, 9 also had remnants of an original set of ties that had been in use before the final set was installed, presumably at the time of reversal. There are only three specimens that have two sets of ties but are not worn on their tops. There are two double sandals, each consisting of two used sandals that have been joined and evidently reused.

In the first of these double sandals, the pairs have been joined by final ankle and toe ties that go through both sandals. The original ties of the upper sandal lie between the two sandals, but those of the lower were left flopping loose on the bottom, hardly a neat or efficient arrangement! In the second of these, the sandal ultimately on the bottom is a left, while that on top is a right, and because of structural similarities they probably were once a pair; the old ties of the top one lie between the two, which were sewed together by transverse stitching with a coarse fiber. Another two sandals are worn and broken yet have complete and apparently relatively new ties, which, in the latter, are unworn although they are exposed on the well-worn bottom; this suggests that the ties were new replacements when the sandals were abandoned (or stored) and that old sandals were being re-used in a very dilapidated condition. Yet another two are broken but show little or no wear; the question arises as to how they were used so roughly as to be broken before sustaining wear, but perhaps a hint lies in a personal experience: Two of us, doing archaeological survey in a range of limestone mountains whose bare surfaces had been eroded into tiny, razor-sharp ridges by millennia of rainwater rivulets, completely destroyed our rugged field shoes in two days of walking. One sandal specimen is heavily encrusted with mud and stones both top and bottom, both warps are missing at the toe, and there is a rather large knot, probably from an old toe tie, on the top, indicating reversal, conditions that obviously had to exist at the time of abandonment and that, therefore, would appear to be indicative of a certain insensitivity, both physical and aesthetic, on the part of the last wearer. Another sandal has its heel worn completely through and the ends of the warps extending a considerable distance back of where the heel of the wearer would hit the ground; from the destruction of the heel and the very marked toe- and ball-of-the-foot depressions, it is apparent that the sandal was still used with its warps projecting, a rather ungainly condition. From all of the above (and other such instances not reported here), there develops a picture of physical indifference and insensibility or, if one wishes to view the matter differently, of extreme conservation, even miserly hoarding, and an attitude of "if it can be used, let's use it," with little or no concern for the niceties of comfort, order, neatness, style, or other such modern values.

Two-Warp Plaited Sandals from CM74

This burial cave had been vandalized before we entered it. Some cultural material brought to light by the vandals had been placed together on a large boulder at the mouth of the site, from where we collected it. There were four sandals, all two-warp plaited of sub-Type F1ai. Three of them are made entirely of zamandoque and one of decorticated lechuguilla. One has a big-toe depression that indicates it was for a right foot, but the wear at the heel suggests that it is a left; ties are present but cannot be typed. Another has some padding elements that appear to have been added after the "regular" padding had been installed, because they are less worn than the rest of the padding; the ties are anchored at the ankle by being looped around the wefts inside of the warps, an unusual method; heel, ball, and small-toe depressions indicate that it is a right sandal. A third is scantily padded and has no interpretable depressions, but it is completely worn through at the ball on the right side, making it probably a left; the one remaining ankle tie, as on the preceding specimen, is anchored by being looped around the wefts. On the lechuguilla sandal, padding was installed in all directions and at present is very loose and disordered; there are no clear-cut depressions or signs of wear, but the ball of the foot is broken out on the right, possibly indicating a left foot; there are no ties or traces of them. In general, the cultural materials from this site appear to come from a relatively late time period in the Coahuila sequence, and one specimen, a deer skull with mandibles crossed and tied into the antlers, is reminiscent of the deer ceremonialism reported for the Laguna District of southwestern Coahuila by early ecclesiastic colonists (Taylor 1972:175).

SUB-TYPE F1aii, THREE-WARP PLAITED SANDALS

Description of the Sub-type

The warp frame is constructed by arranging two elements parallel to form the lateral margins and turning them inward at the toe end, just as in sub-Type F1ai. But at a point about equidistant between the two lateral warps, one of them, instead of being wrapped around the warp, is turned and run back toward the heel, forming a third, central warp (Figure 5-1c). From here on, the construction is the same as in sub-Type F1ai.

Distribution of Three-Warp Plaited Sandals

1/CM24, 36/CM68 = 37/2

Discussion: Except for the difference in warping and the strong association with one type of sandal tie (see Chapter 7), these sandals are essentially identical in technique of manufacture with the two-warp plaited sub-Type. Their appearance in Frightful Cave probably occurred in Middle Level times, but they are very scarce until the Top Level, when they increase sharply. These facts suggest that this type may have developed elsewhere and, about the same time as the aboriginal occupation of Frightful Cave ended, was in the process of becoming more common than sub-Type F1ai, which was quite certainly its cultural ancestor. Again contrary to what occurred with two-warp sandals, they were found virtually in the quantities of expectancy in the horizontal Sectors, from Front to Passage. This could be taken to mean that there was no localization of occupation in the site during latest times, when the people were more nomadic and more casual in their visiting. This in contrast with being relatively permanent occupants as the people of the earlier times had been. The problem with all such inference is, of course, that the sample of three-warp sandals is very small. A larger sample might have shown some localization within the cave. There is only one example from Fat Burro Cave (CM24), where it occurred in the Middle Level, supporting the inference from other lines of evidence that this stratum is to be equated with the Top Level of Frightful Cave (see Table 5-1).

All the plaited sandals, both two-warp and three-warp, found in Fat Burro Cave were made of lechuguilla, a fiber that was used for sandals more commonly during the earliest times in Frightful Cave than during its later epochs. We looked in the collections and our records for conjunctives that might indicate whether this obvious selection of materials could be considered a cultural or an environmental compulsive, but aside from the fact that today lechuguilla is very scarce around Frightful Cave, we came up with no suggestive evidence. Both the relative frequencies of right- and left-foot sandals and the rank order of magnitude of breaks and depressions found in Fat Burro Cave are different from those characteristic of Frightful Cave, but in order to permit inferences of substance, rather than merely inferences of fantasy, other and more abundant conjunctive data are needed.

Three-Warp Plaited Sandals from CM24, (Fat Burro Cave) ... /1

avg. per m^3 ... 0.08

avg. per blk ... 1.00

Discussion: The one three-warp plaited sandal to come from this site was found in Block H6, Center and East Wall Sectors, in the "Dust, Sand, and Fiber Layer," which is Middle Level. It is made entirely of lechuguilla and is possibly a left as suggested by a rather uncertain big-toe depression on the right. It is well padded longitudinally and both toe and heel ends are worn through. Its bottom is very worn, and the top is compressed and caked, also slightly worn. Its incomplete length is 221 mm, and its complete width is 121 mm. It was found lying in situ and on edge, propped against a large rock within the deposits, obviously placed in that position in aboriginal times.

Three-Warp Plaited Sandals from CM68 (Frightful Cave)

Discussion: There can be no doubt that three-warp sandals are associated with the latest occupation of Frightful Cave (Table 5-14). Although they are technically very similar to, and appear to be a variant of, the much more numerous two-warp sandals, their significantly different distribution indicates that, in the minds and/or practice of the ancient inhabitants of the site, they must have been a variety apart (cf. Tables 5-14, 5-15, 5-16).

These differences in distribution appear to be too distinct and too consistent to be chance variations

Table 5-14. Distribution of Three-Warp Plaited Sandals (F1aii) from Frightful Cave (CM68).

Level	Sector				Total	MMd
	Front	Center	Back	Passage		
Top	14	9	4	2	29	+54
Middle	0	2	0	1	3	-26
Bottom	0	0	0	2	2	-28
Total	14	11	4	5	34	
MMd	+02	-02	+01	-01		
					+2 not in situ	
					36	

... /36
avg. per m^3 ... 0.26
avg. per blk ... 1.21

within a single universe. They surely must represent two universes with separate, but probably related, culture histories. This situation can be more clearly seen when the ratios of increase from bottom to top are calculated as presented in Table 5-17.

However, one thing should be noted in anticipation with regard to the provenience of the two sandals that are attributed to the Passage (Block 37) Bottom Level in Table 5-15, a provenience that is "corrected" in Table 5-14. The Block Card says that these sandals were part of a "cache of sandals in nests on the w[est] side." The profile of Line 37, which formed the north side of the block in which they were found, shows two nests that have their bottoms within the Bottom Level but actually start, and appear to have been dug down, from the vertical middle of the lower part of the Middle Level above. Thus, it is probable that these sandals pertain to the Middle Level, not the Bottom Level to which they were attributed by an uncorrected interpretation of their stratigraphic position. In view of additional evidence presented in the section on sewed sandals (Type F1d, Chapter 6), we feel that this cache definitely belongs in the Middle Level.

It is immediately apparent that the greater increase in two-warp sandals comes between the Bottom and Middle Levels, while that of the three-warp variety shows a unidirectional progression from middle to top, but with the largest increase coming between the Middle and Top Levels. These data are conjunctive with, and supportive of, the inferences reached above by application of Student's *t*-test to the lengths of two-warp sandals (see Table 5-6), namely that the sandal population (and thus probably the human population also) represented in the Top Level was significantly different from that of the Middle and Bottom Levels.

The horizontal distribution of three-warp sandals (Table 5-14) is remarkably uniform and virtually identical with expectancy. This is again in sharp contrast to that of two-warp sandals which, as shown in Table 5-3, increases significantly toward the back of the cave, as do most of the artifact types that are particularly characteristic of the Bottom and Middle Levels.

The measures of tendency shown in Table 5-18 are not very informative.

Thirty-four of these sandals are entirely of zamandoque and one is entirely of sotol. It is probably significant that the sandal now considered to have come from the Middle instead of the Bottom Level, but still one of the earliest three-warp sandals in the collection, is made almost entirely of lechuguilla. This is conjunctive and supportive of the evidence of two-warp and twill-pad sandals, of which those made predominantly or entirely of lechuguilla are slightly more prevalent in the earliest levels, and much less so in the Top Level, than are those of zamandoque (cf. Table 5-7).

In technique of manufacture, three-warp sandals

Table 5-15. Quantitative/Distributional Analysis by Level and Sector for Three-Warp Plaited Sandals (F1aii), from Frightful Cave (CM68).

Level	Sector	By Level			By Sector		
		N	MM%	MMd	N	MM%	MMd
Top	Front	14	31	+17			
N=29	Center	9	40	-09			
MM%=85	Back	4	12	+02			
MMd=+54	Passage	2	17	-10			
	Front				14	25	+75
	Center				9	36	-36
	Back				4	35	+65
	Passage				2	33	+07
Middle	Front	0	40	-40			
N=3	Center	2	30	+37			
MM%=9	Back	0	11	-11			
MMd=-26	Passage	1	18	+15			
	Front				0	36	+46
	Center				2	31	-13
	Back				0	36	-36
	Passage				1	39	-19
Bottom	Front	0	45	-45			
N=2	Center	0	32	-32			
MM%=6	Back	0	9	-09			
MMd=-28	Passage	2	13	+87			
	Front				0	33	+07
	Center				1	39	-19
	Back				0	29	-29
	Passage				2	28	+12

Table 5-16. Recapitulation of Table 5-15, Showing Only the Signs of the MM Deviations for Three-Warp Plaited Sandals (F1aii) from Frightful Cave (CM68).

	Front	Center	Back	Passage
By Level				
Top	+	-	+0	-
Middle	-	+	-	+
Bottom	-	-	-	+
	Top	**Middle**	**Bottom**	
By Sector				
Front	+	-	-	
Center	+	-	-	
Back	+	-	-	
Passage	+0	-	+	

- = significant minus deviation
-0 = Nonsignificant minus deviation
00 = No deviation, i.e., precise expectancy
+0 = Nonsignificant plus deviation
+ = Significant plus deviation
> ±8 = Significant

Table 5-17. Ratios of Increase in Frequencies from Bottom to Top Level for Two- and Three-Warp Sandals from Frightful Cave.

Level	F1ai 2-Warp	F1aii 3-Warp	3-Warp "Corrected"*
Top	0.98	9.67	5.80
Middle	2.64	1.50	1
Bottom	1	1	0

*See discussion pp. 85–86

are virtually identical to those of the two-warp type, except that there are three warps made from two elements—one of which was turned between two lateral warps and run back toward the heel across the toe to the center of the sandal where it was turned toward the heel—and also there is only one (basic) weft strand. In one specimen, the center warp is doubled back again at the heel, thus reinforcing itself. Another also has its center warp reinforced, by the addition of a separate strand doubled longitudinally around it. A third has five warps: The left primary one is turned back in the usual manner at the toe end, but a new, double

Table 5-18. Measures of Central Tendency for Sandals from Frightful Cave (CM68), Having Complete Length and/or Width Measurements.

	Length (N=18) mm	Width (N=33) mm
Range	197–293	44–128
Mean	244.2	105.81
Mode*	220–229 (4)	110–119 (11)
Median	241.5	106.5

*10 mm class interval

element has been doubled around its bent-down section; the right primary one is single, not doubled back but brought across as usual and woven back and forth to form the weft. Another had four warps, i.e., both lateral warps are bent inward and doubled back to form the warp frame. Another, unusual in that it is made entirely of sotol, appears also to have an unusual warp frame: The two primary or lateral warps are each of a single strand bent into a U-shape with its closed end at the toe; another U-shaped strand is bent around the middle of the toe end and runs back toward the heel; it is also unusual in that its toe end is distinctly rounded instead of being squared. In 10 specimens, or 28% of three-warp sandals, the warps converge toward the rear. This is considerably less than the records show for some two-warp sandals (see Table 5-8), although the smallness of the present sample casts some doubt upon the significance of this difference.

Table 5-19 presents the data on sandal padding. The only difference between these and those of the two-warp sandals that now requires notice is that the frequency order as between transverse and diagonal padding is reversed. In addition, although the details are not given in Table 5-19, the number of three-warp sandals with little or no padding is proportionately much larger than in the two-warp sub-Type; in fact, it comes to nearly 50% of the total three-warp sample. There is one other set of conjunctives that should be mentioned here: when we noted that a few of the two-warp sandals had padding around the toe (see Table 5-9), we thought this might indicate influence from the twill-pad sandal, the earliest type from our collections. After analysis, however, it was apparent that this kind of padding was more characteristic of the Middle than the Bottom Level, which lessened but did not completely negate the first hypothesis; now we find that nearly all three-warp sandals came from the Top Level and not one of them had around-the-toe padding. These data are conjunctive and supportive of the inference that this style of padding is characteristic of two-warp sandals during Middle-Level times and may, after all, have been influenced by the design of twill-pad sandals. One sandal has some of its wefts joined to its warps by small stitches of fiber; another has no padding except one narrow strand that pierces a warp and a weft element. The padding of a third is transverse and seems to be wrapped (not woven or plaited) around the sandal in bands about 35 mm wide, some of which pierce the wefts.

With regard to right and left sandals, as shown in Table 5-20, the situation is again reversed from what it was for the two-warp sandals (cf. Table 5-13): Lefts are more numerous than rights. The differences are small and may be due to a considerably smaller sample.

Table 5-21 covers the same material for F1aii sandals as Table 5-11 does for two-warp sandals. The numbers of specimens represented on Table 5-21 is small, and interpretations are therefore to be considered inconclusive. However, the weight of the almost complete reversal between the two types with regard to the ratios of breaks and depressions found on right

Table 5-19. Padding Frequencies and Percentages for Three-Warp Plaited Sandals from Frightful Cave (CM68).

Padding	#	%
Longitudinal	22	71
Transverse	2	6
Diagonal	7	23
Around Toe	0	-
Total	31	

Table 5-20. Identified Right and Left Three-Warp Plaited Sandals (F1aii) from Frightful Cave (CM68).

	Right		Left		Questioned Identification		Ratio
N	#	%	#	%	#	%	R:L
36	11	31	14	39	11	31	1:1.27

and left sandals (cf. Table 5-11) is enough to suggest that something of the sort was actually obtained. However, as to what may have been responsible for this reversal, we are still at a loss. A similar consistency, once again differing between the two types, is seen in the quantitative rank order of the locations of breaks and depressions, as found within each of the two universes. Table 5-22 presents the data.

In the universe of breaks, the heel location is always of the first rank and ball-of-the-foot last. In the universe of depressions, the ball is first-rank, while heel is last, a complete reversal from what was obtained for two-warp sandals. In both universes, the total and the left foot have the same rank order, while the right foot has the two middle ranks reversed. Once again, this internal consistency would seem to indicate some reality for the relationships depicted, but what factors may lie behind that reality have not come to light nor even been inferred.

Comparing Table 5-23 with Table 5-10, it is seen that the amount of wear on the bottoms of the two types of plaited sandals follows the same rank order of magnitude, but there appears to have been more wear on the three-warp variety than on the two-warp type.

For the tops of the sandals, the rank order is not the same, but again the three-warp type seems to have suffered (slightly) more wear. This is strange in view of the fact that most of these sandals had little or no padding on which wear would be expected to be more noticeable than on a less-well-covered warp frame. We must conclude that wear on the three-warp type was indeed more—but an acceptable reason for this condition has eluded us.

Table 5-21. Breaks and Depressions in the Fabric of Three-Warp Plaited Sandals from Frightful Cave (CM68).

	Certain Identifications								Questioned Identifications	
		Right + Left		Right		Left		Ratio		
	N	#	% of N	#	% of R+L	#	% of R+L	R:L	#	% of N
Breaks										
Heel	24	21	88	9	43	12	57	1:1.33	3	13
Toe	4	3	75	3	100	0	0	-	1	25
Ball	6	1	17	1	100	0	0	-	5	83
Arch	6	6	100	2	33	4	67	1:2.00	0	0
Depressions										
Heel	4	3	75	1	33	2	67	1:2.00	1	25
Big Toe	8	8	100	3	38	5	63	1:1.67	0	0
Small Toe	6	6	100	4	67	2	33	2.00:1	0	0
Ball	13	13	100	5	38	8	62	1:1.60	0	0

Note: The quantities in this table do not represent individual sandals, because a considerable number of sandals have more than one break or depression; thus the various subsamples record instances of wear, not the number of sandals having wear. In spite of the fact that many sandals have been identified as right or left on the basis of their breaks and depressions, the interdependence and circularity of these data and derived inferences is considered minimal because of the cumulative evidence of the above-mentioned multiple marks—in any case not sufficient to impair credibility.

Table 5-22. Order of Magnitude of Numbers of Specimens with Breaks and Depressions in Stated Locations of Three-Warp Plaited Sandals (F1aii) from Frightful Cave (CM68).

Breaks	
Total	Heel > Arch > Toes > Ball
Right Foot	Heel > Toes > Arch > Ball
Left Foot	Heel > Arch > 0 = 0
Foot Uncertain	Ball > Heel > Toes > 0
Depressions	
Total	Ball > Big toe > Small toes > Heel
Right Foot	Ball > Small toes > Big toe > Heel
Left Foot	Ball > Big toe > Small toes > Heel
Foot Uncertain	Heel > 0 = 0 = 0

Note: Raw data are located in Table 5-21 above. If percentages had been used rather than quantities to order the magnitudes, the consistency of this table disappears. Thus what this table expresses is the order of magnitude of breaks and depressions within each stated locus, not within the total universe of either breaks or depressions.

Table 5-23. Amount and Area of Wear Based on Observation of Three-Warp Plaited Sandals (F1aii) from Frightful Cave (CM68).

	Amount of Wear			
Area of Wear	+	o	-	Total
	well worn	worn, worn and compressed	compressed well compressed	
Top of Sandal	# = 6 % = 17	# = 23 % = 64	# = 7 % = 19	36
	well worn	worn	slightly worn	
Bottom of Sandal	# = 31 % = 86	# = 3 % = 8	# = 2 % = 6	36

Worn means that fibers are frayed and/or broken by fraying.
Compressed means that the fibers are merely pressed down and/or pressed together.

CHAPTER 6

Other Coahuila Sandals

Having considered plaited sandals, the predominant footwear recovered by the Coahuila Project, we turn now to the less numerous types: twill-pad, checker pad, sewed, and braided sandals.

TWILL-PAD SANDALS, TYPE F1b

Description of the Type

This footgear was made by sewing reinforcing and padding elements through the margins of all four sides and across the underside of a basic, foot-shaped, twill-plaited fabric (Fig. 6-1). Ties appear to have been installed after the padding.

Distribution of Twill-Pad Sandals

28/CM24, 1/CM65, 42/CM68 = 71/3

Discussion: These are well-made sandals and are of more refined design, better craftsmanship, and represent more care and more time in manufacture than any of the other types of footgear found by us in Coahuila. That they are not as rugged as the other types is apparent from their relative delicacy of construction and their very poor condition when abandoned (and found). The materials of which they were made and the specifications of their manufacture and final form are comparatively uniform, suggesting a cultural pattern of stability and possibly considerable antiquity before the date of the oldest ones found by us. When this inference is viewed in conjunction with the type's very restricted geographical range and localization in the very earliest levels of the sites where it was found in situ, it seems justified to make the further inference that it represents a type imported into the Cuatro Ciénegas Basin from some presently unknown outside area at an early stage in the occupation of the Basin. Since the plaited sandal, Type F1a, was also found in the lowest level of the earliest site, Frightful Cave, and in the largest quantity there, and since it endured in the region of northern Coahuila for several millennia after the twill-pad sandal had disappeared, there is reason to believe that the plaited type represents the basic form characteristic of the local culture. It is hoped that someday other examples of twill-pad sandals will be found in other areas. If I were to play a hunch, I would look to the south, specifically in the neighboring states of Zacatecas and Durango upstream along the Aguanaval and Nazas rivers that flow, or used to flow, into the Laguna District of southwestern Coahuila. If, after diligent search, no trace of them is discovered in those regions, then I would look farther south and east in the states of San Luis Potosi, Nuevo Leon, and Tamaulipas, particularly in the Meseta Central and the flanks of the Sierra Madre Oriental, not in the eastern lowlands or the coastal plain.

Another aspect of these artifacts, which, however, cannot be fully discussed in this report, is that they appear to be associated in Frightful Cave with several other cultural types that together constitute a cultural congeries that I have called the Ciénegas Complex, possibly representing a broader, integrated complex (Taylor 1966: 62f.). This association is spatial and, consequently by inference, chronological, in that all members are present in the lowest stratigraphic level of the site and all disappear or notably decrease at approximately the same time.

Twill-Pad Sandals from CM24 (Fat Burro Cave) (Table 6-1)

Discussion: As a group, these specimens, when found, were in very poor condition, probably more so than any of the other varieties of sandal. This seems to be only partly due to factors of preservation, but apparently as much or more it is the result of the condition of the specimens when they were originally abandoned. Why this should have been, cannot be told at this point with any assurance. One possible geographic difference is the fact that the terrain around Fat Burro Cave is much more rocky and rugged than the canyon and monte adjacent to Frightful Cave. In fact, the hunting area immediately adjacent to Fat

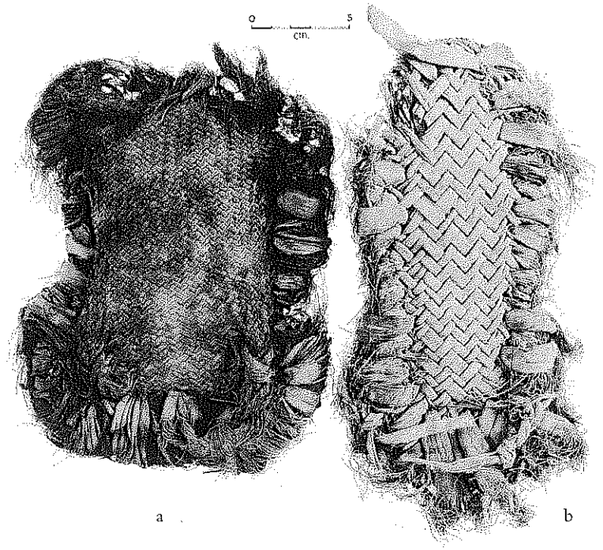


Fig. 6-1
Twill-pad sandals, Type F1b: a) CM65, F1; Pad of decorticated lechuguilla, narrow averaging about 2.5 mm wide, closely woven, very worn, generalized toe depression, clear heel depression on left, ends folded under; Padding of unpeeled lechuguilla, very full at toe and heel; Ties of peeled lechuguilla in 2-ply, z-spiral yarn, heel ties twisted into yarn after being run through sandal, i.e., after pad made and probably after padding installed, Type A; probably left foot; agave needles, fiber Category F14, in padding along left margin on bottom of sandal; b) CM24,F-186; Pad of split sotol (*Dasylirion williamsii*), averaging about 5mm wide, only slightly worn, ends folded under, long sides with selvage, pad may be double; Padding of lechuguilla, very worn on bottom; Ties of unpeeled maguey? (*Agave* sp.), remaining only at heel; c) CM68,F-1017; Pad of lechuguilla, about 5 mm average width, big-toe depression (?) left, left edge of heel worn through, toe-end of pad shows line of twining just before it turns under; Padding of lechuguilla, first in usual figure-eight pattern and then later in U-shape; Ties of lechuguilla, toe ties a single strand doubled and run up from bottom of sandal through two holes, tied together and then tied to instep tie (see details in section on sandal ties, this volume); d) CM24,F-88b; Pad of stripped lechuguilla with most of cortex adhering, averaging about 4 mm wide, quite worn especially at heel, where it is completely worn through, big toe broken out through wear, depressions at heel, ball-of-foot, and small toes, ends turned under; Padding of lechuguilla, woven around edges of pad in figure-eight pattern, very worn on bottom; Ties of peeled lechuguilla, Type A; left foot; e) CM68,F-371; Pad of stripped lechuguilla and perhaps partly peeled, averaging about 5 mm wide, worn at toe, especially right, worn through at heel, especially left, ball-of-foot and heel depressions, selvage at heel end; Padding of some lechuguilla but mostly zamandoque, sewed in figure-eight, very worn; Ties now only at toe, lechuguilla 2-ply, z-spiral yarn; probably left foot.

Table 6-1. Summary of Twill-Pad Sandals (F1b) at Fat Burro Cave (CM24).

Level			Sector			Wall		
	N	MMd		N	MMd		N	MMd
Top	6	-26	Front	0	-25	East	2	-16
Middle	6	+06	Center	5	-31	North	1	-36
Bottom	15	+20	Rear	22	+56	West	8	+02
						Rear	16	+50

... /28
avg. per m^3 ... 1.96
avg. per blk ... 1.73

Burro Cave is probably the most vicious walking surface that I have ever encountered: a vast expanse of bare limestone etched by rainwater into tiny, razor-sharp ridges and peaks that can cut a pair of tough, modern, leather field shoes into ribbons in a couple of days walking—as I can well attest!

As in Frightful Cave, the twill-pad sandals from this site were found primarily in the Bottom Level and decrease upward in the deposits. Here, however, they continue more strongly into the Middle Level, a situation that is probably at least in part due to the relative shallowness of the deposits and the greater amount of disturbance and compaction that they have undergone. Horizontally, there was a greater accumulation of sandals along the rear and west walls than elsewhere and a noticeable deficiency of them in the Front and Center sectors and along the east wall (Table 6-2). These areas of localization and nonlocalization, when compared with those of artifacts having inferred associations with the sex of their makers and/or users, develop a picture of differential use of the various sectors of the cave by the sexes. Such inferences derive especially from categories of stone work, such as the metate/mano complex (female connected), projectile points, chipped stone artifacts, and debitage (male connected).

The deteriorated and fragmentary condition of these sandals has made it virtually impossible to obtain details within many of the categories of measurement and observation that proved productive in the study of other kinds of sandals, particularly the plaited Type F1a above. Therefore, instead of reporting all the details and then not being able to use them because they are so few and unconnected, a checklist is presented of measurements and observations that we used as a guide and mnemonic device during our original, descriptive study in the laboratory. Under the appropriate headings of this list, some of the details we have recorded are mentioned and briefly discussed. In this way, not only are a few of our ideas and lines of investigation brought out but also some of the potentially significant substantive details are made available for the record.

Distribution: see Table 6-2

Dimensions: There are only four of these sandals that have been accorded a designation of "Length, complete?"; none is reported as being unequivocally "complete." As to widths, the situation is somewhat better; there are 14 specimens with complete measurements, and these are clustered in three groups: (1) 93 to 106 mm (9 specimens); (2) 45 to 79 mm (4 specimens); (3) 27 mm (1 specimen). When a scattergram is made of the dimensions of the four specimens having both "complete?" lengths and complete widths (Fig. 6-2), it is found that those from this site are longer for their widths (or narrower for their lengths) than are those from Frightful Cave (for which see Fig. 6-2). However, since the very few sandals of the present type fall well within the regression line of the 107 Type F1a specimens from Frightful Cave (Fig. 5-7), the apparent difference is probably due more to sample size than anything else.

Twill pad:

a) Dimensions: There are seven specimens with complete pad dimensions, but one of these is aberrantly small (78 mm x 31 mm) and has not been used in

Table 6-2. Quantity, Distribution, and Association of Twill-Pad Sandals (F1b) from Fat Burro Cave (CM24).

Level	E	N	W	R
Top				
Front	–	–	–	–
Center	–	–	1	–
Rear	–	–	2	3
Middle				
Front	–	–	–	–
Center	–	1	2	–
Rear	2	–	1	–
Bottom				
Front	–	–	–	–
Center	–	–	1	–
Rear	–	–	1	13

Sector	E	N	W	R
Front				
Top	–	–	–	–
Middle	–	–	–	–
Bottom	–	–	–	–
Center				
Top	–	–	1	–
Middle	–	1	2	–
Bottom	–	–	1	–
Rear				
Top	–	–	2	3
Middle	2	–	1	–
Bottom	–	–	1	13

Wall	F	C	R
East Wall			
Top	–	–	–
Middle	–	–	2
Bottom	–	–	–
North Wall			
Top	–	–	–
Middle	–	1	–
Bottom	–	–	–
West Wall			
Top	–	1	2
Middle	–	2	1
Bottom	–	1	1
Rear Wall			
Top	–	–	3
Middle	–	–	–
Bottom	–	–	13

deriving averages. For the six other complete pads, the average length is 202 mm, the average width is 74.5 mm, and the average area is 15,049 mm.[2]

b) Material: With only four exceptions, the material of manufacture is lechuguilla; two are of sotol, and two of "maguey" (probably dampened, soft, worn lechuguilla). The lechuguilla leaves have been filleted/split in three specimens, merely filleted in 19, and 20 specimens are described as retaining "much" or "almost all" the original cortex; none is said to retain either "no" or "all" cortex.

c) Technique of Manufacture: All twilling is 2/2. The measures of central tendency of the widths of lechuguilla-weaving elements, that is the individual strands of lechuguilla, are as follows for a sample of 25 strands:

N = 25
range of measured widths = 2 to 9 mm
mean of observed widths = 4.9 mm
mode of observed widths = 5 and 6 mm
(8 specimens each)
median of observed widths = 5 mm

The sotol elements have approximately the same central tendencies as those made of lechuguilla in the other sandals, but in one they are considerably wider (10–13 mm). The heel and toe ends of the twill pads are, except for F-185, either destroyed or are turned under and are thus invisible, and nothing has been learned about their end selvages, if any, or how they might have been otherwise terminated; 10 pads were turned under at both ends, 5 at the heel, and 4 "at one end," i.e., whether at the heel or toe end

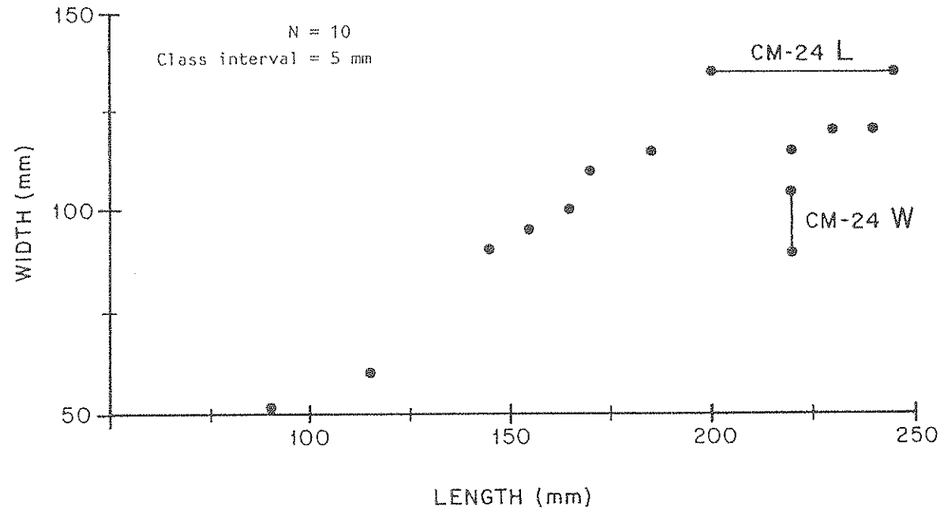


Fig. 6-2
Length to width proportions of all twill-pad sandals (F1b) having complete measurements of both length and width (N=10) from Frightful Cave (CM68). Also included are length and width measurements on the very limited sample (N=4) from CM24 (Fat Burro Cave).

is uncertain. One sandal is unfinished and represented by only one of its narrow ends, i.e., either the heel or toe; to terminate this end and to keep it from unraveling, the elements are held together with two stitches of one strand of crude fiber ("crude fiber" means undecorticated leaf, single, either whole or partial, and without twist), whose ends are tied together by a square knot. Lateral or "long-sided" selvages are "single," the usual ones for twilled fabrics, nine of which are down-right and six down-left. The dextrals and sinistrals of the twill-pads cross each other either at right angles (2 specimens) or at acute angles (20 specimens) or both (2 specimens), and the rest are unknown.

d) Wear/Soiling: The very fragmentary condition of these sandals made it most difficult to distinguish between deterioration from use and that due to postdepositional decomposition. We recorded the fact that all these sandals showed wear varying from "slight" to "much," but we could not decide upon further critieria that appeared significant and auspicious for further investigation, and so we stopped inquiries along these lines. One specimen was stitched at the heel from side to side with at least four lines of lechuguilla fiber, quite certainly for the purpose of reinforcement or repair although there seems to be relatively little wear to justify such an action, especially in view of some sandals that are quite worn through, yet had not received such additions.

Our purpose in making observations on "soiling" was to provide us with ideas as to the conditions under which the sandals had been used, whether on rocks, on sand, in alluvium/mud, or "around the cave." This investigation also proved disappointingly inconclusive, and the "results" are not reported here. However, it should be mentioned that 14 sandals were "caked," for example, they had foreign materials such as ash, dust, sand, "dirt," apparently consolidated and caused to adhere to the top of the pad through the agency of water (such as sweat, ground water). When there appeared to have been no moisture involved in the consolidation, it was recorded as being "probably from the (cave) deposits"; there are 13 such identifications. When the deposit on a sandal was entirely or largely of ash and/or dust, it was inferred to have been formed within the cave, possibly postdepositionally; when sand, gravel, and/or "dirt" comprise a considerable proportion of the "caking," then it was assumed that it

had been acquired outside the cave and hence by human action.

e) Depression: No depressions were recorded from 15 specimens, either because the fragment of pad is too small to reveal them (3) or because none is apparent (12). Heel depressions were found on 8 (5 certain, 3 "probable" or questionable), ball-of-the-foot (6 and 2 questionable), and 1 each at the big toe (questionable) and "toes in general."

f) Foot: Determination of whether a sandal is a right or a left depends most often on identification of the depressions. However, on some specimens that reveal no depression, it is sometimes possible, with varying degrees of certainty, to make the identification based on the shape of the whole fabric. If, when it is viewed from the foot or "top" surface, a sandal margin is concave on the right, it is inferred to be a left, and to be a right when the convexity is on the left. Among the twill-pad sandals from CM24, 2 are certainly and 8 are "possibly" lefts, 3 are "possibly" rights, and for 14 no determinations were possible.

Padding:

a) Dimensions: There are no distinct dimensions for padding.

b) Material: With one exception, all the padding of all Type F1b specimens is of lechuguilla. There is one in which the padding is of sotol.

c) Technique of Manufacture: The application of padding elements to the twill-pad appears to have been accomplished by the same techniques in all twill-pad sandals from all three of the sites in which they were found. Details of the techniques are given in the section on Frightful Cave, below. On one specimen, a few longitudinal elements were definitely seen to have been applied in the usual manner around the toe and the heel ends before the transverse elements had been added and covered them. It is possible that such a practice was common in the manufacture of all these sandals but was not observed during our laboratory work because to do so would have required the destruction of the specimen, and we had no indication that such a procedure might produce information valuable enough to justify the loss; on one other specimen, longitudinal elements under the transverse elements are indeed recorded. On only one specimen were there additional bindings of lechuguilla fibers around the edges of the sandal; this practice may have occurred also on other examples and been missed during laboratory study because we had not become fully aware of it as a subject of investigation.

d) Wear/Soiling: The 25 specimens on which there is padding (2 specimens have no padding remaining) are said in our lab notes to be either "worn through" or "very worn."

Twill-Pad Sandals from CM65

Only one twill-pad sandal came from this site. It was found on the spoil pile at the front of the cave and obviously had been dug up by the guano hunters who destroyed much of the cultural deposit. Its fragmentary length measures 211 mm, and its width 152 mm complete; its pad measures 187 x 115 mm complete. It is made entirely of lechuguilla. Its pad is very worn and has a generalized toe depression and a good heel depression, especially pronounced on the left; the sandal, therefore, is taken to be a left. The pad has been turned under at the ends, while the side selvages are the "simple" kind closed left, and its elements cross more or less perpendicularly. The padding has been installed in the usual way but is unusually thick. The right heel tie was run through the pad from below as a double strand of decorticated lechuguilla leaf, which was then twisted to form a two-ply yarn that served as a tie; it is attached to the left tie by a square knot. At least four "agave needles," Type F14, were observed in the padding along the left side of the bottom of the specimen, evidently used, as their designation indicates, to thread the padding elements through the pad and other padding to develop the sole of the sandal. Both "agave needles" and twill pad sandals are predominantly Bottom Level in Frightful Cave and thus strengthen the case for their cultural and chronological association.

Twill-Pad Sandals from CM68 (Frightful Cave) (Table 6-3)

Discussion: This is the earliest type of sandal yet recognized by us in Coahuila. It has been designated as a component of the so-called Ciénegas Complex, the earliest cultural expression of which we have record in the state (Taylor 1966: 62ff). In view of this, it is necessary to make some explanation of the three specimens attributed to the Middle and Top Levels in the distribution tabulation (Table 6-3). The two from the Top Level of the Passage Sector came from one block, F-40, Bottom Level; the Block Card says, "One split

Table 6-3. Summary of Twill-Pad Sandals (F1b) from Frightful Cave (CM68).

Level	Front	Center	Back	Passage	Total	MMd
Top	0	0	0	2	2	-26
Middle	0	0	0	1	1	-33
Bottom	5	13	10	11	39	+59
Total	5	13	10	14	42	
MMd	-27	-03	+13	+17		

... /42
avg. per m^3 ... 0.32
avg. per blk ... 1.75

strand cross (also a component of the Ciénegas Complex) was uncovered at the base of the pile of earth that had been thrown down from above. Also a few fragments of twill sandals. All came out from last four buckets on cleaning up pile." Because of restricted space and great depth of deposit in the Passage, the Top Level of P-40 could not be excavated from the side but had to be thrown down from above and reshoveled from a "platform" on the surface of the culturally sterile "cave spalls"; this surface lay beneath the already-cleared deposits of the previous excavation, Column P-30. Thus, it is possible, even probable, that both the fiber cross and twill-pad sandals had originally been incorporated in the deposits of the Bottom Level of Column P-39 and had been missed in the darkness and dustiness of that remote part of the site—and then picked up later in the thrown-down and reshoveled deposits of the Top Level of Column P-40. Concerning the specimen assigned to the Middle Level of Column P-34, the Block Card says, "Twilled sandal fragment found at 1.50 level or within .05 of it." In other words, it was found right at the dividing line between the Middle and the Bottom Levels; in view of the rather imprecise stratigraphic controls forced upon us by the stringent conditions of excavation within the Passage and the really minute margin by which it was assigned to the Middle Level, it may equally well belong to the Bottom Level. If these "special pleadings" are allowed, then all twill-pad sandals from Frightful Cave can be attributed to the Bottom Level. It is my opinion that they should be. The horizontal localization of these sandals is in the Back and Passage Sectors and thus conjunctive and supportive of the inferences made in connection with plaited sandals, Type F1a above: that the Back and Passage Sectors during Bottom-Level times were a dumping area for abandoned artifacts.

The lengths of only 10 twill-pad sandals are complete, or close enough to being so to provide acceptable "complete" measurements; 31 widths are complete. Table 6-4 presents the data.

When a scattergram showing the length-width proportions is constructed from all sandals having complete measurements in both length and width, the results are as presented in Figure 6-2. The smallness of the sample here is prejudicial, but the Figure, within its limits, shows that the sandals are wider in proportion to their length than is the case with plaited sandals (Fig. 5-7) but, as in the latter, there also appear rather distinct groupings. In terms of modern shoe sizes, the groupings among twill-pad sandals from smallest to largest are: child's 0 to 4+, child's 7+ to 12+, adult male's 3+ to 5½+. These groupings are different from those of the plaited sandals, for which there are only two groupings and among which the break does not correspond with either of those among the twill-pad sandals. Until we have more twill-pad sandals and a fuller regression line for them, these implicit problems concerning sandal dimensions/proportions will have to wait.

The materials of manufacture used in making the pad are lechuguilla in 30 specimens, of which 18 are of filleted but not decorticated fiber, while 11 are either partly or completely decorticated; 6 are of zamandoque and 5 of sotol, while 1 is of both lechuguilla and zamandoque.

Table 6-4. Measures of Central Tendency, Corrected and Rounded, for Twill-Pad Sandals (F1b) from Frightful Cave (CM68).

	Length (N=10) mm	Width (N=29) mm
Range	90 - 244	52 - 124
Mean	174	100
Mode	none	*
Median	171	99

Note: Only sandals having complete lengths and widths were used. Two impossibly wide widths have been eliminated from these calculations.

*8 at 2 specimens each (98, 99, 100, 102, 105, 115, 118, 123 mm)

The technique of manufacture is pretty well understood through evidence from a number of specimens. Compared with that of the plaited sandals, it is a rather complicated procedure, and this difference is one of the reasons for inferring a decline of craftsmanship from early to late at Frightful Cave. The twill pad was made first, using narrow strands of fiber (range: 1–8 mm, mean: 4 mm, mode: 3 mm, 12 specimens), spaced predominantly from 2 to 3 per cm (28 specimens) but in one case as closely as 8 in 1 cm. In one sandal, a zamandoque leaf was split into four strands that were not cut loose but were woven directly into the pad while still attached to the basal segment of the original leaf that extends outward from the left side of the toe end of the sandal, an awkward protuberance. It should be noted that these facts are conclusive evidence that the toe end was the starting place in weaving the pad. The dextrals and sinistrals of the fabric meet at acute angles in 27 specimens and at right angles in 15, and there are two in which the angles are about half-and-half. The 14 pads that are complete range from 80 to 254 mm in length, with a mean of 194.9 mm (the sandal with the 80 mm length and a 37 mm width has not been used in calculating the following measures of central tendency, either in length, width, or area, because it is obviously aberrant, being isolated in all measurements an unusual distance from its nearest neighbor); mode = 160, 170, 200, 240 (2 specimens each; 10 mm class interval); median = 188. For width, the range is 37 to 100 mm, with a mean of 78.9 mm; mode = 80 (4 specimens; class interval 10 mm); median = 82.5. In area, they range from 2960 to 25,400 mm^2, with a mean of 15,617.9 mm^2. The finished sandals, of course, are considerably larger because of the way the padding was later installed. The two lateral, i.e., longitudinal, edges of the twill-pad were finished by simple selvages (evidence from 21 specimens), while at the heel or toe, originally possibly at both, the strands are held by a single row of twining (two rows in only one specimen, F-1017), that is, with the one exception, always slanted down-left. The moving ends of the dextrals and sinistrals were not treated in any way, except probably to be cut off; this made for a rather loose fabric. However, in a number of sandals where observation was possible, and possibly in all sandals originally, at least one of the toe or heel ends of the pad was turned under and back before the padding was installed. In fact, one specimen has a few padding elements lodged between the fold formed when its twill-pad was turned under at the toe end; the toe end of this specimen is also unique in that, on reaching the end of the pad, one of the dextrals was split, wrapped around the entire end, including the tie, and was folded under the back as in the other examples. In another instance, the toe tie is a continuation of a sinistral of the twill-pad.

On 17 specimens, the pad has been so worn as to remove most of the cortex from the fibers. Twenty-one sandals show moderate wear on the foot side of the pad, while only four show little or none. On two specimens, the heel has been broken or worn and then reinforced by a stitching of zamandoque; it is interesting, in view of the later predominance of zamandoque for basic sandal manufacture, that repair was done with that fiber and not with lechuguilla, which is the common basic sandal material during the early, "twill-pad sandal times." Another sandal was also reinforced at the heel, but only after a deep depression had been worn, not a break or worn hole. Depressions are present in the pads of several specimens: at the heel in 20, ball of the foot in 4, and at the toes in 4, of which 2 are definitely at the big toe; this does not agree with the order of magnitude found in plaited sandals (see Table 5-12). Breaks have not been counted because the sandals are generally too fragmentary to make identification sure.

After the twill-pad had been made, the sole or "padding" was installed. From the sandals that are complete and tractable enough to permit examination in detail, it is apparent that this was done in one of two ways: (1) the padding element was started by being sewed upward from "ground side" through the edge of the twill-pad to the top or foot side, carried around the edge and across the ground side almost to the opposite edge, then upward through the pad to the foot side again, from where it was passed around the edge to the bottom side, back across to the other edge again, and continued in the same manner producing a figure-eight pattern; (2) the padding element was started upward through and around the edge as before, carried across underneath, but passed around the outer edge of the pad and then sewed downward through the pad to the bottom side to be carried across the underside, around the edge, and again downward through the pad producing a U-shaped pattern. Both techniques produced a fat roll at all the four peripheral edges of the sandal. In three instances, additional padding was sewn around and around the edges without crossing the underside; in another specimen, this addition was made by whipstitching an element along the edges. On the ground side of one sandal, the needle of agave, probably *A. lechuguilla*, had been left attached to the leaf that had been used as a padding element; it is obvious that the whole leaf had been used and that the spine had served as a needle to assist in sewing the padding into the sandal. Here we are reminded again of the agave needles tied into bunches (Type F14) that were found in the Bottom Level of Frightful Cave and which have been attributed to the Ciénegas Complex (see Taylor 1966: 62f).

The padding elements of twill-pad sandals are largely of lechuguilla. A tabulation of materials is as follows:

lechuguilla	26
lechuguilla > zamandoque	4
lechuguilla = zamandoque	2
lechuguilla, zamandoque, sotol	2
zamandoque > lechuguilla	3
zamandoque	2
sotol	3
Total	42

Thirty-two of the 42 twill-pad sandals show extreme wear on their ground sides, while none is described as being unworn or "only slightly worn." On the foot or twill-pad side, the wear is generally much less, only 17 specimens are said to have "extreme" wear, while on 21 wear is said to be moderate, and there is little or no wear on 4. Twenty sandals have heel depressions, and there are depressions at the toes and the ball of the foot on 4. It is significant to note that, in all instances of reinforcing stitching, the location is at the heel where, on two specimens, it is of zamandoque and on only one is it of lechuguilla.

In general, probably because of its resilience, the twill-pad did not retain depressions very well, and the identification of sandals as either right or left has been more difficult than among the plaited sandals. Sixteen have been identified as rights, 5 as lefts, but for 21 no designation has been possible. This excess of rights over lefts is nearly three times what it was among the two-warp plaited sandals (see Table 5-13), but caution is called for in attaching meaning to this because of the large number of specimens whose foot sides, right or left, have to be listed as "unknown."

Finally, it should be pointed out that, although twill-pad and plaited sandals were found together in the Bottom Level of Frightful Cave and were thus contemporary at the earliest epoch of which we now have record, their differences are so basic and so pronounced as to suggest that they pertain to two quite distinct traditions and, if this is true, that in Coahuila even at the earliest times there was more than one cultural line. We have been unable to determine whether they were mixed into what was actually a single "hybrid" culture or represent two cultures whose bearers occupied the site separately.

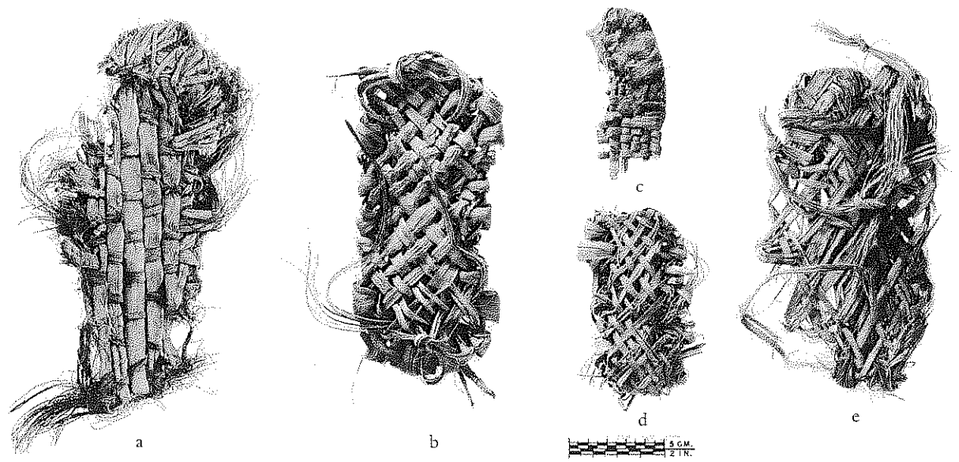


Fig. 6-3
Checker-pad sandals, Type F1c: a) CM68,F-950; Pad of lechuguilla, longitudinal elements split and unpeeled, transverse peeled and shredded, somewhat worn, left big toe and both sides of heel broken out; Padding of lechuguilla with some zamandoque at toe, woven in figure eight, very worn; no ties or traces of them; probably right foot; b) CM68,F-1124; Pad of lechuguilla split and stripped, not worn or depressed, selvages at long sides; Padding of lechuguilla, woven in U pattern, not worn; Ties of peeled lechuguilla, toe tie has agave needle at one end, Type A; no positive signs of use; c) CM68,F-1226; Padding of maguey? (*Agave* sp.) whipped around edges and sewn down with soft fiber (maguey?) yarn, 2-ply, z-spiral; no ties or traces of them; d) CM68,F-628; Pad probably of *Yucca* sp., stripped, ends turned under, not worn; Padding of zamandoque and/or *Yucca* sp., sewn in usual figure-eight pattern, cortex peeled off in some places but otherwise no sign of wear; no ties or traces of them, probably not used; one tip of lechuguilla ("agave needle") evidently used to thread padding element, leaf fiber below tip trimmed around making needle more prominent and easier to break off—if so wished; e) CM68,F-1044; Pad of *Yucca* sp., stripped but not peeled, bottom somewhat worn, side selvage; Padding of *Yucca* sp., woven in usual figure eight; Ties, heel ties only, i.e., around heel and instep; one "yucca needle" remains.

CHECKER-PAD SANDALS, TYPE F1c

Description of the Type

Footgear made by sewing reinforcing and padding elements through the sides and across the ground side of a checker-plaited fabric (Fig. 6-3).

Distribution of Checker-Pad Sandals (Table 6-5)

CM68 = 7/1

Discussion/Description: The geographic distribution of this type is even more restricted than that of the quite similar twill-pad sandal, F1b above. Within Frightful Cave, both types are concentrated in the Back and Passage Sectors, but the checker-pad sandal was found higher and, therefore, later in the deposits. In spite of these differences and, to some extent, because they are indeed so small, it seems probable that the two are culturally related, and the difference may be attributed to a time differential, to some cultural specialization either in the age/sex destination of the sandals, or to differences in traits of craftsmanship. To make a choice between these possibilities, more comparative data will be required. Comparison between the regression lines of length/width association (Figs. 6-2, 6-4) shows a rather suggestive consistency in the clustering of all pad sandals. At present, there is too little information on this topic to warrant construction of hypotheses as to the meaning of this fact. It is unfortunate that there are not more conjunctive data in the literature as well as more specimens in our own collections, through which comparative investigations could be made.

From observation of the design and the manufacturing technique of these sandals, there can be little doubt that they are culturally related to the twill-pad

Table 6-5. Summary of Checker-Pad Sandals (F1c) from Frightful Cave (CM68).

Level	Front	Center	Back	Passage	Total	MMd
Top	-	-	-	-	0	-31
Middle	-	-	2	2	4	+22
Bottom	-	1	1	1	3	-09
Total	0	1	3	3	7	
MMd	-39	-20	+32	+27		

sandals described in the preceding section. However, it is also obvious that they were somewhat later in time. Like the twill-pad sandals, they were recovered principally from the Back and Passage Sectors of the site, where a large proportion of the artifacts of the early- and middle-period occupation was found.

Only five specimens are complete enough to be reported here. However, if we assume that they are representative, it becomes apparent that the length/width proportions of these sandals (Fig. 6-4) are similar to those of all other sandal types with the exception of the twill-pad, Type F1b (Fig. 6-2). This is rather strange in view of the otherwise close similarities between the two. The size differences and the differences in the quality of workmanship may indicate that the checker-pad sandals were made by and/or for different groups of people and/or for a different purpose than the twill-pad; it is also possible that, being somewhat later, these sandals represent a deterioration of technique among the "pad sandals," which had started as "quality footwear." Furthermore, when we compare the more or less general trends apparent in all three graphs of length/width association for other sandal types (Figs. 5-7, 6-2, 6-4), we find that each of the three regression lines is broken into three segments. Even though the breaks come at slightly different locations along the lines, the consistency of the breaks is enough to make us think that they might be expressive of some culture-historical or biological truth that we would like to know about.

The five complete checker-pads range from 94 to 210 mm long, with a mean of 164 mm and from 49 to 89 mm wide with a mean of 69.9 mm. These measurements are considerably smaller than those of the twill-pad sandals from the site. The frequency of the checker-pad sandals is too small to make inferences from these differences in dimensions. We need more comparable materials from other sites and areas in order to follow out, control, and profit by the suggestive leads that have developed from these data.

The fibers used in making the checker-pads include lechuguilla (three specimens), yucca (two), sotol (one), and lechuguilla with zamandoque (one). With regard to the padding, there are two sandals of lechuguilla, one of lechuguilla or yucca, one in which lechuguilla exceeds zamandoque, one of yucca, and one identified as being of "maguey," a term we generally use for a fiber that is probably agave, but which appears to be "softer" and fuzzier than those identified as *Agave lechuguilla*. One specimen was evidently in the process of manufacture when discarded or lost: no padding or ties or any indication of them are present.

The technique of manufacture is, from all we can learn, identical to that of the twill-pad sandals. However, there is one aberrant specimen, in which the padding has been installed in a U-shaped pattern throughout (no figure-eight pattern) and added elements were introduced longitudinally over and under the "primary" ones. Another has padding whipped around the edges of its checker pad and sewn down with a somewhat soft (maguey?) two-ply, s-spiral yarn. On yet another, the transverse elements of padding are fastened around the longitudinal ones and to each other by a series of square knots at one edge. Three specimens retain an agave spine or "needle," two in the padding and one at the end of a toe tie. The checker plaiting of the pad is diagonal in two cases and perpendicular in three. The individual elements of the checker-pad range from about 3.5 to 10 mm in

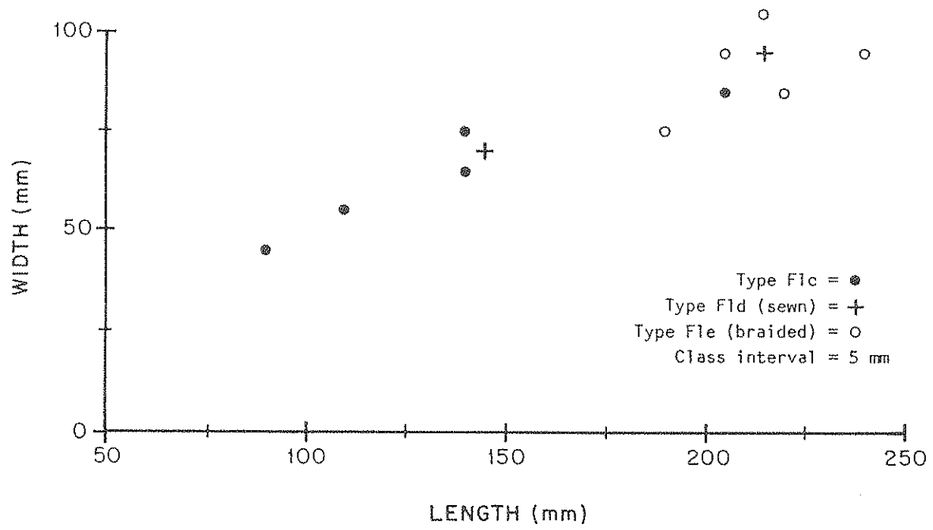


Fig. 6-4
Association of length and width for checker-pad (F1c), sewed (F1d), and braided (F1e) sandals from Frightful Cave (CM68)

width with an average of 6 mm; they are spaced one element per 1 cm on the average.

Much less evidence of wear is present on these sandals than on other types. In only one instance (F-1030) is the checker pad said to be "very worn," and then only the horizontal elements; the padding is said to be "very worn" in only one specimen. Only two identifications as to right or left could be made, and both of these are questionable: F-950 is "probably a right" and F-1044 is "possibly a left."

SEWED SANDALS, TYPE F1d

Description of the Type

Footgear made upon a base consisting of a mass of preshaped (to foot form), decorticated fiber sewed together to stabilize the shape, firm the substance, and probably to achieve greater durability (Fig. 6-5).

Distribution of Sewed Sandals

4/CM24, 18/CM68 = 22/2

Discussion: In their materials and technique of manufacture, these sandals are descriptively closer to the pad sandals, Types F1b and F1c, than they are to the plaited ones comprising Type F1a: made largely of lechuguilla in both body and sewing, essentially a reinforced pad, not a woven frame, and having shape and proportions more like pad sandals than plaited ones. When present, ties are Type A exclusively (see Chapter 7). Further, in stratigraphic position, relatively restricted geographical distribution, and number of specimens, pad sandals and sewed sandals are more like one another than either is like the plaited kind. In fact, these characteristics seem to have cultural significance, and it is possible, even probable, that the pad and sewed sandals (Type F1b, F1c, F1d) were imports into the local culture whose native, basic sandal was the plaited Type F1a.

To my knowledge, sewed sandals have been found in only one other area: one specimen from the collection of Everardo Gamiz, of the city of Durango, Mexico, was collected by Dr. J. Alden Mason, of the University Museum, Philadelphia. Finding the specimen in Durango does not surprise me, because I have long thought that there must have been connections with other cultures, particularly cultures of higher attainments, by way of the two large rivers, the Nazas and the Aguanaval, that empty into southwestern Coahuila from the west and south, respectively (see Chapter 1).

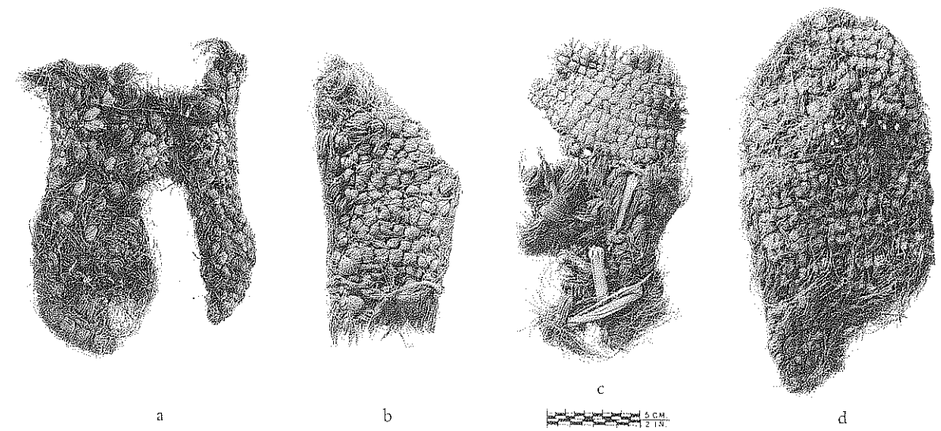


Fig. 6-5
Sewed sandals, Type F1d, from Frightful Cave: a) CM68,F-1140; Pad is a mass of decorticated lechuguilla fibers formed into foot shape, only slightly worn on bottom although sandal has been broken between instep and ball of the foot, worn through in the right and center heel area; Sewing of decorticated lechuguilla fibers in two sequentially applied sets (the first set of smaller diameter, the second of larger), stitches go in all directions but around edges they follow contour, some stitches appear to be 2-ply, in loose z-spiral; no ties or traces of them; b) CM68,F-531; Pad like F-1140 but well worn on bottom and around edges of breaks; Sewing of decorticated lechuguilla fibers, many appear to be loose 2-ply and z-spiral, stitching irregular but in general is transverse across body although at edges it is roughly longitudinal or at slight angle, worn on bottom; Ties, only heel ties present, of loosely spun 2-ply, z-spiral lechuguilla fibers, appears to be Type A; c) CM68,F-1329; Pad like F-1140 with very worn bottom and somewhat worn top, slight heel depression left; Sewing, original sewing now present only in toe area, 2-ply, z-spiral lechuguilla-fiber yarn in closely spaced, slightly curved diagonal stitches, rest of sandal seems to be later addition very crudely done with some lechuguilla stitches (in 2-ply, z-spiral yarn) and a few large stitches of crude (i.e., unworked) zamandoque fibers, old stitches worn and caked; d) CM68,F-962; unlike the others, this photograph is of the bottom of this sandal; Pad like F-1140, worn top and bottom, especially around edges and on margins of break, big toe depression at left (top right in photo) and ball of the foot, worn through at left heel (right in photo); Sewing of maguey (*Agave* sp.) plus some lechuguilla in heel area and around big toe, mostly a loose 2-ply, z-spiral yarn in transverse stitch across body but following contour at margins especially at big toe, more worn on bottom than on top; no ties or traces of them; evidence is contradictory as to foot: heel says left, big toe says right.

Sewed Sandals from CM24 (Fat Burro Cave)

..../4

avg. per m3 .... 0.30

avg. per blk 1.00

Discussion/Description: The collection of this type of sandal from this site is very small and the specimens are in very poor condition. Little conclusive data could be abstracted and few inferences made and supported. Two examples came from the Top Level, one from the Middle, and the fourth was found in the debris of the vandal hole at the very rear of the cave; one of the Top-Level specimens came from the Rear/Rear Wall Sector, but the other two had no wall association. Measurements of length and width are complete for only one specimen: L = 141 mm, W = 65 mm; the heel of another has been worn through, but it is estimated that its present length, 265 mm, is probably not more than 5 mm short, and its width of 112 mm is complete. All materials, both body and sewing, are of agave, apparently mostly *A. lechuguilla*, but some of the bodies, either through wear or postdepositional decomposition, now appear as a "fuzzy," naplike mass of fiber that typically has a "soft yellow" color unlike any other sandal material in our Coahuila collections (except for certain specimens of this same type from Frightful Cave, see below).

The technique of manufacture was to form into a foot-shaped "body" a mass of decorticated agave fiber that was then sewed across the width with strands of

Table 6-6. Summary of Sewed Sandals (F1d) from Frightful Cave (CM68).

Level	Front	Center	Back	Passage	Total	MMd
Top	0	4	0	1	5	-03
Middle	1	4	0	6	11	+26
Bottom	0	0	0	2	2	-23
Total	1	8	0	9	18	
MMd	-33	+10	-11	+34		

two-ply z-twist yarn also of decorticated agave fibers to give the fabric more rigidity and sturdiness. There are mending stitches on F-151, both transverse and longitudinal, several of which are of lechuguilla but the rest are zamandoque and either maguey or yucca. Specimen F-7, the unusual one to be described in more detail below, was whipstitched around its entire circumference with two alternating sets of peeled lechuguilla fibers, which, together with its transverse or "cross-stitching," made it a very compact structure. The ties of this sandal are made of both fiber and rawhide, the details of which are described in Chapter 7. All these sandals, in comparison with those of other types, are heavily caked both top and bottom with what appears to be some combination of dirt, dust, clay, sand, or other such substance mixed with water to form a very tough, durable coating that now hides the details of the underlying fabric. There can be no doubt that these incrustations are aboriginal or that the sandals were worn in that condition. Only one specimen retains depressions: It has a pronounced heel depression, is folded and broken at the ball of the foot, and has a small-toe depression on its left side indicating that it was used on the left foot.

One specimen is among the best-preserved sandals that we have from Coahuila. It is most unfortunate that it had been removed from its original resting place by the vandals who dug the pothole in the deposits adjoining the center of the rear wall: we now have no vertical provenience for the sandal and only a wide and imprecise horizontal one. Its length/width measurements (141 mm x 65 mm), when corrected to 124 mm x 57 mm, indicate a sandal of something less than a modern child's size 5 but a width that would be considerably narrower than any made today in that length. Thus it seems possible that child-sized sandals may need less correction than an adult's, if any at all, and that it might be more appropriate to use uncorrected figures for the smaller sizes of prehistoric footgear when comparisons are to be made with modern foot and shoe sizes. In this case, then, using uncorrected measurements, this sandal indicates a child's size 7 quadruple A, which, according to information from the shoe stores of Carbondale, would fit a child of from four to seven years of age—although we were warned that there is considerable variation in such age/size correlations. Whether we can extrapolate from the feet of modern Americans backward to the feet of ancient Coahuilans several millennia ago is a problem for which we need more pertinent data.

Sewed Sandals from CM68 (Frightful Cave)

... /18

Discussion/Description: These sandals (Table 6-6) are most characteristic of the Middle Level of Frightful Cave but, when compared with checker-pad sandals (Type F1c, above), they are seen to have less representation in the Bottom Level and more in the Top. Thus, it can be said that they are later than twill-pad sandals and generally contemporary with checker-pad, although they outlast the latter and, if the small sample is representative, were more common but never numerous. They are also more common in the Center and entirely absent in the Back Sector, a distribution that is conjunctive and supportive of their middle-epoch association, when occupation of the cave had become more intensive in the Center Sector. Their presence and provenience in Fat Burro Cave are also supportive of this inference.

There are only two examples that are complete enough in length to justify discussion: the proportions of these are more like those of plaited and checker-pad than of twill-pad sandals; they are shorter and narrower (cf. Figs. 5-7, 6-2). In all specimens, the body of the sandal is made of decorticated lechuguilla. The sewing elements are usually entirely or predominantly of lechuguilla, sometimes "crude" and sometimes decorticated, but in seven cases some or all of the elements are tentatively identified as "maguey," by which is meant a softer, "fuzzier" fiber, probably an agave but certainly different from lechuguilla. In two cases, "crude" cordage of zamandoque was used; these are identified as repair or reinforcing stitches added subsequent to a previous (original?) manufacture.

The technique of manufacture is the same as at Fat Burro Cave. Although two sandals were sewn in two separate operations, the first diagonal and the second longitudinal, all of the rest, except one, which is too fragmentary to provide information, were originally constructed with a single set of stitching, on some specimens randomly in all directions and on others regularly and evenly but in different directions: transverse more or less straight, transverse but noticeably arched, and diagonal (one). Of the regularly stitched sandals, all except three have coarse, secondary stitching sewn randomly in all directions, evidently for the purpose of reinforcing and/or mending places that had been weakened by wear.

The primary stitching covers from about one-half to very nearly all the area of the sandal. One sandal (F-7) is unique in that it was enlarged and reinforced after considerable wear: a new and larger mass of decorticated lechuguilla fibers was placed on top of an old sandal and secured by large, irregular stitches of both crude and two-ply, z-twist lechuguilla yarn. In general, wear on the tops is only moderate, but 12 specimens show extreme wear on their bottoms. There are "probable" heel depressions on four specimens; two have depressions at the ball of the foot, one of which also has a big-toe depression. The foot can be identified, even with reservations, on only three sandals: two left and one right. Ties are strangely absent, only three specimens retaining even suggestions of their former presence.

BRAIDED SANDALS, TYPE F1e

Description of the Type

Footgear made of two bundles of fiber doubled over each other and braided from toe to heel, where they are turned over and woven back up the sandal to form the padding (Fig. 6-6).

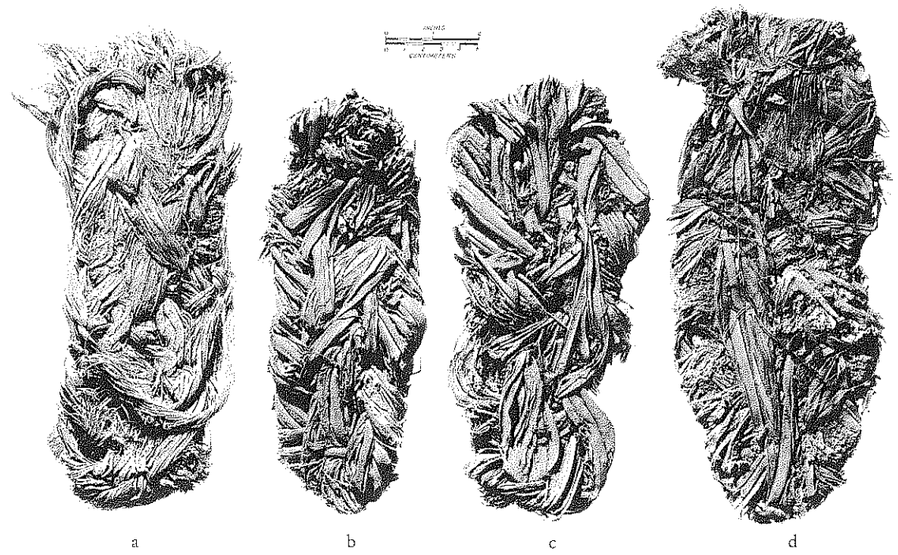
Distribution of Braided Sandals

1/CM24, 5/CM68 = 6/2

Discussion: These sandals, from the standpoint of technique of manufacture, are entirely distinct from those of any other type in our Coahuila collections. The difference lies in the fact that the other types are constructed by two sequent operations that create two separate structural parts of the resulting whole, body and padding. But the braided sandals are not made on either a warp frame or a pad. They are made of a single set of fiber elements that serve as both body and padding and that are manipulated through only a single step of manufacture. What padding they do have seems, from evidence that is not entirely clear, to be wholly or in good part a continuation of the elements of basic construction. Judging from the tightness of the fabric, this back-weaving for the padding (as well as the original braiding also?) suggests the use of an awl. As far as we can determine, there is no possible way that braided sandals could have evolved from either plaited sandals or pad sandals. Also, while certain of the techniques used on plaited and pad sandals are, at the least, very similar (such as figure-eight and U-shaped padding installation, marginal stitching, ways of adding padding elements, pad formation and renewal by stitching), the technique of braided sandals is unique, not derivative.

In regard to the manifest similarity, we can perhaps see the workings of Goldenweiser's doctrine of limited possibilities, as it pertains to the demands of a stringent environment that often provides but one solution to a problem such as the most suitable materials for so important and necessary a commodity as sandals (Goldenweiser 1933; see also Taylor 1961: 73–74). Sandals of this type were found only in the Top Level of Frightful Cave and in the Middle Level of Fat Burro Cave. Thus we have one more bit of supportive evidence for that stratigraphic correlation.

As for length/width dimensions (see Fig. 6-4), the braided sandals are seen to be longer and wider than those of Types F1c and F1d, but it is probably more significant that, in all the regression lines of length/width proportions of all types of sandal, the breaks marking more-than-usual differences are found to be



a b c d

Fig. 6-6
Braided sandals, Type F1e: a) CM24,F-134; of *Yucca* sp.; padding mainly diagonal and moderate (original braid quite thick and heavy, toe worn away evenly across and at sides, heel depression especially right, ball-of-foot depression left, small-toes depression right, very worn on bottom, somewhat on top; Ties of soft fiber (maguey? = *Agave* sp.) in loose s-spiral, toe ties double, not knotted but ends lying unattached parallel to long axis on top of sandal, Type undecipherable; b) CM68,F-1377a; of zamandoque, padding moderate mostly diagonal, some longitudinal, ball-of-foot depression more right than left, heel depression left, bottom worn but top not, probably left foot; Ties of zamandoque, rodent-chewed flush with padding, double, not knotted, enter body of sandal through two longitudinally aligned holes 27 mm to rear of them, emerge as toe ties, both ties pierce braided bundles at ankle; c) CM68,F-1050b; of zamandoque, padding moderate, mostly diagonal, some longitudinal, heel depression right, slight ball-of-foot depression especially left, bottom very worn, probably right foot; Ties of zamandoque, rodent-chewed flush with padding, double, not knotted, ends on top more or less parallel long axis of sandal, enter body 28 mm from toe-tie emergence; d) CM68,F-1050d; of zamandoque, padding moderate, mainly longitudinal, some diagonal, possible big-toe depression right, small-toe depression left, worn bottom and top, all margins of heel area worn, probably left foot; Ties of zamandoque, all rodent chewed, single, through to bottom but not worn.

alike in number (two) and, more or less, in location (see Figs. 5-7, 6-2, 6-4). It seems justified to infer that these remarkably consistent, conjunctive, and supportive similarities in the measurements and proportions of all types of sandals are indicative of the validity of the technique of analysis, of the measurements, and of the biological/cultural significance of the results. In view of this, we are proposing the working hypothesis that these breaks in the regression lines delineate age/sex differences in sandal measurements and that from this we may, with normal caution, proceed to infer the age/sex makeup of the human groups that occupied Frightful Cave, if not other sites in the Ciénegas Basin as well (see Table 5-5 and Fig. 5-7).

These are sturdy sandals and are generally in better condition than the other types. But wear is apparent, particularly on the bottoms, and caking was found on both top and bottom, especially on the former. One specimen from Frightful Cave, F-1196, has padding that seems to have been a secondary addition over a very broken down sandal, a final padding that is not worn on top but is noticeably caked. This might suggest that the water-consolidated caking found on the tops and bottoms of many sandals actually served to preserve the fiber structure of the fabric, both during and after use, and might even have provided a modicum of extra comfort to the feet, easing the harsh and uneven surfaces of the coarse fiber itself.

We have been able to determine very little as to the nature of the sandal ties of these specimens. The ties of all but one sandal of this Type have been gnawed off at the level of the foot surface, apparently by rodents. Rodents are fond of the salt left on man-handled and man-footed objects, but knowledge of this fact does not answer the implied question, only removes it to a different arena: why should the ties of braided sandals be so much more salty (sweaty) than those of other types of sandals as to provoke a virtually 100% destruction? From the one set of ties that still remains on any of these braided sandals (from Fat Burro Cave), it is apparent that we have an as yet unrecognized type of tie, and this might be of significance for comparative studies when we have more information on the details of sandals from other sites and other areas.

Braided Sandals from CM24 (Fat Burro Cave)
... /1
avg. per m^3 ... 0.08
avg. per blk ... 1.00

Discussion/Description: This specimen came from near the base of the second Fiber Layer, which is Middle Level here, and from the Center and West Wall Sectors. It is 255 mm long and 102 mm wide (223 x 89 mm "corrected"). It is made of *Yucca* sp., but the ankle tie is of *Agave* sp. Padding is moderate and mainly diagonal with some longitudinal; its bottom is very worn and is broken across at the toe, particularly the left side (from which it is thought to be a right foot). The top is slightly worn and somewhat caked. A heel depression is on the right, the ball at the left, and small toes on the right, all indicating a right foot. Toe ties start on the foot surface as two separate strands, go downward into the body, and are brought to the top again at a point nearer the toe end. They do not cross and are carried, each along its own side, to the ankle, where neither strand appears to have been anchored, a fact that takes the tie out of Class I and places it in Class II (see Chapter 7). But the handling of the ties at the ankle is not like any other set of ties and for this reason does not allow their being placed within any of the other sandal-tie types.

Braided Sandals from CM68 (Frightful Cave)
... /5
avg. per m^3 ... 0.04
avg. per blk ... 1.25

Discussion/Description: All these sandals came from the Top Level, three from the Back and two from the Passage Sector. As seen from Figure 6-4, they fall outside the proportions of plaited, checker-pad, and sewed sandals but are somewhat narrower than the twill-pad type. All of them are of zamandoque. As far as can be told from the five specimens, they were all constructed alike: Two bundles of nondecorticated fiber are each doubled back upon itself, then looped one over the other at what will be the toe end, making four moving ends that are then braided toward the heel to form the body of the sandal. At the heel, the four ends are tucked back into the body and woven in and out of the braided fibers to form padding and eventually to terminate usually on the bottom of the sandal; it is not certain whether adding more padding was customary, but it is sure that ties were added only when the body and initial padding had been made. These technological procedures led to a rounded toe and constricted heel. Wear appears on the bottom of all specimens but, on the top, only two specimens showed very much wear; caking, indicative of moisture, occurs on all, more on the foot than on the bottom side. All examples exhibited depressions: on four at the ball of the foot; on two at the heel; and on one at both big and small toes. It can be said with reasonable assurance that three are left sandals, while two are rights.

CHAPTER 7

Sandal Ties

A large number of sandals from Frightful Cave retain complete or fragmentary ties. In all, there are 750 examples of sandal ties distributed among the sandal categories as follows:

Sandal Type	With Ties	Without Ties	Total
F1a (plaited)	719	165	884
F1b (twill pad)	22	20	42
F1c (checker pad)	2	5	7
F1d (sewed)	2	16	18
F1e (braided)	5	0	5
F1f (residual)	0	2	2
Total	750	208	958

Of this number, 250 ties are complete and clear enough to be typed, and seven types have been identified. Of these types, six are found only on plaited sandals, Type F1a, while the seventh is found only on the so-called pad sandals, Types F1b, F1c, and F1d. Table 7-1 presents the data.

TYPES OF SANDAL TIES

After several attempts to categorize sandal ties as an aid to analysis, it became apparent that the most consistent and significant characteristics lie in the number of elements employed and how the ties were manipulated at the ankles of the sandal. Thus, all the sandal-tie types recognized at present can be subsumed under two major Classes (Fig. 7-1). Class 1 is characterized by having three constituent elements all made of twisted cordage, a single-strand toe tie and a two-strand ankle tie; Tie Type A comprises the entire Class. Class 2 ties have only one element, made of crude, i.e., nondecorticated and untwisted (or very loosely twisted) fiber usually of zamandoque, but occasionally of some other kind of xerophytic plant.

Based on the way the tie was manipulated at the ankle, Class 2 has been divided into two sub-Classes each containing three types. In sub-Class 2a are Types B, C, and D; in sub-Class 2b are Types E, F, and G. The difference is that in sub-Class 2b each of the two moving ends of the tie are run through the lateral side warps from the foot side to the ground side at the ankle, but one is terminated by a stopper knot after passing through the warp, while in sub-Class 2a one or both ties continue and meet either behind the heel, in front of the heel, or over the instep, to be tied together by a square knot.

Type A

Here, in contrast to Types B to G, the one-element ties, there are three distinct elements used. The toe tie and each of the two ankle ties are made of separate elements. On the four specimens where toe and instep ties are joined, they are tied together over the instep, and on the three of these where determination can be made, the joining element is an extension of one of the moving ends of the toe tie beyond the terminating square knot. Also in contrast, Type-A ties are usually made of plied yarns, not "crude" cordage (of the 23 specimens with ties, complete or partial sets, 18 are two-ply, z-spiral lechuguilla yarns), although on three specimens the toe tie is of crude cordage, while the two ankle ties are of the usual plied yarn. As for the technique of manufacture of Type-A ties, there can be no doubt that the toe ties were started by running the two moving ends of a loop from the bottom to the top of the sandal pad. On all specimens that have ankle ties complete enough for determination, there are two square knots, one in the back over the heel and one in the front over the instep. After we recognized this fact and its implications, it became obvious that the ankle ties could have been installed only in two parts: starting with two moving ends from each of two loops of two-ply yarn, one at each side of the ankle. These ends were run upward from the ground to the foot-side of the pad and then twisted, sometimes tightly and sometimes loosely, to make a

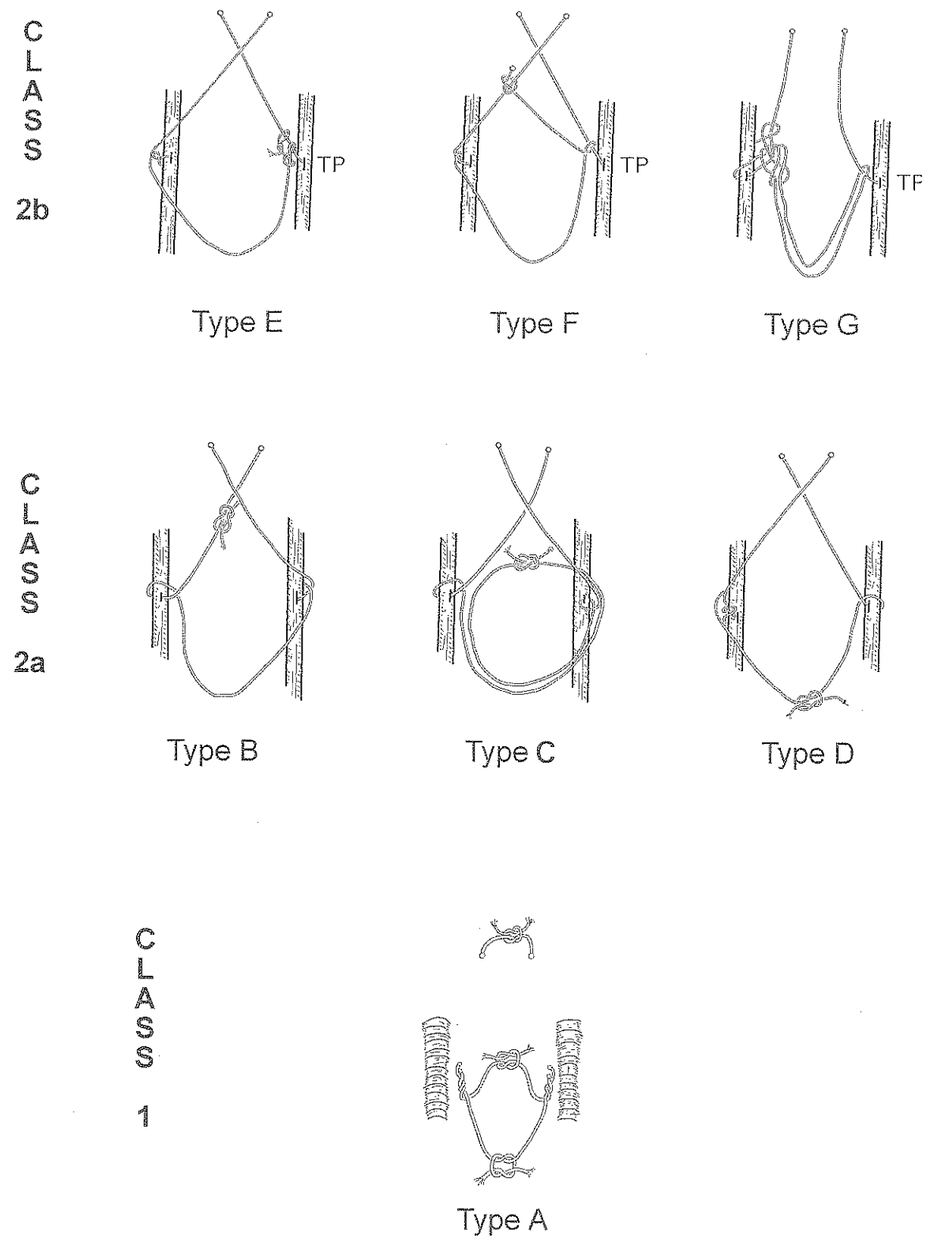


Fig. 7-1
The seven types of sandal ties recognized to date in the Cuatro Ciénegas Basin

Table 7-1. Association of Sandal Ties with Type of Sandal.

Sandal Type	Tie Type A	B	C	D	E	F	G	Total
F1a							14*	14
ai		31	11	7	20	101	21	191
aii							19	19
F1b	22							22
F1c	2							2
F1d	2							2
F1e**								
Total	26	31	11	7	20	101	54	250
%	10	12	4	3	8	40	22	

*The 14 Type-G ties are on plaited sandals that could not be identified as either two-warp or three-warp.
**Only stubs of ties remained on Type F1e sandals (probably chewed off by rodents), and these could not be typed.

four-ply, re-plied yarn. After the twisting had reached a certain point at some distance from the pad, the basic two-ply yarns were kept separate, one going to the front and the other to the rear. When these pairs of basic yarn met, one pair over the instep and the other at the back of the heel, they were fastened and terminated by being tied together with a square knot.

Type B

The moving ends cross. One element goes to the ankle and is anchored there, after which it passes around the heel to the opposite side of the ankle, where it is anchored again and from there it then continues toward the toe end at the side of the instep to meet the end of the other element, to which it is tied with a square knot and thus terminated.

Type C

As in Type F, the moving ends emerge at the toe and cross. Each is carried backward to the ankle and there anchored by being run through the lateral warp. From there, each goes around the heel to the front of the ankle, where both are fastened and terminated by being tied together with a square knot over the instep.

Type D/B

This was once thought to be a discrete type; now there is considerable doubt as to its cultural separateness, and it has not been included in the counts. Empirically, it is a combination of Types D and B: there are square knots attaching the ends of two elements at both the heel (as in Type D) and the side of the instep (as in Type B)—and sometimes at other places as well. It is possible, even probable, that these ties represent nothing more than ties of Types D and/or B that have been mended after one or more breaks. More comparative data are needed before their true nature can hope to be determined.

Type E

The moving ends cross and, as with the other types in Class 2b, one of them is fastened and terminated at the ankle by being run through the warp and stoppered on the bottom by an overhand knot. The other element is anchored at the opposite side of the ankle, from where it is carried around the heel to be fastened and terminated by being tied around the other element at the instep with overhands or half-hitches, sometimes together in sequence.

Type F

The moving ends cross just after they emerge on the foot surface near the toe of the sandal. Each end goes to the ankle, where one is anchored by being

Table 7-2. Association of Non-Crossing and Crossing Type G Sandal Ties with Two-Warp and Three-Warp Plaited Sandals from Frightful Cave (CM68).

Sub-Type	Non-Cross	Cross	Unidentifiable	Total
Two-Warp (F1ai)	10	9	2	21
Three-Warp (F1aii)	18	0	1	19
Unidentified (F1a)	0	0	14	14
Total	28	9	17	54

run through the lateral warp, stoppered by an overhand knot on the bottom, and thus terminated. The other moving end, after being anchored at its side of the ankle in one of several ways, continues around the heel, under and then over the other strand at the ankle, then over the instep to be fastened and terminated by an overhand knot around its own first segment. Sometimes a second knot, to serve as a stopper for the first overhand knot, is tied at the very end of the tie.

Type G

On 28 (52%) of the 54 recognized examples of this type, the ties do not cross at the toe, on 9 (17%) they do cross, and for the remaining 17 (31%) nothing can be specified because of the condition of the specimen. There is also a 100% association between noncrossing ties and three-warp sandals (Table 7-2). As for the remainder of the tie, one element was carried to the ankle, where it was fastened by being run through the lateral warp, stoppered with an overhand knot on the bottom surface, and thus terminated. The other strand, after being anchored at the ankle by being run through the warp, passes back of the heel to the other side, around the other element, and around again back of the heel to its original side where it is fastened and terminated by being tied to itself with multiple knots, usually two half-hitches ended by one or more overhands, sometimes including a last, tightened overhand as a stopper knot. The consistent character of this tie, particularly in regard to its noncrossing toe tie, its terminating knots, and its strong associations with three-warp plaited sandals, is especially notable and would appear to indicate some significant cultural connections, not merely the "normal" variation in a technique of manufacture.

Sandal-tie types have strong and meaningful chronological associations. The basic data are presented in Table 7-3, where the maze of figures may be difficult to digest and interpret. However, when the figures are arranged according to the major classes defined above and according to the stratigraphic position of the largest plus-deviation of each type, a remarkable picture develops, as is shown in Table 7-4. Here it is easy to see that the progression of deviations within each tie type with due regard for magnitude is orderly without exception. The progression of the major classes is also orderly, from those with their largest plus-deviation in the Bottom Level to those with it in the Middle and then the Top Level, i.e., from Class 1 to Class 2a to Class 2b. It seems that this is too much to attribute to mere chance and that they validate the classification and the reality of the temporal sequence it portrays.

On these assumptions, then, it seems possible to make further inferences based on sandal ties and the sandals on which they occur (cf. Tables 7-1, 7-4). In the first place, we see that in the Bottom Level there are two quantitatively dominant types of sandal tie, each associated 100% with a single type of sandal. In other words, we appear to have evidence for two distinct traditions of sandal making, not two variations within a single tradition. Since one of these traditions (the twill-pad sandal and its Type-A tie) disappeared by Middle-Level times and since the other (two-warp plaited sandal, sub-Type F1ai, and Class-2 ties) con-

Table 7-3. Summary Table of Sandal Ties from Frightful Cave (CM68).

	A			B			C			D			E			F			G			Total
	#	%	MMd	#	%	MMd	#	%	MMd	#	%	MMd	#	%	MMd	#	%	MMd	#	%	MMd	
Top	-	-	-31	2	6	-25	-	-	-31	2	29	-02	11	55	+24	58	59	+28	35	66	+35	108
Middle	1	5	-30	9	29	-06	9	82	+47	4	57	+22	8	40	+05	38	38	+03	18	34	-01	87
Bottom	21	95	+61	20	65	+31	2	18	-16	1	4	-20	1	5	-29	3	3	-31	-	-	-34	48
Total	22			31			11			7			20			99			53			243

Table 7-4. Stratigraphic Ordering of Master Maximum Deviations of Sandal-Tie Types (from Table 7-3.)

	Type-F1b Sandals	Type-F1a Sandals					
	Class-1 Ties	Class-2a Ties			Class-2b Ties		
Tie Type (# of ties)	A (22)	B (31)	C (11)	D (7)	E (20)	F (99)	G (53)
Top	-31	-25	-31	-02	+24	+28	+35
Middle	-30	-06	+47	+22	+05	+03	-01
Bottom	+61	+31	-16	-20	-29	-31	-34

tinued and increased until the cave was abandoned, we have reason to suspect that we are also observing a difference in culture that is more basic than one merely affecting "sandal culture." In the second place, Table 7-4 points strongly to the possibility that there was a gradual but definite diversification of sandal ties (as there was in sandal types). This happened on Type-F1a sandals exclusively, as far as we can witness now. In the Bottom Level, there was one dominant type of sandal tie, two in the Middle Level and by Top-Level times there were three, that is, as many as there had been in the two lower levels combined over a temporal span of nearly 5000 years. If this picture is correct, then we have more conjunctive and supportive evidence for the cultural disjunction that can be glimpsed in other aspects of culture, beginning around 2000 B.C., at the start of Top-Level times, and of the growing climatic desiccation and accompanying nomadism.

SANDAL-TIE MATERIALS

The materials of which sandal ties were made are presented in Table 7-5, where they are conjoined with the sandal types on which they are found. Several associations are apparent: lechuguilla ties are more common on sandals in which lechuguilla is also the more common material of manufacture: pad sandals (Types F1b, F1c, F1d) and Type F1a (see Table 7-6). Although the total number of specimens with lechuguilla ties is relatively small, sandals of sub-Type F1ai have different deviations in relation to levels than do those with zamandoque ties. This evidence is far from conclusive due to the small number of specimens involved, in most cases, but it is still possible to accept as a working hypothesis the inference that the idea (culture trait) of using lechuguilla for both sandals and sandal ties was taken from the already well-developed, very probably foreign, twill-pad sandals (Type F1b) and applied to the plaited ones (Type F1a). Later, when the twill-pad sandals disappeared, some of the ties on plaited sandals continued to be made of lechuguilla. However, the virtually exclusive use of zamandoque for both bodies and ties of plaited sandals throughout the occupation of Frightful Cave suggests that this combination of material and style was the "native" one. Also one gets the impression that neither the early, pad-sandal types (F1b, F1c, and F1d) nor the contemporaneous and later types (warp-frame plaited Type F1a, and braided Type F1e) were experimental, representing early stages of development or the primal search for the most suitable material.

The fact appears to be that all sandal types were well established and the best materials were already discovered by the time we first viewed the cultural record in the Cuatro Ciénegas Basin. There are two alternative implications of this: either that there are yet undiscovered and/or unexcavated sites in the basin, occupied earlier than about 7000 B.C., where the people lived who were searching for, and experimenting with, acceptable sandal designs and materials, or that those early trials took place in

Table 7-5. Materials of Manufacture for Sandal Ties from Frightful Cave (CM68).

	Sandal Types							
Tie Material	F1ai	F1aii	F1b	F1c	F1d	F1e	F1f	Total
Zamandoque	626	30	-	-	-	5	-	661
Lechuguilla and Lechuguilla +	59	1	22	1	2	-	-	85
Sotol	1	-	-	-	-	-	-	1
"Maguey"	1	-	-	-	-	-	-	1
Yucca sp.	-	-	-	1	-	-	-	1
Unidentified	1	-	-	-	-	-	-	1
No ties	160	5	20	5	16	-	2	208
Total	848	36	42	7	18	5	2	958

Table 7-6. Association of Sandal-Body Material with Sandal-Tie Material for Plaited Sandals (F1a) from Frightful Cave (CM68).

Tie Material	Body Material			Total
	Zamandoque*	Lechuguilla*	Sotol	
Zamandoque	654	6 **	1	661
Lechuguilla	13	43 ***	-	56
Sotol	-	-	1?	1?
Total	667	49	2	718

*Counts for lechuguilla and zamandoque body materials are based on specimens made predominantly of the named material, but they may also have smaller amounts of other materials.

**Included here is one specimen made almost entirely of lechuguilla but with its ties at the left ankle of zamandoque, the rest of the tie being of plied yarn made of lechuguilla.

***Included here is one specimen described in the laboratory note as having ties of "maguey?", which could be of *Agave lechuguilla*, not *Agave* sp., cf. maguey.

some other area—but one not unlike the basin and specifically one where lechuguilla and zamandoque grew in quantity at a date earlier than around 7000 B.C.

Examining these associations somewhat further, specifically in regard to plaited sandals, Type F1a, we find that there is a correspondence between material used for the body and material used for ties on the same sandal. Table 7-6 shows that 98% of zamandoque-bodied sandals have zamandoque ties, while 88% of lechuguilla sandals have ties of lechuguilla —and 12% have zamandoque ties. This concord of body and tie material also carries the implication that the lechuguilla association is not quite as strong as that of zamandoque. Then, when it is remembered that the latter appears to have been the "native" standard, while the former was perhaps an imported one, the difference becomes conjunctive and supportive.

Accordingly, we may offer the working hypothesis that it is the result of old custom maintaining itself in the face of new custom. When the MMds of the six plaited sandals with lechuguilla bodies and zamandoque ties are calculated (Top +02; Middle +15; Bottom -17), they turn out to be just what might be expected in the light of this working hypothesis: unusual at the beginning, most common in the Middle, by which time the influence of the twill-pad sandals had taken hold, and fading away in Top-Level times, when there was little if any of the twill-pad influence remaining.

When we examine the comparable data for sandals of other types, the same general picture develops. Of the two examples of sandal Type F1c that retain ties, one is entirely of yucca, both body and ties, and the other entirely of lechuguilla. The two specimens of Type F1d having ties are of lechuguilla throughout, although the sewing element of one is of zamandoque. All five specimens of sandal Type F1e are entirely of zamandoque. Thus with the inconsequential exception of the sewing element of the body of one sandal, there is 100% conformity between materials of body and ties among all specimens of these types from Frightful Cave.

Among the specifications of sandals from other sites, we find the same situation. From Fat Burro Cave, the bodies of all the 38 plaited (Type F1a) sandals are of lechuguilla and, on all the 20 sandals that retain them, the ties are also of lechuguilla. Among the 28 twill-pad sandals (Type F1b), 17 are all lechuguilla (bodies and ties) and one has a pad of sotol, padding of lechuguilla, and its one remaining tie is of "maguey" (possibly lechuguilla); of the 10 specimens having no ties, nine have bodies of lechuguilla and one of sotol. Among the sewed sandals (Type F1d), one has both pad and sewing of lechuguilla with ties of two-ply, z-twist lechuguilla yarn, but with its heel segment of rawhide tied to the fiber cord; the remaining three have bodies of "lechuguilla or maguey," one of which has no ties remaining and the other two having both sewing elements and ties of "maguey" (possibly lechuguilla). The one specimen of sandal Type F1e from Fat Burro Cave has a body of yucca and ties of "*Agave* sp." (possibly lechuguilla). From CM65, of the six two-warp plaited sandals (sub-Type F1ai), five are all zamandoque, and the sixth has warps and wefts of that material but padding and ties of lechuguilla; of the eight plaited sandals (Type F1a), four are all zamandoque, two are all lechuguilla, one is all "maguey," i.e., a "soft, fuzzy" agave (and therefore possibly a somewhat deteriorated lechuguilla), and one specimen has a zamandoque body and lechuguilla tie. The one specimen of twill-pad sandal (Type F1b) is entirely of lechuguilla. From CM74, the one plaited sandal (Type F1a) has a lechuguilla body but no ties, and the three two-warp plaited sandals (sub-Type F1ai) are entirely of zamandoque. In all the above, we see again the tendency of body and tie material to be the same, with remarkably few exceptions. It is to be regretted that we have been unable to obtain a computerization of the full range of descriptive and provenience data with a view to revealing conjunctives that might lead us to a better understanding.

Tables 7-7 and 7-8 present the data from Frightful Cave on materials of manufacture of ties and bodies of the 22 twill-pad sandals (Type F1b) that have describable ties. The concordance between materials of the several parts of the sandals is immediately noticeable. With only one exception, all 10 ties that are complete have all three parts of the same material; the one exception has toe ties of crude zamandoque cordage, while the ankle ties are of plied lechuguilla fiber. Of the 22 bodies, both pad and padding are of the same material in all but five specimens (one additional sandal whose pad is of lechuguilla has padding that is approximately half lechuguilla and half zamandoque); as we might expect, since both were (and had to be) installed in a single operation, the instep and heel ties

Table 7-7. Association of Materials of Manufacture in Ties and Bodies of Twill–Pad Sandals (F1b, N=22).

	Ties			Body	
Number	Toe	Instep	Heel	Twill pad	Padding
F371	L 2/z	-	-	L	Z > L
F445	L 2/z	-	-	L	L
F591	L f	L c	L c	L	Z > L
F592a	-	L c	L 2/z	S	S
F615a	-	-	L 2/z	L	L
F615b	L c	L 2/z	L 2/z	L	L
F627	-	-	L 2/z	L	L
F741a	-	L 2/z	L 2/z	L	L > Z
F741b	-	L 2/z	L 2/z	L	Z > L
F810	-	L 2/z	L 2/z	L	L > Z
F918b	Z c tw	L 2/z	L 2/z	Z	L
F1017	L f	L 2/z	L 2/z	L	L
F1021	L 2/z	L 2/z	L 2/z	L	L
F1023	L c	L 2/z	L 2/z	L	L
F1087	L 2/z	-	-	L	L
F1130	-	L 2/z	L 2/z	L	L > Z
F1134	L 2/z	L 2/z	L 2/z	L	L
F1141	-	L c	L c	L	L
F1150	L c	L 2/z	L 2/z	L	L
F1153b	L c	L c	L c	Z	L
F1293	L c	L c	L c	L	L
F1296	-	L 2/z	L 2/z	L	L
Summary of Materials					
Lechuguilla	12 (92%)	17 (100%)	19 (100%)	19 (86%)	18 (82%)
Zamandoque	1 (8%)	-	-	2 (9%)	3 (14%)
Sotol	-	-	-	1 (5%)	1 (5%)
Unidentified	9	5	3	-	-
Summary of Manufacture					
L 2/z	X	X	X	2	
"	-	X	X	6	
"	-	-	X	2	
"	X	-	-	3	
L c/f	X	X	X	3	
"	X	L 2/z	L 2/z	4	
"	-	X	X	1	
Z c	X	L 2/z	L/2z	1	
	13	17	19	22	

L = lechuguilla
Z = zamandoque
S = sotol
2/z = two-ply, z-spiral
c = crude cordage
f = untwisted fibers
tw = twisted fibers

Table 7-8. Summary of Table 7-7, According to Technique of Manufacture of Ties

Toe Tie			13
not plied		8	
	with plied ankle ties 5		
	with no ankle ties 3		
plied		5	
	with plied ankle ties 2		
	with no ankle ties 3		
No toe tie			9
			22
Ankle ties (instep and heel)			17
both ties plied	13		
both ties crude	4		
Only heel tie (plied)			2
No ankle ties			3
			22
All three ties same (toe, instep, heel)			5
not plied	3		
plied	2		

are in 100% agreement in the matter of the materials. But there is also virtually perfect concordance among the distinct and separately installed toe ties, there being only one variance out of 13 possibilities. As regards the bodies of the sandals, the variation seen among padding elements is slightly greater than in the twill-pad, probably because the latter was made as a unit and would have been very difficult, if not impossible, to repair or otherwise alter when it had once been incorporated into the sandal. Padding and ties, in plaited sandals, on the other hand, could have been added to or changed virtually at will and with almost any material that came to hand.

It is perhaps supportive of the concept of "traditional" or "best" materials that there was not actually more variation, at least in the padding and toe ties, than our records show. Thus, we arrive at the generalization and working hypothesis that the relative complexity and technological demands of the twill-pad and possibly the ankle (instep/heel) ties induced a closer adherence to a "norm," while both padding and toe ties are more varied because of their somewhat less complicated manufacture and consequent greater ease of replacement and change.

There is one specimen that carries in it what may be an answer to at least one uncertainty implicit in the above discussion: the toe tie on a twill-pad sandal from Frightful Cave, CM68 (Block F-22, Bottom Level), is the continuation of a sinistral of the pad itself and is, therefore, of untwisted lechuguilla fibers, not plied yarn. It also demonstrates that the tie is an integral part of the pad and was made along with it at the time the sandal was made—it could not have been a later mend or replacement. Although this evidence is meager, its interpretation is beyond question: the only toe tie that we can be sure is an original part of one of the earliest twill-pad sandals is of "crude cordage" and is associated with ankle ties also of "crude cordage." Therefore, until we have equally conclusive evidence pertaining to ties of plied yarns, we may make the tentative inference that ties of crude cordage were an original norm, possibly the original norm, for the toe ties of twill-pad sandals.

However, we do have some evidence relative to the use of plied yarns in the ties of these early sandals and, while it may not be as conclusive as that pertaining to untwisted fibers, as discussed above, it is suggestive and probably worth putting into the record. With the exception of one example that may be from the Middle Level, all twill-pad sandals from Frightful Cave

came from the Bottom Level. This means that at the very earliest times of which we have record, of the 66 possible ties on these 22 specimens, 17 are missing and, of the remaining 49 ties, 33 are of plied yarn and only 16 of crude cordage. In other words, there are slightly over twice as many of the former as of the latter. Taken at face value, this would appear to indicate that plied yarns were the "norm." But the problem is that we have no way of telling whether the ties of plied yarns are the original ones or are replacements for worn ones that may have been of untwisted fibers. And so, while we do not have enough evidence to state flatly that plied yarns were indeed the norm, we do have enough to make us cautious about pronouncing that those of untwisted fibers were the norm, as it seemed they might have been after our analysis above of the sandal from CM68, Block F-22, Bottom Level.

It is entirely possible that, when twill-pad sandals first appeared in the Cuatro Ciénegas basin, it was the custom to install ties of either (or both) kinds. Further, in view of the fact that the contemporaneous two-warp plaited sandals were made almost exclusively with ties of crude zamandoque, it may be that there was a culture exchange that put a few ties of crude zamandoque on twill-pad sandals and a somewhat larger number of ties of plied lechuguilla yarn on those of the two-warp plaited type. In fact, when we assemble the conjunctive evidence, it seems that, with the addition of a bit of culture theory, we have a pretty good case for just such an inference. In the first place, the pad sandals (Types F1b, F1c, and F1d) made predominantly of lechuguilla fiber and with sandal ties of Type A, fashioned of plied yarns also of lechuguilla, comprise an obvious, distinctive, and novel complex, both culturally (technologically) and chronologically. In the second place, when two definitive characteristics of a complex theretofore unknown locally, such as the use of lechuguilla fiber and of plied yarns in sandal making, suddenly appear as minor variations on sandals of another, equally distinctive, and patently more indigenous type, it seems justifiable to infer that we are seeing the result of an idea transfer between two disparate culture traditions, not the evolution of new cultural forms through internal variation. When we add to this the evidence of other transient and apparently anomalous forms associated in the Bottom Level of Frightful Cave, certain kinds of coiled basketry (James M. Adovasio, personal communication), round and self-pointed wooden atlatl dart foreshafts, the formal and technological characteristics of early stone projectile point types, it becomes increasingly likely that during the early occupation of Frightful Cave there existed what we can best describe as "foreign" cultural influences upon the local cultural expression, i.e., the Coahuila Complex (Taylor 1966: 63ff.)

Further evidence in support of the above inference is found in the comparative distribution of twill-pad and plaited sandals: those that are predominantly (or entirely) made of zamandoque and those that are predominantly (or entirely) made of lechuguilla. Table 7-9 presents the data. When we examine this table, it is apparent that there are several consistent relationships between kinds of sandal and areas of the site and also among the three kinds of sandal. But before discussing these in detail, a short digression may help to explain why a large plus-deviation in one category does not mean that its "raw" frequency is necessarily larger than that of another category with a smaller plus-deviation, or even a minus one. What it does mean is that the unit-of-excavation-frequency of the one category comprises a larger percentage of all specimens of that category from that site than does the frequency of the other category. This is to say that the MM deviations are measures, not of raw quantity, but of relative concentration.

A specific example may help clarify this matter. In the Bottom Level of the "total" column at the far right of Table 7-9, sandal Type F1b shows a MM deviation of +64, while Type F1a(L) shows a -14 and Type F1a(Z) a -19. The order of these figures, from left to right, goes from the largest plus-deviation to the largest minus-deviation, in other words from the heaviest concentration to the lightest. But the order of magnitude of the actual frequencies upon which these deviations are based is quite different: Type F1a(Z) has the largest frequency with 81, next comes Type F1b with 41, and last is Type F1a(L) with only 9 specimens from the Bottom Level. The discrepancy between these two orders lies in the differential sizes of the total populations of which the Bottom-Level samples are parts. For example, the total population of Type-F1b sandals in Frightful Cave numbers a mere 42, while that of Type F1a(Z) is 546! This means that

Table 7-9. Comparison of MM Deviations of Twill-Pad Sandals (F1b, Bodies and Plied Yarn Ties Both of Lechuguilla) and Two Varieties of Plaited Sandals (F1a, Predominantly Lechuguilla Bodies and Ties [L] or Predominantly Zamandoque Bodies and Ties [Z]) from Frightful Cave (CM68).

	Front			Center			Back			Passage			Total		
	F1b	F1a (L)	F1a (Z)	F1b	F1a (L)	F1a (Z)	F1b	F1a (L)	F1a (Z)	F1b	F1a (L)	F1a (Z)	F1b	F1a (L)	F1a (Z)
Top	-10	-01	-01	-12	+02	+14	-04	+05	+01	-05	+02	00	-31	+07	+14
*		F1a(Z)=F1a(L)			F1a(Z)			F1a(L)			F1a(L)			F1a(Z)	
Middle	-14	-05	-04	-10	-01	-05	-04	-04	+01	-04	+15	+14	-33	+07	+05
*		F1a(Z)			F1a(L)			F1a(Z)			F1a(L)			F1a(Z)	
Bottom	-04	-16	-15	+20	-09	-10	+21	+06	+01	+26	+06	+04	+64	-14	-19
*		F1b			F1b			F1b			F1b			F1b	
Total	-27	-21	-19	-03	-10	-02	+13	+07	+04	+17	+24	+18	F1a(Z) = 546		
		F1a(Z)			F1a(Z)			F1b			F1a(L)		F1a(L) = 45		
													F1b = 42		

*The symbols in the second row indicate which kind of sandal predominates in that Sector/Level based on MMd.

the 41 specimens of F1b sandals in the Bottom Level represents 98% of its total population of 42, while the 81 Type-F1a(Z) sandals are only 15% of its total population. Deviations are thus considered to be parameters of concentration inasmuch as they combine factors of both quantity and space. This is to say that if 98% of Type F1b but only 15% of Type F1a(Z) are contained within an equal spatial compass, in this case the Bottom Level of Frightful Cave, then the proportional representation of the former is greater than that of the latter, 98 to 15, and the MMds are +64 to -19. But these concentrations are not merely physical, because quantity is a cultural factor, being derived from a culturally defined population.

It follows from the above that the purely physical factors in these parameters of concentration, the MM percentages (see Chapter 4), serve primarily, if not entirely, as a "culture-free" control to permit comparisons of MMds within and between units of excavated cultural debris and matrix. And this brings us to the final point in this explanation: the differences between the sizes of units of archaeological provenience and between the sizes of specimen populations, that is the difference, say, between the cubic meterages of the Bottom and Middle Levels of Frightful Cave and/or the difference between the total frequencies of twill-pad and of plaited sandals, are compensated for by the use of percentages and the practice of adding the space and frequency parameters together, with due regard for sign, to derive the MMd. This technique has the purpose and advantage of freeing the major premise of the pesky problems of differential size and frequency in units of archaeological excavation and in populations of culture-connected finds.

Returning now to the culture-historical interpretation of Table 7-9, it is immediately apparent that the subscript letters in each Level-Sector square present certain patterns. But since the multiplicity of raw data may be confusing, an abstraction has been made from this table and is presented below as Table 7-10. Looking first at the two left-hand columns depicting chronological relationships between twill-pad sandals (Type F1b) and the two varieties of plaited sandals (Types F1a[Z] and F1a[L]), we see that all three were present in the Bottom Level. We also see that the order of magnitude of the MMds in that level runs from the very large plus-deviation of Type F1b, to the fairly large minus-deviation of the zamandoque variety of F1a, with the smaller minus-deviation of the lechuguilla variety lying between the two.

This order of magnitude is in conformity with our hypothesis that the use of lechuguilla in sandal making and Type-A sandal ties of plied yarn were introduced in Bottom-Level times through the agency of the twill-pad sandal. On such a premise, it follows that the concentration of lechuguilla-made sandals (if not necessarily their actual frequency) would be greater at a time when twill-pad sandals were also in greater concentration. Once the twill-pad sandals disappeared in Middle-Level times what appears to have happened is entirely expectable: that their influence should wane and that, although both varieties of plaited sandal might increase, it would be the lechuguilla variety that would increase least, because the immediate impetus of the lechuguilla-made, twill-pad sandal would have been lost. The F1a(Z) variety of plaited sandal continued to increase during Top-Level times, but the lechuguilla variety increased less, thus widening the quantitative gap between the two varieties of Type-F1a sandals.

In other words, what seems to have happened is that warp-frame, plaited sandals were present during the earliest epoch of the occupation of Frightful Cave. At that time, however, outside influences introduced the idea of twill-pad sandals of lechuguilla. Some of the local sandal-makers took over both of these traits, while continuing to manufacture their usual form of sandal. I believe that the long continuity of plaited sandals and their quantitative superiority even in Bottom-Level times essentially eliminates the possibility that it was twill-pad sandal-makers who actually made the specimens of lechuguilla warp-frame plaited sandals with Type-A ties. Taking all of the above into consideration, a working hypothesis may be proposed: The culture history of twill-pad and plaited sandals at Frightful Cave indicates the more conservative nature of the style and technique of manufacture when compared with material of manufacture. This is because, in the face of a definite if somewhat tentative inclination toward the use of a new material, the basic pattern of plaited sandals and their ties as well as the techniques of their manufacture did not change at all. And this was the case from beginning to end of the occupation of Frightful Cave, a span of over 7000 years.

The information conveyed by the third column of Table 7-10 adds little but support to the picture

Table 7-10. Distribution of Master Maximum Deviations of All Types of Sandals, by Levels and by Combined Sectors.

	Sandal Type		
Level	F1a(Z)* F1a(L)*	F1a(L)* F1b	F1e F1d F1c
Top	+14	+07	+69
	+07	-31	-03
			-31
Middle	+07	+04	-35
	+04	-33	+26
			+22
Bottom	-19	-14	-34
	-14	+64	-23
			-09

	Sectors	
Sandal Type	Front and Center	Back and Passage
F1e	-73	+73
F1d	-23	+23
F1c	-59	+59
F1a(L)*	-31	+31
F1a(Z)*	-21	+21
F1a(L)*	-31	+31
F1b	-30	+30

*Type F1a has been broken into two varieties based on material of manufacture: Z = zamandoque, L = lechuguilla.

already developed from the preceding two columns. Both Types F1c and F1d are pad sandals made largely or entirely of lechuguilla, with Type-A ties, when any ties remain. These were distributed from Bottom to Top Level but they were concentrated in the Middle Level. The checker-pad sandal, Type F1c, is obviously an only slightly modified variety of the earlier twill-pad sandal. The subsequent position of its concentration does nothing to contravene this hypothesis; other than being a pad sandal, there is nothing in Type F1d, the sewed sandal, that would suggest close relationship with the twill-pad type, although its material of manufacture, its ties, and its distribution are similar to the latter and are thus both suggestive and permissive. The braided sandals, Type F1e, are quite distinct from any of the others. For this reason and, because of their stratigraphic position, they appear to have been not a native development but an introduction either of idea or of article. The deviations in the two columns at the right of Table 7-10 do little to advance our understanding of culture history, but they do emphasize the strong localization of the sandals within Frightful Cave and support the inference that the majority of the specimens recovered from Frightful Cave had been abandoned and relegated to a "dumping area." Also, their consistency and uniformity of (large) size lend credence to their identities.

Before leaving this topic, another set of correlations is presented. Of the eight two-warp plaited sandals that have ties of plied yarn, four have bodies of zamandoque and four of lechuguilla. Of the former, three are Middle and one is Top Level, while of the latter, two come from each of the Middle and Top Levels. The one three-warp plaited sandal with ties of plied yarn is also the only one of its type that has a body of lechuguilla (except for a few elements of zamandoque) and is one of the five specimens from the Middle Level, thus making it one of the earliest specimens of the three-warp subtype. In both of these aspects of this sandal, we see a change in the usual material and a provenience that is at the earliest end of its temporal range. Taken separately, these data would probably not be regarded as of much significance. However, taken in conjunction with the data pertaining to the twill-pad and the two-warp plaited sandals, the interpretations are all mutually supportive without procrustean accommodation. This complex of data is conjunctive, i.e., in agreement, and therefore can probably be considered significant.

CONSTRUCTION TECHNIQUES IN MANUFACTURING SANDAL TIES

The padding of the large majority of plaited sandals covers the toe ties on the bottom of the sandal, suggesting the probability that ties were put in after the warp frame had been completed but before the padding was installed. However, there are a number of specimens with full padding, but without signs of wear or any trace of toe ties. This suggests these sandals were new (not used ones awaiting repair), on which ties were to have been installed after the padding. We were able to discover no data that would provide an explanation for this difference in technique of manufacture and at present look upon it as merely a "normal" variation of technique. If this is so, it would be interesting to know how many other such variations there were in the manufacture and use of sandals, with a view to assessing the relative stability/instability of sandal culture in comparison with the situation in other spheres of ancient culture in Frightful Cave.

We already have some data suggestive of such "normal" variation in the culture of stonework in northern Coahuila and possibly in other cultural spheres as well (e.g., Taylor 1983: 108, 119 inter alia). There is also evidence that at least one tie was installed, neither before nor after the padding, but at the same time (see above): the single toe tie is a continuation of a padding element. It is possible, of course, that both padding and tie were renovations, not part of the original construction. But we could find no evidence for this possibility. Most ties are of a single element made up of a single strand of crude cordage, but there are 1 four-strand tie, 4 of three strands, and 26 of two. Some of the latter may originally have been a single strand that later split apart, but we found no evidence of this and probably cannot expect to do so without destructive examination. Usually the two moving ends of the toe ties were run through two holes, quite certainly made with some sort of awl and, when they emerged on the top or foot side of the sandal, were crossed and brought to the vicinity of the ankle. On 10 sandals, the majority from the Middle Level, both ends were put through a single hole.

There are other ways in which the toe ties were handled. Two sandals, which may be a pair (they came from the same block and are themselves identical while being markedly different from other sandals), have their toe ties running around the toe, not through. They are of two strands, stoppered on the bottom by an overhand knot on each strand, run up through the padding to the top, then around the toe to the bottom again, up through the body a second time, and from there to the ankles; the sandal is worn on both surfaces, suggesting that it had been reversed; the toe is worn off, suggesting why reversal and repair had been necessary. Both of these conditions point to the possibility that these ties were secondary adjustments and not a formal tie type. They are so unusual they may hardly be considered a "normal" variation. Instead they are best viewed as the result of some "special cause." One specimen had the starting loop of the toe tie on the top, unworn surface, not on the bottom as usual, suggesting that the sandal had been reversed—except for the fact that there is no further corroborating evidence for this. There are six plaited sandals with toe ties that are neither looped nor knotted but threaded through the padding parallel to the long axis of the sandal and thus held (by friction) without being more firmly anchored. This same technique was used for three of the five ties of braided sandals, Type F1e.

There are 10 sandals, having clear and unmistakable depressions resulting from pressure of the toes during use, that provide evidence on the relationships between ties and toes. On all of them, the holes for the toe ties lie at approximately the midpoint between the big-toe and the small-toe depressions. On five of them, there is a single, small-toe depression immediately anterior to and between the tie holes, indicating that one tie passed between the big toe and the next, and the second tie between the latter and the one next to it. On still another specimen, there are two small-toe depressions, each immediately in front of a tie hole. We tried to make a study of the toe ties on sandals of present-day users around Cuatro Ciénegas, but the study did not produce evidence that was very comparable or very enlightening for our understanding of sandal use or typology: there was too much variation and/or our sample was too small.

A quantitative analysis of other toe-tie characteristics provided bases for further cultural inference. Table 7-11 presents the data. Taken in pairs, the six characteristics generate 12 permutations: Each is discussed below to bring out some of the possibilities of technology and use implied by the data. But first it will be

Table 7-11. Associations among Various Characteristics of Toe Ties on Plaited Sandals (F1a) from Frightful Cave(CM68).

	Single/Double			Through/Not Through			Worn/Not Worn		
	S	D	?	S	D	?	S	D	?
Single	445	-	-	75	13	13	67	10	24
Double	-	65	-	95	2	3	63	6	31
?	-	-	184	-	-	-	-	-	-
Through	332	62	-	394	-	-	85	8	8
Not Through	56	1	-	-	66	-	6	26	68
?	57	2	-	-	-	134	-	-	-
Worn	297	41	-	334	4	-	338	-	-
Not Worn	43	4	-	30	17	-	-	47	-
?	105	20	-	30	45	-	-	-	200

Single consists of one element, which may be of from one to four strands.
Double means that there are two separate elements.
Through and Not Through indicate whether or not the toe ties were found exposed on the ground surface of the sandal.
Worn and Not Worn specify whether or not the fibers of the toe ties show appreciable wear.

well to re-state a working hypothesis upon which the discussion is based: It was the usual practice to install the original ties of plaited sandals using a single element and starting at the toe end of the fabric.

75% of single ties "through"
95% of double ties "through"

Whatever else we may be able to say it is certain that the single-element tie was the most common. The double-element tie was much less common, but a significantly larger percentage of them appear exposed on the bottoms of the sandals. Since there appears to be no reason for believing that double ties wear through padding more often or more rapidly than do single ties, it is probable that the former were more often exposed on the sandal bottoms from the very beginning. In other words, it seems probable that single ties were used in the primary installation and double ones, when they were used at all, were used almost entirely as replacements.

13% of single ties "not through"
2% of double ties "not through"

On the basis of the hypothesis of the last paragraph, it is concordant that single ties should have a larger percentage of their number not through than do the double ones. As part of the original installation, single ties were placed beneath the padding and were exposed only after an appreciable amount of wear, while the double ties were more often used as replacements and were thus exposed from their very inception. Of course, this interpretation means that both single and double ties that are not through were located under padding that was either part of the original construction or was replacement for padding that had become worn.

67% of single ties "worn"
63% of double ties "worn"

There is probably not much, if any, significance to the small difference between these two percentages, but again their relationships remain concordant: Sandals that had already gone through one set of single ties and then had received a replacement set of double ties might be "used up" and abandoned before the double ties became notably worn.

10% of single ties "not worn"
6% of double ties "not worn"

Again the percentage difference is small, being quantitatively the same as between worn ties and with the same relationship, i.e., a few more single ties not worn.

If these percentages mean what they seem to, it would appear that being originally under padding and being relatively new replacements result in approximately the same amount of wear and nonwear upon sandal ties. It must be said, however, that this interpretation carries little weight because of the small number of specimens involved.

85% of worn ties "through"
6% of worn ties "not through"

One might expect that worn ties should be "through" because being through is what exposes them to wear.

8% of "not worn" ties "through"
26% of "not worn" ties "not through"

This is the reverse of the above permutation and is just as expectable: a larger percentage of ties that have little wear are that way because they have been protected by not being through the padding and exposed to friction with the ground. Ties that show no wear and yet are through and exposed are inferred to have become exposed recently enough to have suffered little or no wear.

Although the above study and report may seem to be an exercise in the obvious, I thought it worthwhile to publish them in order to establish yet more firmly the internal consistency of both the data and the method of analysis and to show that they are not contradictory, but both conjunctive and supportive of inferences as to aboriginal techniques of manufacture derived from other data.

Details of the construction of both sandals and ties indicate that on many specimens at least some of the padding had been installed before the ties were brought from toe end and anchored at the ankle. This means that tie elements were first threaded through the warp frame (and any padding that was there) up through the toe end from bottom to top, and then allowed to remain free and unattached during the process of filling out most, if not all, of the padding. One of the reasons for believing this is because not a few specimens have the ankle tie anchored by being passed around a padding element. Consequently, the ties for almost their full length were left dangling, and we can surmise that this was not a very efficient or handy way by which ties could be placed beneath the padding and thus given much-needed protection. We believe that the latter concern was the reason for the sequence of sandal and tie construction that is evident from the data.

Another line of analysis proved inconclusive. However, on the chance that other archaeologists may have reason to study such matters, a brief presentation is made. Perhaps these data will suggest approaches and topics for investigation by other workers at other sites. Table 7-12 presents the data. On the tentative, working hypothesis that toe ties passed between the big toe and the second, or on each side of the second toe, we set up the test implications that, in order to accommodate the three small toes, the right toe-tie hole of a right sandal would be farther from the right edge than the left hole would be from the left. For a left sandal the reverse would be the case. If this should prove true, then we would have evidence to help in determining the foot for which the sandal had been intended, or if it had been intended for any particular foot. When the data of Table 7-12 are viewed with these hypotheses in mind, the results are not impossible or contradictory but the differences are very small and far from conclusive.

Another analytic gambit using these data was designed to conjoin the measurements of various sandal segments with those taken from corresponding human skeletal parts. This was done with the hope that any resulting coincidence would help us in making inferences regarding such matters as foot contour and size (thus helping with demographic studies, e.g., age and sex ratios) and wear patterns (suggesting motor habits, handedness, use of footgear inside and outside the cave). But our recovery of pertinent skeletal material was much too limited to give us the information we needed. Also, the lack of comparable data from other sites and areas was another factor in our failure to fulfill these intentions. But the curves represented by the figures in the two left-hand columns of Table 7-12 are so "normal" that we feel that our approach is a valid one, whether or not clearly significant information was brought to light. Moreover, the consistency of the data as a whole is certainly encouraging. In fact, such differences as there are, even as small as they are, do not gainsay our hypotheses and lead us to believe that, with more comparative information, some meaningful results might be expected.

One final line of approach and the resulting data are discussed. When analysis moves from the toe ties to the ankle ties (comprising the ties over the instep and the heel ties), we find there are, indeed, two major schemes, as expected: Scheme 1 is diagnostic of Class-2b ties,

Table 7-12. Measurements Used in the Study of Sandal Ties on Plaited Sandals (F1a) from Frightful Cave (CM68).

	Toe Tie Holes				
	L. Hole to L. Margin	R. Hole to R. Margin	Holes to Toe End	Holes to Ankle Ties	Ankle Ties to Heel Loop
All Sandals					
Number	429	425	415	321	128
Range	13–59	12–73	11–66	42–175	42–131
Mean	36.9	36.4	32.6	115.6	83.2
Mode	36, 37 (28)	40 (32)	30, 32 (26)	132 (12)	75, 76 (7)
Median	37	37	32	120	81
Left Sandals					
Number	89	87			
Range	17–59	22–56			
Mean	37	35.2			
Mode	36 (11)	34, 39, 43 (7)			
Median	37	35			
Right Sandals					
Number	103	104			
Range	19–56	21–50			
Mean	38	38.3			
Mode	40 (11)	40 (12)			
Median	37	38			

Note: All measurements are in mm.

wherein one tie is both anchored and terminated at the ankle but the other is merely "anchored" and then continues. Scheme 2 is diagnostic of Class-2a ties, wherein neither tie is terminated at the ankle but both are anchored there and then continue onward to be terminated by being tied together either at the instep or back of the heel. The possible ways of terminating, fastening, and anchoring the ties at the ankle are many, with a host of descriptive differences and associations among themselves and between themselves and other data such as provenience, materials of manufacture, side of foot, and so on. Without a computer to catalog and associate all of these the search for significance would be such a huge undertaking that we have not attempted it.

Instead, the ways of terminating, fastening, and anchoring ankle ties are merely described and some points of significance discussed. Figure 7-2 presents schematic drawings of the types of ankle ties. Since in Class-2b sandal ties (Types E, F, G) only one tie is terminated at the ankle, both Scheme-1 and Scheme-2 ankle ties can be and are actually found on a single sandal, while for Class-2a ties (Types B, C, D) neither tie terminates at the ankle but both continue and therefore the ties must be of Scheme 2. On Scheme-2 ties, the moving end of the strand is manipulated so as to be "locked" by its trailing segment—otherwise there would be no "grip" on the moving or continuing element and the tie would be loose and hence inefficient. It should also be mentioned that Scheme-1 ankle ties are sometimes run through the lower, hidden part of the warp when the warp is of zamandoque, which has a markedly triangular cross section; this almost certainly indicates that the ankle tie was installed before the padding.

Table 7-13 brings together the ankle-tie and sandal-tie types in their quantitative associations. It should be mentioned that the frequencies of association in Table 7-13 represent the number of sandals on which the indicated association occurred, rather than numbers of individual tie associations—because on many sandals there are two ties, which may be of either the same or different types; in fact, on Class-2b ties, where one tie is terminated at the ankle and the other continues, it is a technological necessity that the two ankle ties be different, not merely in type but in series. It is also true, as a comparison of the two right-hand columns makes clear, that some type-identifiable ankle ties were found on sandals whose overall tie types could not be identified.

When we analyze the quantitative data on sandal-tie/ankle-tie associations, we can observe several suggestive details. Out of the 72 possibilities, only six associations are represented by more than 20 instances, and only 7 by more than 10. Furthermore, the six "high frequency" associations are not evenly spread among the sandal-tie types: they are found only in Types F and G, and it is noteworthy that both these types belong to Class-2b sandal ties and are the two most numerous (see Tables 7-1, 7-4). This means that it is the most numerous types that have the most concentrated associations. From this, it seems highly probable that the associations derive from something other than chance. On looking at the quantitative figures for these associations, we find that the differences between the highest number of associations and the next highest is large in Class-2b tie types (Types E, F, and G) and relatively small in those of Class 2a (Types B, C, D). This suggests that the former is a more ancient and/or more integrated technique than the latter, but then it must be remembered that Type B, belonging to Class 2a, is probably the earliest sandal-tie type of all those associated with plaited sandals, Type F1a (see Table 7-4). This circumstance is somewhat of a paradox, and one that we have not yet been able to resolve.

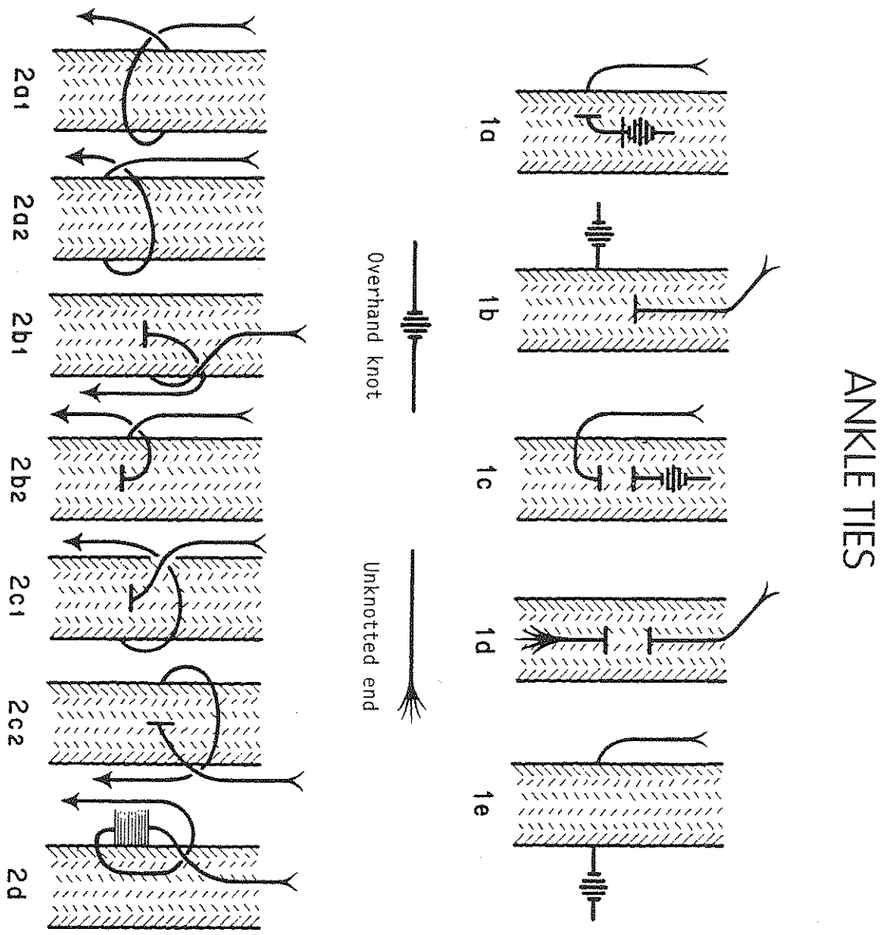


Fig. 7-2
Typology of ankle ties/terminations for plaited sandals (F1a) from Frightful Cave (CM68)

Table 7-13. Association of Ankle-Tie Types with Sandal-Tie Types for Plaited Sandals (F1a) from Frightful Cave (CM68).

Ankle-Tie Type	Sandal-Tie Type: Class 2a B	C	D	Class 2b E	F	G	Total Associated With Sandal-Tie Types	Total Ankle-Tie Types Ident.
1a				4	56		60	105
1b				5	2	23	30	52
1c						1	1	2
1d						9	9	11
1e				5	21	1	27	38
Total				14	79	34	127	208
2a1	1	1		3	24	1	30	30
2a2		2	1+ 1	1		3	7+ 1	8
2b1	4	2		2	54		62	63
2b2	1						1	1
2c1		7	5+ 4	11	1	28	52+ 4	94
2c2			+ 1		2		2+ 1	3
2d	1	1				1	3	7
Total	7	13	6+ 6	17	81	33	157+ 6	206

Figures represent number of sandals, not number of ties (some sandals may have two of one type).
The figures straddling the line between tie types D and E represent the abandoned type D/B (see text).

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APPENDIX A

Taxonomic Plant Index

Common Name	Taxonomic Name
Aguapilla (Mex.)	*Hechtia* sp.
Alicoche (Mex.)	*Echinocereus* sp.
Arizona cypress	*Cupressus arizonica*
Arizona pine	*Pinus arizonica*
Basket grass	*Nolina erumpis*
Bear grass	*Nolina* sp.
Buckeye	*Ungnadia* sp.
Candelilla (Mex.)	*Euphorbia antisyphilitica*
Catclaw	*Acacia greggii*
Cholla (Mex.)	*Opuntia* sp.
Coral bean	*Sophora* sp.
Creosote bush	*Larrea* sp.
Desert willow	*Chilopsis* sp.
Douglas fir	*Pseudotsuga taxifolia*
Drago (Mex.)	*Jatropha* sp.
--	*Echinocerus*
Gramagrass	*Bouteloua* sp.
Guayule (Mex.)	*Parthenium argentatum*
Hackberry	*Celtis* sp.
Huisache (Mex.)	*Acacia farnesiana*
Juniper	*Juniperus pachyphloea*
Leather plant	*Jatropha spathulata*
Lechuguilla	*Agave lechuguilla*
Live oak	*Quercus virginiana*
Madrona	*Arbutus xalapensis*
Maguey (Mex.)	*Agave* sp.
--	*Mammillaria* sp.
Mescal bean	*Sophora secundiflora*
Mesquite	*Prosopis glandulosa*
Mexican buckeye	*Ungnadia speciosa*
Monilla (Mex.)	*Ungnadia speciosa*
Oak	*Quercus* sp.
Ocotillo (Mex.)	*Fouquieria splendens*
Ojase (Mex.)	*Flourensia cernua*
Pecan	*Carya* sp.
Peyote (Mex.)	*Lophophora* sp.
Piñon	*Pinus cembroides*

Prickly pear	*Opuntia* sp.
Quaking aspen	*Populus tremuloides*
Quapilla (Mex.)	*Hechtia scariosa*
Rubber plant	*Parthenium argentatum*
Sotol (Mex.)	*Dasylirion* sp.
Tarbush	*Flourensia cernua*
Tule (Mex.)	*Typha* sp. or *Cyperaceae* sp.
Walnut	*Juglans* sp.
Zamandoque	*Hesperaloe* sp.

(Mex.) = Spanish/Native name

Taxonomic Animal Index

Common Name	Taxonomic Name
Antelope	*Antilocapra americana*
Bison	*Bison bison*
Grizzly bear	*Ursus horribilis*
Jaguar	*Felis onca*
Land snail	*Humboldtiana taylori, H. moctezuma*
Mule deer	*Odocoileus hemionus*
White-tailed deer	*Odocoileus virginianus*
Yellow-haired porcupine	*Erethizon dorsatum epixanthum*

APPENDIX B

RADIOCARBON DATES

The first radiocarbon dates from Coahuila were published early in the life of the ^{14}C technique (Crane 1956: 664; Taylor 1956: 219). If I was startled by the age of the readings in 1956, I was certainly encouraged and confident of the most recent dates when their coherence became so apparent. This series of 34 dates was produced, sometime before March 1973, by Dr. Robert Stuckenrath, who at that time was the director of the Radiocarbon Laboratory, Smithsonian Institution. The following pages contain his report sent to Dr. James Adovasio of the Department of Anthropology, University of Pittsburgh.

FRIGHTFUL CAVE (CM68) SERIES, MEXICO

Plant and organic materials, identified by A. Archer (AA), W. W. Taylor (WT), David Brugge (B), and G. F. Fry (GF), from Frightful Cave, CM68 (27°N, 102°W), ca. 48 km ESE of Cuatro Ciénegas, Coahuila, Mexico, on eastern edge of Cuatro Ciénegas Basin. Cave was excavated in arbitrary levels, and stratigraphy is complicated by large roof-fall deposit across middle of cave. The samples were collected in 1941 by W.W. Taylor and submitted by J. M. Adovasio, University of Pittsburgh.

On the basis of stable isotope measurements made by Teledyne Isotopes, Inc., on SI-1061 ($\delta^{13}C$ -11.9 per mil) and SI-1065 ($\delta^{13}C$ -12.6 per mil), all other dates in this series on *Hesperaloe funifera* have been corrected for an average $\delta^{13}C$ value of -12.3 per mil. Measured $\delta^{13}C$ for SI-1083 (-23.1 per mil) in another series has been used as a correction here for SI-1133. While no measurements have been made for *Yucca* sp., SI-1084, the plant exhibits a crassulacean acid metabolism and is believed to be one of the C4 metabolism groups in the Coahuila area; $\delta^{13}C$ therefore was assumed to be approximately -12 per mil, and the date was corrected accordingly.

1660 ± 50 B.P. SI-1071 A.D. 290
CM68 Passage, upper middle, 37P
Hesperaloe funifera, id. by WT, $\delta^{13}C$ = -12.3 per mil, 2-warp sandal fragment (F-1108) from upper part of middle level in passage, column 37P, 0.5 to 1 m deep.

1755 ± 45 B.P. SI-1133 A.D. 195
CM68 Front, top, 17E
Cache bag of *Dasylirion* sp., id. by AA, $\delta^{13}C$ = -23.1 per mil, containing seeds (see SI-1134) in top level, column 17E, 0 to 0.5 m deep.

1955 ± 75 B.P. SI-1059 45 B.C.
CM68 Front, upper middle, 14D
Hesperaloe funifera, id. by WT, $\delta^{13}C$ = -12.3 per mil, 2-warp sandal fragment (F-275) from upper part of middle level at front, column 14D, 0.5 to 1 m deep.

2015 ± 80 B.P. SI-1134 65 B.C.
CM68 Seeds, front top, 17E
Unburned seeds of hallucinogenic *Ungnadia speciosa*, id. by AA, found in cache bag (see SI-1133) in top level, column 17E, 0 to 0.5 m deep.

2210 ± 45 B.P. SI-1060. 260 B.C.
CM68 Front, top, 14D
Hesperaloe funifera, id. by WT, $\delta^{13}C$ = -12.3 per mil, 2-warp sandal fragment (F-250) from top level at front, column 14D, 0 to 0.5 m deep.

2495 ± 75 B.P. SI-1063. 545 B.C.
CM68 Center, middle, 26HIJ
Hesperaloe funifera, id. by WT, $\delta^{13}C$ = -12.3 per mil, 2-warp sandal fragment (F-1301) from middle level at center, column 26HIJ, between floor and consolidated dust layer.

2700 ± 85 B.P. SI-1148 750 B.C.
CM68 Wood, passage, top, 37P
Cut stick (W-420) from top level in passage, column 37P, 0 to 0.5 m deep.

2945 ±55 B.P. SI-1068 995 B.C.
CM68 Back, top, 30F
Hesperaloe funifera, id. by WT, $\delta^{13}C$ = -12.3 per mil,

2-warp sandal fragment (F-1031) from top level at back of cave, column 30F, 0 to 0.5 m deep.

3125 ± 55 B.P. SI-1144 1175 B.C.
CM68 Wood, back, top, 29F
Two worked sticks from top level at back, column 29F, 0 to 0.5 m deep.

3180 ± 110 B.P. SI-1139 1230 B.C.
CM68 Wood, center, top, 27I
Pointed piece of wood (W-550), from top level at center, column 27I, 0.25 to 0.5 m deep.

3310 ± 55 B.P. SI-1140 1360 B.C.
CM68 Wood, center, lower top 26/27HIJ
Worked piece of wood (W-532) in column 26/27HIJ, 0.5 to 1 m deep.

3445 ± 60 B.P. SI-1141 1495 B.C.
CM68 Wood, center, top, 26/27J
Piece of cut wood (W-559) from top level at center, column 26/27J, 0 to 0.25 m deep.

3495 ± B.P. SI-1065 1545 B.C.
CM68 Center, upper top, 26HIJ
Hesperaloe funifera, id. by WT, $\delta^{13}C$ = -12.3 per mil, 2-warp sandal fragment (F-1267) from upper part of top level at center, column 26HIJ, 0 to 0.25 m deep.

3590 ± 50 B.P. SI-1062 1640 B.C.
CM68 Center, upper bottom, 26HIJ
Hesperaloe funifera, id. by WT, $\delta^{13}C$ = -12.3 per mil, 2-warp sandal fragment (F-1299), from upper part of bottom level, column 26HIJ, within consolidated layer.

3610 ± 60 B.P. SI-1064 1660 B.C.
CM68 Center, lower top, 26HIJ
Hesperaloe funifera, id. by WT, $\delta^{13}C$ = -12.3 per mil, 2-warp sandal fragment (F-1342) from lower part of top level at center, column 26HIJ, 0.25 m deep.

3665 ± 75 B.P. SI-1137 1715 B.C.
CM68 Wood, center, upper top, 27I
Pointed piece of wood (W-519), from upper top level at center, column 27I, 0 to 0.25 m deep.

3710 ± 140 B.P. SI-1147 1760 B.C.
CM68 Wood, passage, middle, 38
Pointed stick (W-350) from middle level in passage, column 38, 0.5 to 1 m deep. Comment: small sample, diluted.

3780 ± 50 B.P. SI-1058 1830 B.C.
CM68 Front, lower middle, 14D
Hesperaloe funifera, id. by WT, $\delta^{13}C$ = -12.3 per mil, 2-warp sandal fragment (F-282) from lower part of middle level at front, column 14D, 1.0 to 1.5 m depth.

3815 ± 85 B.P. SI-1138 1865 B.C.
CM68 Wood, center, top, 27H
Worked piece of wood (W-525), from top level at center, column 27H, 0.25 to 0.5 m deep.

3825 ± 90 B.P. SI-1136 1875 B.C.
CM68 Wood, center, top, 26H
Pointed piece of wood (W-573), from top level at center, column 26H, 0.25 to 0.5 m deep.

3840 ± 80 B.P. SI-1072 1890 B.C.
CM68 Passage, top, 37P
Hesperaloe funifera, id. by WT, $\delta^{13}C$ = -12.3 per mil, 2-warp sandal fragment (F1075) from top level in passage, column 37P, 0 to 0.5 m deep.

4225 ± 75 B.P. SI-1061 2275 B.C.
CM68 Center, lower bottom, 26HIJ
Hesperaloe funifera, id. by WT, $\delta^{13}C$ = -12.3 per mil, 2-warp sandal fragment from lower part of bottom level at center, column 26HIJ, in consolidated rock and dust layer 0.2 m above roof-spall deposit. F-1324.

4380 ± 85 B.P. SI-1069 2430 B.C.
CM68 Passage, bottom, 37P
Hesperaloe funifera, id. by WT, $\delta^{13}C$ = -12.3 per mil, 2-warp sandal fragment (F-1138), from bottom level in rear passage, column 37P.

4530 ± 140 B.P. SI-1084 2580 B.C.
CM68 Burial 1 center, middle
Yucca sp., id. by B, rope fragment, est. $\delta^{13}C$ = -12.3 per mil. Burial 1 in bottom level, between 1 m depth and cave-spall deposit.

4600 ± 65 B.P. SI-1067 2650 B.C.
CM68 Back, middle, 30F
Hesperaloe funifera, id. by WT, $\delta^{13}C$ = -12.3 per mil,

2-warp sandal fragment (F-1147), from middle level at back of cave, column 30F, 0.5 to 1 m deep.

4665 ± 55 B.P. SI-1070 2715 B.C.
CM68 Passage, lower middle, 37P
Hesperaloe funifera, id. by WT, $\delta^{13}C$ = -12.3 per mil, 2-warp sandal fragment (F-1368), from lower part of middle level in passage, column 37P, between 1.5 m depth and roof-spall deposit.

5070 ± 90 B.P. SI-1145 3120 B.C.
CM68 Wood, passage, bottom, 37P
Piece of cut wood from bottom level in rear passage, column 37P, 1.5 to 2 m deep.

5690 ± 70 B.P. SI-1146 3740 B.C.
CM68 Wood, passage lower middle, 37P
Piece of cut wood (W-563), from lower part of middle level in passage, column 37P, 1.0 to 1.5 m deep.

6130 ± 105 B.P. SI-1066 4180 B.C.
CM68 Back, bottom, 30F
Hesperaloe funifera, id. by WT, $\delta^{13}C$ = -12.3 per mil, 2-warp sandal fragment (F-984), from bottom level at back of cave, column 30F, between 1m deep and roof-spall deposit.

7050 ± 115 B.P. SI-1057 5100 B.C.
CM68 Front, upper bottom, 14D
Human feces (A-55), id. by GF, from upper part of bottom level at front, column 14D, 1.5 to 2 m depth.

7380 ± 75 B.P. SI-1143 5430 B.C.
CM68 Atlatl, back, middle, 29F
Atlatl fragment (W-474), from middle level at back, column 29F, 0.5 to 1 m deep.

7770 ± 125 B.P. SI-1135 5820 B.C.
CM68 Front, bottom, 14D
Unworked piece of wood, 2.0 to 2.5 m deep in deepest part of bottom level, column 14D.

7795 ± 120 B.P. SI-1142 5845 B.C.
CM68 Wood, back, bottom, 29F
Worked piece of wood (W-400), on floor atop cave-spall deposit at back, 1.0 to 1.5 m deep. Comment: small sample, diluted.

9215 ± 85 B.P. SI-1056 7265 B.C.
CM68 Front, lower bottom, 14D
Pointed piece of wood (W-126), from lowest portion of bottom level, directly on floor at deepest part of cave at front, column 14D, 2 m below surface.

FAT BURRO CAVE (CM24) SERIES, MEXICO

Plant materials, identified by A. Archer (AA) and Brugge (B), from Fat Burro Cave, CM24 (27°N, 102°W), ca. 32 km W of Cuatro Ciénegas in Cañon de Jora, Coahuila, Mexico. Collected 1941 by W.W. Taylor; submitted by J. M. Adovasio, University of Pittsburgh. On the basis of stable isotope measurements made by Teledyne Isotopes, Inc., on SI-1073 (-11.2 per mil), other dates on samples of *Nolina* sp. in this series have been assumed to have a $\delta^{13}C$ = -11.2 per mil and have been so corrected.

1430 ± 50 B.P. SI-1077 A.D. 520
CM24 Front, top
Nolina sp., id. by AA, $\delta^{13}C$ = -11.2 per mil, sewed sandal fragment (F-38), from fiber of top level at front.

1875 ± 80 B.P. SI-1078 A.D. 75
CM24 Rear, top
Nolina sp., id. by AA, $\delta^{13}C$ = -11.2 per mil, sewed sandal fragment (F-151), from fiber in top level at rear.

1965 ± 105 B.P. SI-1076 15 B.C.
CM24 Rear, lower middle
Nolina sp. coiled basketry fragment, $\delta^{13}C$ = -11.2 per mil, with *Dasylirion* stitching, id. by B, in sand, dust, and fiber of lower part of middle level at rear. Comment: small sample, diluted.

4755 ± 90 B.P. SI-1075 2805 B.C.
CM24 Front, middle
Nolina sp., id. by AA, $\delta^{13}C$ = -11.2 per mil, 2-warp sandal fragment (F-170), in dust-fiber-sand of middle level at front.

3930 ± 55 B.P. SI-1074 1980 B.C.
CM24 Rear, upper bottom
Nolina sp., id. by AA, $\delta^{13}C$ = -11.2 per mil, 2-warp sandal fragment (F-89), in tan sand of upper part of bottom level at rear of cave.

5245 ± 85 B.P. SI-1073 3295 B.C.
CM24 Front, lower bottom
Nolina sp., id. by AA, $\delta^{13}C$ = -11.2 per mil, 2-warp sandal fragment (F-155), in rock and gray dust in lower part of bottom level at front of cave.

UNNAMED CAVE (CM59) SERIES, MEXICO

Yucca sp., identified by W.W. Taylor, from Cave 59B (27°N, 102°W), ca. 30 km SSW of Cuatro Ciénegas, in Puerto San Marcos, Coahuila, Mexico. Collected in 1941 by W.W. Taylor; submitted by J. M. Adovasio, University of Pittsburgh.

No stable isotope measurements have been made on these yucca samples, but the plant exhibits a crassulacean acid metabolism (CAM) and is believed to be one of the C4 metabolism groups in the Coahuila area. $\delta^{13}C$ was assumed to be approx. -12 per mil, and dates were corrected accordingly.

1000 ± 45 B.P. SI-1080 A.D. 950
CM59 F-4 basketry
Coiled basketry, est. $\delta^{13}C$ = -12 per mil.

2100 ± 70 B.P. SI-1079 150 B.C.
CM59 F-1 basketry
Coiled basketry, E half, est. $\delta^{13}C$ = -12 per mil.

CAVE CM79 SERIES, MEXICO

Plant materials from Cave CM79 (27°N, 102°W), 3 km E of house on Rancho Piedra de Lumbre, 100 km W of Cuatro Ciénegas, Coahuila, Mexico. Site is most northerly of Mayran Complex cultural material and one of few burial sites in Coahuila. Collected 1941 by W.W. Taylor; submitted by J. M. Adovasio, University of Pittsburgh.

920 ± 75 B.P. SI-1083 A.D. 1030
CM79 F-20 matting
Dasylirion, id. by W.W. Taylor, $\delta^{13}C$ = -23.1 per mil, matting.

1000 ± 60 B.P. SI-1082 A.D. 950
CM79 F-9 matting
Cyperaceae, id. by D. Brugge, $\delta^{13}C$ = -20.9 per mil, matting.

1200 ± 70 B.P. SI-1081 A.D. 750
CM79 F-6 matting
Cyperaceae, id. by D. Brugge, $\delta^{13}C$ = -20.9 per mil, matting.

COYOTE CAVE (CM88) SERIES, MEXICO

Samples of *Agave lechuguilla*, identified by Edward Palmer, from Coyote Cave, CM88, near Torreon in Laguna area of SW Coahuila, Mexico. These samples were collected in the late 1880s by Palmer and submitted for radiocarbon dating by J. M. Adovasio.

No stable isotope ratios have been determined on samples of this series, but the *Agave* does exhibit a C4 (CAM) metabolism, and $\delta^{13}C$ is assumed to be approx. -12.0 per mil.

1295 ± 45 B.P. SI-1177 A.D. 655
CM88 Coyote Cave, sandal A
Second portion of sandal from mummy bundle of SI-1153, est. $\delta^{13}C$ = -12.0 per mil. Comment: sample boiled in thiophene-free benzene, ethyl alcohol, before standard pretreatment of 2% NaOH and 2N HCl to remove any possible preservatives.

6010 ± 130 B.P. SI-1153 4060 B.C.
CM88 Coyote Cave, sandal
Sandal found on left foot within mummy bundle, 45881G.

APPENDIX C

Cueva Espontosa – A Commentary

David L. Browman
Washington University, St. Louis

Walter Willard Taylor, Jr.'s 1948 monograph, *A Study of Archeology*, caused quite a furor among Americanist archaeologists of the day. He forcefully argued for the need to break away from cultural, historical, or time-space systematics, to a consideration of function and context. He called his strategy the "conjunctive" approach, and he particularly wanted to focus upon what he termed the "cultural conjunctives" within a site.

His naming of names, and his direct frontal attack upon respected, living archaeologists, left his reviewers less than happy. The brunt of proving the merit of the approach was set squarely on Taylor's shoulders, with the proof presumed to be in the monograph on Coahuila that he then indicated was in progress. Typical are the remarks of James B. Watson, who said "Whether he (Taylor) hits the high mark he sets for himself remains for time and actual testing to tell" (1949: 55). And those of Woodbury:

> . . . obviously, then we need from Taylor a thorough application of his "conjunctive approach" before the last word can be said in judgement on it. . . . Is it too much to hope that when he reports in full on this [the 1940–41 Coahuila excavation] expedition we will have an application of the conjunctive approach so that it can be appraised on a firmer basis than promises? (Woodbury 1954: 296)

Taylor's challenge to the conventional archaeology of the period (ca. 1940), especially coming as it did from a mere doctoral candidate, evoked a response in the profession that was to become an albatross around Taylor's neck. This, I would argue, was in part because the excavation procedures that were typical of the early 1940s did not provide him a set of data appropriate for a proper illumination of his conjunctive approach. Severe problems, not foreseen at the time of excavation, subsequently interfered with his interpretation of the data, which must be partly responsible for the long delay in publishing his results. This issue is reflected in his comment in the preface that "I believe that my obligation to the data already processed outweighs any obligation that I might have to myself or my profession." As he notes there, this report lacks certain components, namely items that fit under B1(a), B1(c), D, and E in his conjunctive scheme (see Fig. 1).

Taylor began excavations of Frightful Cave (CM 68) employing artificial units that were 1 x 1 x 0.25 m in size. He quickly changed to 1 x 1 x 0.50 m units, because it became clear that he would be unable to complete the excavation in the time he had available using the smaller-sized units. He divided the fill into three units of equal thickness, and assumed that units of equal thickness were deposited over equal lengths of time. He believed this assumption to be justified because he thought that the lower, water-consolidated dirt and fiber floors showed unusually stable and continuing, if not continuous, occupation of the cave.

In applying his conjunctive approach, he was particularly interested in the relationships within a cultural entity. He saw as his primary goal the elucidation of cultural conjunctives, associations, and relationships within a cultural unit (1948: 5, 93). He was "interested in culture, not age," and reveled in the fact that before radiocarbon dating, he could "study nature and culture with no thought for Time," and pursue "cultural studies blissfully unencumbered by Time of any sort" (1956: 215).

The first set of radiocarbon determinations on Frightful Cave was published by Taylor in 1956, but without lab numbers. Because these 11 dates are not contained in Appendix B, I have included them as Figure 2, deriving the proper lab numbers from Crane (1956), and Crane and Griffin (1958a; 1958b). There is one small difference in the ± error for M-193 between Taylor's listing and the published lab citations, so the archives of the University of Michigan lab were checked to verify the correct figure. Including these

Fig. 1 Procedures for the Conjunctive Approach

A. PROBLEM
B. DATA
    1. Collection
        a. Local cultural
            1) Artifacts
            2) Cultural refuse
            3) Deposits
        b. Local human biological
        c. Contemporaneous geographical
            1) Geological
            2) Meteorological
            3) Floral
            4) Faunal
        d. Non-local human
            1) Contemporaneous
            2) Pre-local
            3) Post-local
        e. Non-contemporaneous geographical
            1) Pre-local
            2) Post-local
    2. Study
        a. Criticism of validity of data
        b. Analysis
        c. Interpretation
        d. Description
    3. Presentation
C. LOCAL CHRONOLOGY (chronicle)
D. SYNTHESIS AND CONTEXT (ethnography or historiography)
E. COMPARATIVE (ethnology)
    1. Cultural
    2. Chronological
F. STUDY OF CULTURE, ITS NATURE AND WORKINGS (anthropology)

(Taylor 1948: 151, Table 4)

1956 determinations provides us with a total of 45 radiocarbon assays for Frightful Cave.

Although Taylor noted the apparent anomaly of two dates out of stratigraphic sequence in his "Middle" unit (Fig. 2), this event does not seem to have caused him much concern, presumably because he believed that Frightful Cave represented a single cultural complex of 8000 to 10,000 years duration. "To be sure, there are variations from early to late. New traits appear, and old ones disappear. Shapes change, and the popularity of different techniques waxes and wanes. But there can be no doubt that we are dealing with a single cultural continuum from beginning to end in the deposits of Frightful Cave" (1956: 231). He maintained that "water territoriality," grounded in "tethered nomadism" were the two factors that gave rise to the remarkable cultural conservatism existing in the region for more than 10,000 years (1964: 200). In a grand synthesis of the archaic cultures of northern Mexico a few years later, Taylor once again argues for a single long-term Coahuila tradition, noting that "without doubt it is a single cultural tradition throughout its approximately 10,000 years" (1966: 62), and that "for the last 10,000 years at least, there was little or no significant culture change and that an essentially Archaic way of life . . . endured with no major modification until it was destroyed" (1966: 93) by European invaders. He does note now that "within this continuum, however, we can distinguish three complexes. These are not to be thought of as 'cultures' or separable entities in any partitive, ethnic sense but merely chronologically separable parts of the total inventory. In brief there was a single 'culture' " (1966: 62), with three divisions: the Ciénegas, Coahuila, and Jora complexes.

Taylor equates each 50 cm with roughly 2000 years. Hence, the bottom 50 cm he dates to 5000–7000 B.C.; the middle 50 cm to 3000–5000 B.C.; and the top 50 cm to 2000 B.C.–A.D. 200. Krieger (1964: 37) saw evidence of mixed stratigraphy, a theme that later commentaries also remarked upon. In Appendix B here, Taylor has now published the complete series of assays that were run in late 1971 and early 1972 at the Smithsonian Institution, with their proveniences, so we can assess to what extent he may have been justified in assuming that he had relatively intact, undisturbed deposits.

Fig. 2 University of Michigan Radiocarbon Determinations, Frightful Cave (CM-68)

Complex	Level	Lab #	Determination	Material
Coahuila	Upper	M-190	1770 ± 250	3-warp fiber sandal
"	"	M-193	3200 ± 250	misc. cut wood
"	"	M-186	3230 ±350	fiber rosettes
"	"	M-185	3620 ± 350	human feces
"	Middle	M-189	6170 ± 300	human feces
"	"	M-192b	9300 ± 400	misc. cut wood fragments, rerun on sample W283, after 192a accidentally included wood from lower level
"	"	M-192a	9540 ± 550	misc. cut wood
Ciénegas	Lower	M-184	7300 ± 400	twill-pad fiber sandal
"	"	M-188	8023 ± 350	human feces
"	"	M-187	8080 ± 450	agave fiber scuffer sandal
"	"	M-191	8870 ± 350	misc. cut wood frags

Data from: Taylor 1956: 219, Table 1; Crane 1956: 669; Crane and Griffin 1958a: 1104; 1958b: 1120; David S. Kennedy, University of Michigan Collections Manager, personal communication, November 11 and 14, 1994

Figure 3 illustrates the radiocarbon assays from three vertical columns in the cave where all three "levels" are represented. It will immediately be appreciated that what is called the "Middle" unit varies in thickness from 50 to 150 cm, and the "Lower" unit varies from 50 to 100 cm, so that the characterization of 50 cm thick upper, middle, and lower complexes is an idealization. In two out of the three columns (14D and 37P), one or more radiocarbon assays occur not only out of stratigraphic sequence, but also outside of the estimated age parameters for that complex.

Figure 4 was constructed to evaluate the appropriateness of assigning the dates of 7000–5000 B.C., 5000–3000 B.C., and 2000 B.C.–A.D. 200 to the three units. Because this was for impressionistic evaluation, the ± uncertainties were not included, although they are certainly an important part of any rigorous evaluation. There are roughly the same number of dates assigned to each unit (18 to the upper, 14 to the middle, and 13 to the lower). While the upper unit seems to have some integrity, the extensive overlap in both the middle and lower units suggests that a good deal more disturbance occurred in the cave than Taylor surmised.

These considerations vitiate any evaluation of the utility of Taylor's "Master Maximum Method" because it is predicated upon adequate stratigraphic control and coherent deposition, which in contexts such as caves are rare, and Frightful Cave proves no exception to this expectation.

Much can be extracted from the radiocarbon determinations, however, even if the integrity of the three units as defined is somewhat suspect. Presuming the samples were selected from each of the three units in roughly representative fashion for each of the vertical profile segments, we can cluster the uncalibrated

Fig. 3 Stratigraphic columns and associated dates, Frightful Cave

Depth	Unit 14D	Unit 37P	Unit 30F	Unit
0–50 cm	260 B.C.	750 B.C.	995 B.C.	Upper
		1890 B.C.		
50–100 cm	45 B.C.	A.D. 290	2650 B.C.	Middle
		2430 B.C.		
100–150 cm	1830 B.C.	3740 B.C.		
150–200 cm		2715 B.C.		
100–150 cm			4180 B.C.	Lower
150–200 cm	5100 B.C.	3120 B.C.		
200–250 cm	7265 B.C.			
	5820 B.C.			

Data from Appendix B; ± error eliminated for ease of viewing, but must be included in any statistical manipulations

Fig. 4 Radiocarbon determinations for Taylor's three units, based on the 45 determinations from Appendix B and from Figure 1 herein.

Upper Unit	Middle Unit	Lower Unit
A.D. 195	A.D. 290	1660 B.C.
A.D. 180	45 B.C.	2275 B.C.
65 B.C.	545 B.C.	2430 B.C.
260 B.C.	1640 B.C.	3120 B.C.
750 B.C.	1760 B.C.	4180 B.C.
995 B.C.	1830 B.C.	5100 B.C.
1175 B.C.	2580 B.C.	5350 B.C.
1230 B.C.	2650 B.C.	5820 B.C.
1250 B.C.	2715 B.C.	5835 B.C.
1280 B.C.	3740 B.C.	6073 B.C.
1360 B.C.	4220 B.C.	6130 B.C.
1495 B.C.	5430 B.C.	6920 B.C.
1545 B.C.	7350 B.C.	7265 B.C.
1670 B.C.	7590 B.C.	
1715 B.C.		
1865 B.C.		
1875 B.C.		
1890 B.C.		

* All dates in this report are uncorrected, with AD/BC derived by subtracting 1950 from the determination

Data from Smithsonian Institution and University of Michigan date series for Frightful Cave, with ± uncertainty left off for ease of viewing

radiocarbon dates in linear fashion, to see if Taylor's three units (7000–5000 B.C., 5000–3000 B.C., and 2000 B.C.–A.D. 200) hold up. First, there is a scattered but somewhat evenly spaced series of eleven determinations from 7600 B.C. to 5100 B.C. (uncorrected). Next, there is rather a lacuna or dearth of assays from 5100 to 2700 B.C., with only four dates. If the samples were equitably secured, this suggests a period of much reduced utilization of the cave. For other nearby areas, there are indications that the general time frame of perhaps 5500 B.C. to 2500 B.C. may have been characterized by warmer and drier conditions than either earlier or later than that era. If this is also the case for the Frightful Cave area, then the scarcity of samples might imply reduced utilization of the cave complex owing to more difficult climatic conditions. Finally, some thirty (two-thirds) of the radiocarbon samples yield assays from 2700 B.C. to A.D. 200, with more than half of this latter group of assays clustering between 1900 and 1200 B.C., implying renewed and heavier utilization of the cave complex.

On the basis of this kind of analysis, it appears that we might be able to talk about an Early Unit rounded-off to 7500–5000 B.C., with moderate usage of the cave complex; a Middle Unit of 5000–2500 B.C., where there is much reduced utilization of the area; and a Late Unit of 2500 B.C.–A.D. 200, with extensive use of the complex, with the most intense occupation or utilization occurring between 1900 and 1200 B.C. If the assumption that the selection of the sample locations was representative is correct, this schema would thus suggest a slight revision of Taylor's dating of the three units, and a changed perception of the utilization of the cave complex in the three epochs. What it does not change, however, is his argument that sandals and other perishable artifacts in his analysis appear to represent a single cultural continuum from beginning to end. This is a rare circumstance prehistorically, and is the basis, as I noted earlier, for his proposal that "tethered nomadism" persisted in this area for more than 10,000 years.

Taylor's greatest contributions in his work at Frightful Cave, however, lie in the analysis of the organic remains. His study of 20,600 chewed fiber quids (1948: 170–171) is a frequently cited example. Through detailed, tedious examination of the individual quids, he was able to show association of the "artichoke-chewed" style with major roasting or feast events, and the more common "gum-chewed" quids with routine daily consumption of the agave and sotol leaves.

In pursuing the dietary angle, Taylor arranged for the analysis of parasite, pollen, and plant microfossils in Frightful Cave human paleofeces (Bryant 1975; Fry 1975). Samples were equally divided among the three units. The 32 samples investigated for parasites and plant parts included 25 taxa; the 47 samples subjected to pollen analysis had 37 taxa, but with only about a third of the taxa overlapping. The diet defined included roots, leaves, seeds, fruits, flowers, and cactus pads, with bones, scales, and feathers indicating meat consumption as well. A minor shift in emphasis among plant taxa was observed between the early and middle units, with the late unit exhibiting a much more significant change in plant utilization. No evidence of helminth parasitism was found. Subsequent paleofecal studies from western North American sites (Reinhard 1992: 246) indicate that nomadic hunter-gatherer populations often exhibit low incidences of parasitism, in contrast to later horticultural populations, who frequently display significant parasitic loads.

The study of footwear or sandals presented in this volume is the crowning piece of Taylor's field and laboratory research. While his initial evaluation of materials resulted in identification of 912 plaited sandals (1948: 132), 46 additional fragments were identified in subsequent analyses, so that the current study details 958 plaited sandals from Frightful Cave. Taylor originally argued (1950: 119) that because archaeology was a historical discipline it was thus non-experimental, and hence "the only way for it to cancel out extraneous factors and make a more or less controlled investigation is to make extensive use of cross-cultural comparisons" under the conjunctive approach. An example of this comparative approach was touched upon in his 1948 study, and is more fully elaborated in the present sandal monograph. Based on a study of contemporary populations in his research area, he determined that "sandals extend, on an average, one-half inch both before, behind, and beside the foot" (1948: 188). From this information Taylor reconstructed the stature and age-groups of the populations at different epochs as evidenced by sandal sizes. Taylor also finds that he can identify right vs. left-handedness, as right-handed people tend to push off (resulting in more abrasive wear) on the right foot, and left on the

left foot. Hence he can quantify "handedness" of the population based on differential wear patterns between right and left sandals. The explication of tying techniques, and similar features results in the most thorough analysis of footgear available for Archaic populations in the Americas.

To return to our original question: has Taylor provided the definitive example that his critics looked to him to produce? By his own admission, he has not. But, as Woodbury noted in his review (1954:293) "It hardly seems a justifiable procedure to condemn a scholar, in archaeology or in any other field, because his accomplishments fall short of his ambition." Thus, it is my judgement that Taylor has provided us with a most fruitful and durable study of one segment of perishables from Cueva Espontosa (Frightful Cave)

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APPENDIX D

Some Thoughts on the Chronology of Cueva Espontosa and the Cuatro Ciénegas Basin

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INTRODUCTION

During the 1971–1972 academic year, I was a postdoctoral fellow in the Department of Anthropology, National Museum of Natural History, Smithsonian Institution, Washington, DC. My original research goal was the expansion of my 1970 dissertation study of prehistoric basketry and textile materials from arid western North America. Specifically, my intent was to "track" the prehistoric perishable complexes I had previously identified in the Great Basin and contiguous areas into the ethnographic period utilizing collections housed at the Smithsonian.

While this focus remained a viable part of my postdoctoral program throughout the year, it was subordinated by a chance series of events initiated by Betty Meggers and the late Clifford Evans. Through them, I was introduced to the voluminous collections of durable and non-durable materials excavated by Taylor from the Cuatro Ciénegas Basin. As these collections contained a remarkable suite of basketry, notably numerous and well-preserved coiled and plaited items, I requested permission first to examine Taylor's entire corpus of perishable data and then specifically to analyze the basketry assemblage.

Evans and Meggers referred my request directly to Taylor, who indicated that he had no objections to my general scrutiny of the Coahuila collections nor to a detailed study of the basketry. However, he pointedly advised me that he had already conducted such a study and intimated that additional research was probably not likely to yield further insights into prehistoric Coahuiltecan basketry technology.

With some misgivings, I nonetheless began my research and shortly thereafter visited Walt in Santa Fe. We compared notes—mine on standardized analysis forms, his on carefully prepared 3" by 5" index cards—on particular specimens of coiling, notably including some of the earliest material from Cueva Espontosa. After just a few minutes, he rather dramatically returned his index cards to their container and observed with some chagrin (but considerable graciousness) that his original research into the basketry assemblage had been somewhat "superficial." He then strongly encouraged me to re-analyze all of the Coahuila basketry and further indicated that he, or his then full-time assistant Jonathan Reyman, would provide me with anything that I needed, including maps, profiles, field notes, etc., to facilitate my research. Suffice to say he was as good as his word.

Within a few months, I and my full-time Smithsonian intern, Bruce Louthain, had analyzed enough of the Taylor collection to realize that the basic basketry sequences of central Coahuila and contiguous lower and Trans-Pecos Texas were quite similar. I had previously examined a portion of the extensive corpus of data from arid southwest Texas (and would shortly examine virtually all of the available materials from more than 60 sites), but it was already obvious that the Texas materials and those from central Coahuila were quite similar both in terms of major basketry subclasses represented and in the general chronological sequencing and construction attributes of specific types. However, it was also clear that the Texas perishable artifact sequence was much better controlled chronologically, with far more radiocarbon dates derived from numerous and often deeply stratified and, for the most part, carefully excavated sites.

To partially rectify what I perceived to be the chronological lacunae at Cueva Espontosa as well as the other Taylor-sampled localities in the Cuatro Ciénegas Basin, I approached Bob Stuckenrath, the director of the Smithsonian's radiocarbon laboratory in Beltsville, Maryland. Simultaneously, I asked Walt if he had problems with running additional dates and, of course, he did not. Stuckenrath quickly agreed to run additional dates and I set about selecting the appropriate samples.

SAMPLING PROTOCOLS

In order to provide the highest-possible resolution to the selection of samples to be dated, I requested and obtained copies of most of Taylor's excavation maps and, more importantly, profile drawings. From these, it was immediately apparent that although Taylor had excavated Cueva Espontosa and the other Coahuila sites in arbitrary levels of considerable thickness (e.g., 50 cm), all of the sites exhibited complex internal stratification. Indeed, the profiles from Cueva Espontosa prepared by Al Schroeder after excavation revealed a remarkable record of attritional, aeolian, and anthropogenic deposition with numerous indications of both human and animal turbation. To a somewhat lesser extent, this condition obtained at the other Coahuila sites as well.

As I was struck by the evident detail in Schroeder's maps, I asked Taylor why he elected to use arbitrary levels where internal stratification was so obvious. He responded, almost sadly, that it was so dusty in the Coahuila sites that he could not excavate by natural levels and that, regrettably, the profiles could only be drawn post facto, after the trenches or squares had been excavated and the dust had settled. Despite this obviously severe methodological limitation, I was nonetheless convinced that careful selection of samples to be dated could yield useful results.

After consultation with Stuckenrath, I elected to choose plant fiber from sandals, modified wood, and, more rarely, basketry samples as the principal media for dating. As is evident from this volume, sandals were abundant at virtually all of the Coahuila sites and the Cuatro Ciénegas collections were also filled with cut, shaved, whittled, and otherwise modified wood. I chose not to date much basketry directly because, although relatively abundant, this class of fiber perishables was the rarest of the plant-fiber-derived artifacts in the Coahuila sample. Moreover, the state of radiocarbon dating at the time required somewhat large samples which I did not elect to sacrifice. Taylor concurred with this assessment.

Following these considerations, I selected 45 samples to be dated, the results of which are presented in Appendix B. Thirty-four of these samples derived from Espontosa or Frightful Cave (CM68); six from Fat Burro Cave (CM24); three from unnamed cave CM79; and two from Coyote Cave (CM88) in southwest Coahuila, excavated by Edward Palmer in the late 1880s.

The rationale for selecting the samples from Cueva Espontosa is worth reiterating in detail, as these dates have a major bearing not only on the occupational chronology of that site and the Cuatro Ciénegas Basin, generally, but also on several of Taylor's basic conclusions about the nature and character of prehistoric utilization of the study area.

After extensive discussions with Taylor, I selected samples from three different parts of Cueva Espontosa. These loci were chosen for several reasons. First, I deemed it desirable to sample the entire length of the cave from the front to the back/passage and, of equal importance, to seek sampling areas where Taylor and I believed that anthropogenic, microtectonic (i.e. rockfall), and bioturbation-related disturbances were minimal. Although it was obvious that there were disturbances of many kinds at Cueva Espontosa, as noted by Krieger (1964), it was also equally obvious that some areas were far less disturbed than others.

Within each of the three "horizontally" representative sample areas chosen for the analysis, which were sometimes composed of a single excavation unit and other times from several adjacent units, specimens were selected from deposits spanning the entire sequence from top to bottom in quasi "columnar" fashion. These samples were specifically chosen from areas where basketry of particular types had also been recovered, which seemed to be in "loose" association with the samples to be dated.

As noted by Browman in Appendix C, some of these "columns" vary from the idealized 150 cm average thickness for the site's deposits as calculated by Taylor. However, I considered this discrepancy to be a secondary issue, because I explicitly attempted to select samples from areas where major depositional contacts or interfaces could be "tracked" *across the site* from

Schroeder's profiles. Hence, the sample from the "top" of units 17E and 14D in the front of the site was generally depositionally congruent with the sample from the "top" of 26H in the center and the top of 37P in the back/passage—whatever the actual thickness of these units. While this process rendered comparison of the new dates to Taylor's earlier radiocarbon sequence somewhat difficult, it did provide a measure of vertical control over the samples to be dated.

I should stress that my basic goals at Cueva Espontosa were to test, and to "confirm" insofar as possible, Taylor's original chronology, and to enhance or refine it where possible with additional determinations. The same objectives obtained at the other sites that were generally much less extensively excavated with generally shallower stratification and more abbreviated occupational trajectories. At the very least, I hoped to obtain a chronological sequence of basketry types at least as precise as that then emerging in lower and Trans-Pecos Texas. I believed this, in turn, would greatly facilitate potentially fruitful comparison between these two adjacent and environmentally similar areas.

RESULTS

The results of the Coahuila dating project are presented in Appendix B. Once it became clear that the assays from specimens made of *Hesperaloe funifera* and *Yucca* sp. had to be corrected for C_4 metabolism related factors, the dates from within each column were relatively consistent. However, as noted by Browman in Appendix C, some dates from two of the three columns were out of stratigraphic order and apparently outside Taylor's age estimates for that particular segment of the sequence (i.e., Bottom [7000–5000 B.C.], Middle [5000–3000 B.C.], Top [2000 B.C.–A.D. 200]). Although I concur with Browman's assessment that the upper or top level seems to have more dating integrity than the middle or bottom levels, I nonetheless believe (as did Stuckenrath) that overall the Smithsonian date series confirms Taylor's original estimates for the ages of his depositional "horizons."

My reasons for this conclusion relate to the sampling parameters articulated above and to the general correlation of the dates from each column to those from the other columns. In my view, the apparent overlaps between the bottom and middle and, to a lesser extent, the middle and top levels reflect not only limited turbation (again as noted by Browman), but also the fact that there was no absolute depth correlation between the so-called middle or bottom of any one column and the middle/bottom of the others. Put another way, the bottom level in one area clearly subsumed the lower third of the middle level in another area. Nonetheless, the dates within columns are reasonably consistent with the aforespecified reversals taken into account.

Perhaps more important, at least to me, is that the general integrity of Cueva Espontosa sequence is supported by the dates on similar perishable material culture suites from the other Coahuila cave sites and also those available from lower and Trans-Pecos Texas. Indeed, the basketry types identified from Espontosa and the other Coahuila cave sites exhibit virtually the *same* age ranges as their typological counterparts in many lower and Trans-Pecos Texas rockshelters. This general chronological congruence both supports the integrity of Taylor's basic Cuatro Ciénegas chronology and, more importantly, also illuminates and reinforces some of his most basic and insightful cultural constructs.

Taylor labeled the "initial" visitors to the Cuatro Ciénegas Basin the "Ciénegas Complex" and suggested, although without any direct artifactual or chronological evidence, that they had first entered the area perhaps as early as 10,000 B.C. (uncalibrated). Only the very deepest parts of the bottom level at Cueva Espontosa are confidently associated with this occupation. It is worth noting here that Bob Stuckenrath and I posited that the initial occupation of Espontosa Cave occurred more reliably by ca. 7600–7500 B.C. (uncalibrated), based on Taylor's original dates and the new dates yielded by our study.

The Ciénegas Complex grades imperceptibly into the Coahuila Complex, probably by ca. 7300 B.C. (uncalibrated). The bulk of the lower, middle, and the lower part of the "top" horizons at Espontosa, as well as most of the Fat Burro Cave materials, are attributed to this cultural manifestation.

By approximately A.D. 1–200 (uncalibrated), certain distinctive stylistic and technological elements appear *within* the Coahuila complex "matrix." Some of these elements have been labeled as Jora by Taylor, and others—especially those recovered by Aveleyra et al. (1956) in Cueva de la Candelaria and Cueva Paila—have been labeled as Mayran. These complexes or oc-

cupations are restricted to the uppermost deposits at Cueva Espontosa as well as the top of Fat Burro Cave and the burial cave CM79. The "end" of the Jora (or Mayran?) occupation at Cueva Espontosa is ca. 300 A.D. (uncalibrated), although these entities or congeries of traits persist into the greater study area until Spanish contact.

DISCUSSION

By the end of my tenure at the Smithsonian Institution, all of the ^{14}C assays from Coahuila were available and the reanalysis of all the Coahuila basketry was complete. Additionally, with the assistance of Elton Prewitt, Donny Chapman, and the late David Dibble, among many others, I had also reanalyzed virtually all of the lower and Trans-Pecos basketry then curated in museums in the western United States and elsewhere (Adovasio 1973). Based on this research, I established temporal chronologies for basketry developments in both Coahuila (Adovasio 1972) and lower and Trans-Pecos Texas (Adovasio 1974; 1980; Andrews and Adovasio 1980).

Probably far more importantly, at least in hindsight, I also determined that the basic resemblance of the individual types—as well as the overall basketry industries from both areas—was so great that they must be parts of the same developmental trajectory and, in fact, reflections or signature artifacts of the same prehistoric culture. Moreover, because this construct could be tracked without significant hiatus or interruption from at least the late Paleoindian period to proto-Historic and even Historic period times, I concluded that the culture in question was the direct lineal ancestor of the ethnohistoric Coahuiltecan bands on both sides of the Rio Grande. Furthermore, I also concluded that they had been *in place* for nine or ten millennia, which is, of course, *precisely* what Taylor posited largely on the basis of the sandals and his preliminary study of the basketry.

Significantly, this seemingly unlikely situation (it is in fact, the *only* such case in the North American record) is what Dibble, Prewitt, and many other lower and Trans-Pecos Texas prehistorians also posit, based on other categories of archaeological evidence specifically including lithics, other material culture diagnostics, and essential lifestyles. In this latter regard, it should be stressed that not only does it appear that the prehistoric Coahuiltecans occupied substantial parts of their ethnohistoric range for most of the Holocene, they may well have been "tied" to this generally inhospitable realm by the same water "tether" postulated by Taylor.

Space precludes any further elaboration of this most singular instance of the long-time in situ residence of a single sociolinguistic entity or, at least, of a very closely related constellation of such entities, but it should be stressed that Taylor's Central Coahuila research—flawed and incompletely published as it was and is—was in *no* substantive sense a failure. Although, as noted by Demerath et al. in their foreword to this volume, Taylor never succeeded in generating the perfect example of the conjunctive approach he so forcefully advocated, he nonetheless showed how far beyond the traditional archaeological limits of his time it was theoretically and actually possible to go. By concentrating on perishable organic artifacts and their critical importance to the success of the lifestyle(s) of their makers and users, he brought into sharp focus an element of prehistoric technology largely ignored or at least minimized by most of his peers. In so doing, he also foreshadowed a cadre of scholars, myself included, who have sought to place what Bob Bettinger calls "soft technology" into its proper perspective in both prehistoric and ethnographic research.

To paraphrase an observation from Tolkien's epic *Lord of the Rings*, Taylor may have failed of his promise, but time and this monumental monograph will show that he did not fail of his intellectual seed.

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