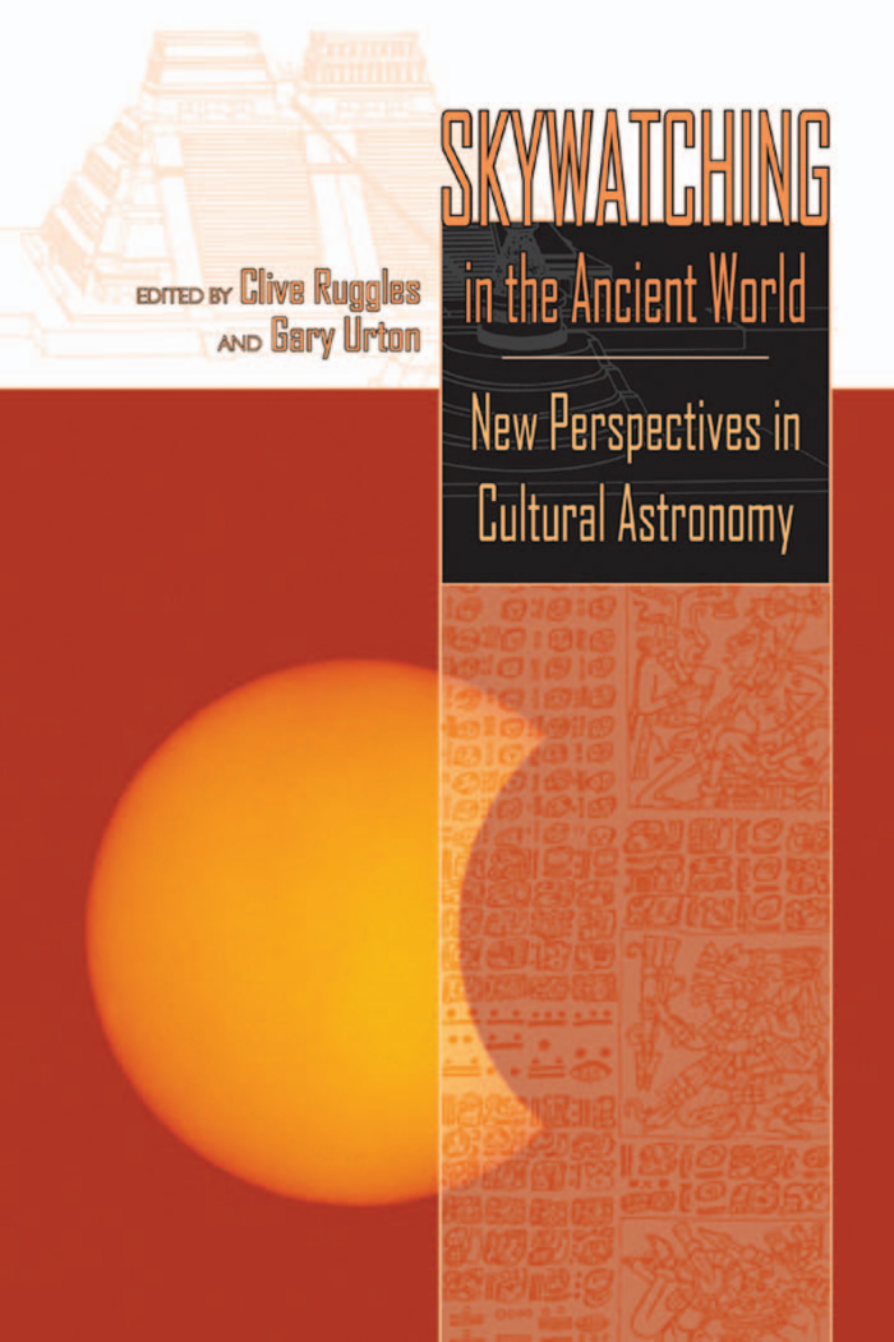

SKYWATCHING in the Ancient World

New Perspectives in Cultural Astronomy

EDITED BY Clive Ruggles
AND Gary Urton

SKYWATCHING
in the Ancient World

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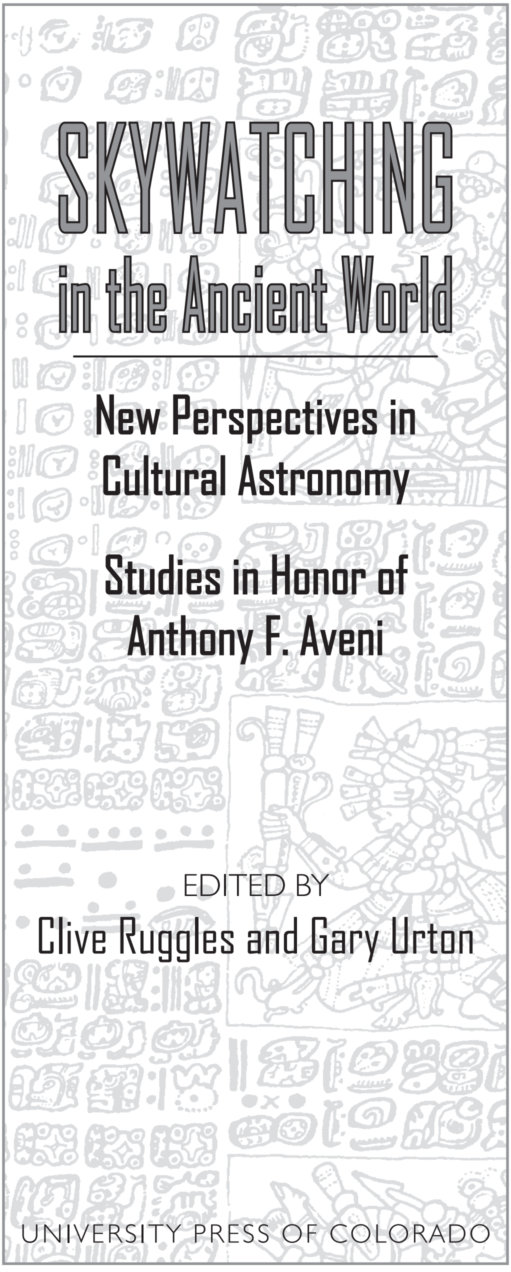

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Studies in Honor of Anthony F. Aveni

EDITED BY
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This volume is the product of a symposium held in the fall of 2003 at Colgate University, New York, to celebrate and honor Anthony Aveni's contributions to a variety of fields of study, and particularly to what has become known as "cultural astronomy," during a forty-year-long academic career.

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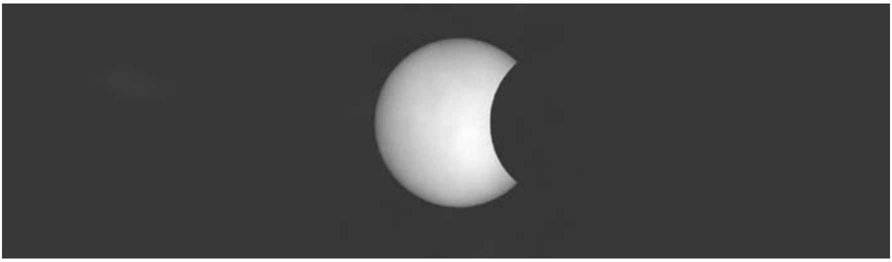

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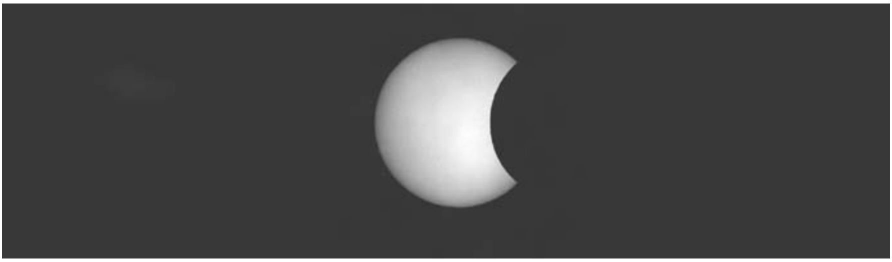


Foreword

ANTHONY AVENI: A PIVOT OF MANY QUARTERS

I met Anthony Aveni in 1982 when he was visiting the University of Colorado to lecture on his recent book *Skywatchers of Ancient Mexico.* This book fascinated me because of its significance for my academic discipline, the History of Religions. At the time, scholars of religion and anthropology had been showing increased interest in the religious significance of the sky, sun, moon, stars, and celestial phenomena, spurred in part by the publication of Mircea Eliade's *Patterns in Comparative Religion*. Paul Wheatley's magisterial *The Pivot of the Four Quarters: A Preliminary Enquiry into the Origins and Character of the Ancient Chinese City* had posited that urban genesis in the seven areas of primary urban generation was undergirded by cosmo-magical thinking that integrated the mathematically expressible regimes of the heavens and the biological rhythms on earth. Aveni's work on the sky, stars, calendar rituals, alignments, and the close-knit relationship between ceremonial centers and celestial patterns seemed to advance the work of these scholars by providing specific data on skywatching and archaeoastronomy, a new method for understanding the ways humans and their cities were oriented on celestial events. Aveni's work resonated with my own on Quetzalcoatl and a series of cities associated with the Feathered Serpent tradition in Mesoamerica. Through meeting Anthony Aveni my own work was "re-oriented" in a productive direction.

Our initial conversation struck mutual chords and I invited Aveni to spend a semester at the University of Colorado working in the Moses Mesoamerican Archive so we could team teach a course and teach each other about archaeoastronomy and the study of religion. That fall in Colorado, Aveni and I held a series of public "conversations" about religion, ritual, astronomy, cities, and calendars in the Aztec, Inca, and Maya worlds, and these talks were turned into a small but appreciated publication titled "Conversations with Anthony Aveni: Archaeoastronomy and the History of Religions" published by the Mesoamerican Archive. Aveni's breadth of knowledge, engaging teaching style, and willingness to collaborate ignited a series of new questions about the relationship between science and religion, Old World and New World, calendars and cosmovision, and ritual and myth and also the similarities and differences *within* the archaeoastronomies of the Americas that helped shape the future research agenda of the Mesoamerican Archive and influence students at Colorado. This was the beginning of a career-long collaboration that has been deeply beneficial to my own scholarship and the overall productivity of the Moses Mesoamerican Archive and its publishing program.

What I then recognized about Aveni's particular form of genius has now become clear to scholars in many parts of the world as evidenced in this excellent book of essays. As Clive Ruggles and Gary Urton write:

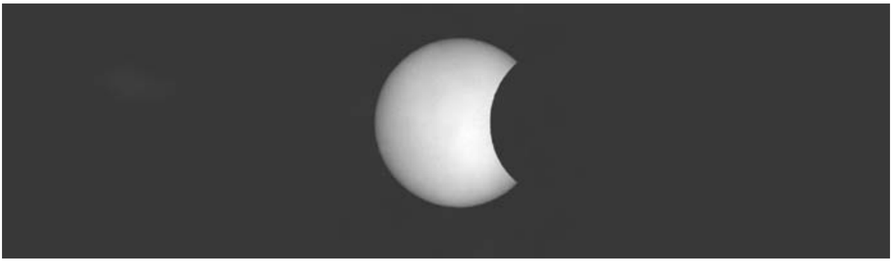
> Tony Aveni is one of the world's great interdisciplinarians, having contributed to a variety of fields of study during his forty-year academic career. He is widely acknowledged as America's leading archaeoastronomer as well as the founding father of Mesoamerican archaeoastronomy. . . . Over the years, he has moved from studying "ancient astronomy" to broader issues of cosmology, perception, and indigenous concepts of space, time, number, and other related concepts. . . . Rather than remaining the astronomer working on the fringes of anthropology, he has constantly moved forward, ensuring that his work is increasingly contextualized in anthropological and archaeological theory and practice, with the result that he has created entirely new ways of comprehending ancient cultures through their knowledge and perceptions of the skies.

In other words, Aveni has become a "pivot of many quarters," a scholar who has achieved a powerful grounding in his own scientific/humanistic world view and is able to face in many cultural and academic directions and enter into productive dialogues with other people, places, horizons, and centers. Unlike James Thurber, who as a young student in chemistry class was only capable of seeing reflections of his own eye in the microscope, Aveni has increasingly been able to put on a variety of academic and cultural lenses and utilize them to help organize new knowledge about how human beings achieve sophisticated orientations in time and space.

This book is the first time the Mesoamerican Worlds series has included a festschrift, although this is no ordinary festschrift. The Aveni-like contributions are outstanding. The stories told, the scope of cultural significances, the angles of vision, and solid case studies constitute a fine academic celebration in multidisciplinary terms. There is affirmation of the state of the art and innovation in the ways we are coming to understand the relationships between cultural astronomy, context, and historical change. We sense how Aveni has, to use a word penned by the editors of the volume, "propelled" these scholarly affirmations and innovations. This propulsion and its results are signaled in the titles and themes of the essays, which can serve as a chart of the fields of cultural astronomy and Aveni's astonishing publishing record. The chapter titles include such terms and names as "correlation" and "calendars" (Justeson and Tavárez), "Kirchhoff" and "Codex Borbonicus" (Calnek), "Dresden Codex" and "Venus Table" (Bricker and Bricker), "Moon Woman" and "lunar almanacs" (Tedlock and Tedlock), "Codex Borgia" and "astronomical cycles" (Milbrath), "measure" and "man" (Coggins), "Tukapu calendar" and "multi-year" (Urton), "solar and lunar" and "Inka" (Zuidema), "cosmology" and "temple orientations" (Ruggles), and "calendrical cycles" and "churches" (McCluskey).

Perhaps Ed Krupp's title "High Fashion" says best how this collection of essays represents what we have come to think of Anthony Aveni as a teacher, friend, and colleague. The varieties of place and academic approach in these essays symbolize how Aveni has raised our levels of awareness and capacities for dialogue and collaboration, expanding our horizons of cultural astronomy and elevating our skills at interdisciplinary work way beyond where they were when he began his journey. His intellectual leadership, wonderful humor, and remarkable achievements have shaped how many of us approach the texts and enigmas of cultural astronomy. His life and work have shown us how other cultures found their ways to the stars, and he also has practiced methods for understanding how the stars were brought down to earth by various peoples who struggled to shape their chaotic and shifting worlds into ordered forms. These essays carry that work forward in exciting and fruitful new directions and signal the ongoing transformations in our knowledge of how human beings seem to be forever waiting for the dawn and the night, measuring themselves against order and chaos, and correlating in texts, buildings, and horizons their earthly humanity and destiny with the stars. Anthony Aveni is indeed a pivot of many quarters.

DAVÍD CARRASCO
MEXICO CITY
AUGUST 2007



Preface

Tony Aveni was once at Stonehenge. He moved on. Many of us who work in cultural astronomy have, like Tony himself, followed challenging and often unconventional paths in order to assimilate the combination of disciplinary perspectives that is a prerequisite for making sensible and sustainable progress in this field. And many of us who have witnessed the evolution of Tony's ideas firsthand have, at various stages in our own development, been inspired and stimulated by his example. Gary Urton writes:

> My first encounter with Tony Aveni came not by way of meeting him face-to-face, but rather through the postal service—between Peru and the United States. This occurred in 1976, during the time I was carrying out my PhD dissertation fieldwork in Misminay, Peru. Tony was just beginning to make his presence known in the field of archaeoastronomy—in fact, as we would all realize later, he was *defining* the field—and I was in need of some good

> advice on several problems in the interpretation of ideas about various celestial phenomena that I had become aware of when talking to and working in the field with people in Misminay. My advisor at the University of Illinois in Champaign-Urbana, R. Tom Zuidema, suggested that I write to Tony Aveni and ask him the questions that were perplexing me. I sat down at my typewriter in Cusco and wrote a long letter to Aveni, having very little hope that an even then well-known professor of cultural astronomy would have, or take, the time to write back to a lowly graduate student in the field. However, within a couple of weeks (rapid by Cusco postal standards of the time), I received a reply from Tony; it was a long, informative, and congenial letter answering most of my questions and asking several even better ones. Tony eventually joined my PhD committee and proved himself to be tireless in extending his support and encouragement during the year I wrote my dissertation.
>
> As I continued my own academic career, which I had the good fortune to be able to pursue as a colleague of Tony's at Colgate University, I saw my own earlier experience with Aveni repeated countless times. Tony was forever receiving letters from young scholars—whether from the United States or abroad, from the field or from a university—asking for help and advice. Tony always replied to those who sought his help even after he had long become the best-known and most highly respected archaeoastronomer in the world. His enthusiasm, optimism, and thirst for knowledge are unparalleled among academics, at least in my experience.
>
> Tony and I went on to work together on a project in Nazca, Peru, bringing Colgate students and groups of Earthwatch volunteers with us to study and measure the famous Nazca lines. As anyone who knows Tony will understand, working with him in the field meant having the pleasure of his nonstop banter and good humor. Lest anyone else in the course of this volume fail to mention this perhaps most salient fact about him, Tony Aveni is one of the funniest people you will ever meet. He knows and tells masterfully a thousand and one jokes, each one—a part of the joke itself—numbered; among a group of friends, he will often shout out a number, evoking at the minimum giggles to those in the know. I have lost count of the number of times I almost, or in fact, fell off my chair laughing at one of Tony's jokes while dining at his and Lorraine's table (the two of them are gourmet cooks).

Few can have known and worked with Tony without collecting their own treasured portfolio of personal recollections and anecdotes. Thus Clive Ruggles writes:

> I first met Tony at the first international symposium on archaeoastronomy held in Oxford in 1981, and it was not long before I had the pleasure of

Tony Aveni at Stonehenge, literally, in 1996. (Photograph by Clive Ruggles.)

> having him and Lorraine to stay in my terraced house in Leicester with the wonky front step, of which Tony was still fondly reminding me a few years later when he came again to help teach some sessions in my archaeoastronomy class. It may seem surprising that I was somewhat reticent about his teaching my class despite knowing that he had been awarded the highest national award in the United States for teaching (he had been voted 1982 Professor of the Year by the Council for the Advancement and Support of Education, Washington, D.C.). My reticence stemmed from a tale he had told my wife about a time he had found himself faced with a lecture-room full of uncomprehending astronomy students who would unthinkingly write down every word that he said. Spontaneously, he had decided to give an entirely ad-lib lecture about the reproduction of galaxies, describing in fantastic detail the gradual reshaping of male and female galaxies and their eventual amalgamation in the process of cosmic copulation. Fortunately, the archaeoastronomy students in my class remained alert, thus sparing themselves a megalithic yarn the likely content of which taxes the imagination.

Lorraine Aveni entertained us at the symposium with some of her own personal recollections, and it is with her permission that we gratefully append a transcript of some of them here. They benefit, quite obviously, from her unique "partner's perspective" and reflect the closeness of her involvement in all of Tony's activities, but in terms of the feelings they convey, they speak for us all.

Tony Aveni has given so much to his friends and colleagues over the course of his long (and continuing) career. With this volume, we hope to return to Tony a modest recompense for all he has given to those around him. The volume is dedicated to Tony with grateful thanks not only for his immense contribution to the field of cultural astronomy but also for making all of our lives, academically speaking as well as in other ways, a great deal richer.

CLIVE RUGGLES AND GARY URTON
LEICESTER AND HARVARD UNIVERSITIES

A PARTNER'S PERSPECTIVE

Lorraine Aveni

It isn't just the books, your voice on every page, always showing us the Big Picture from cosmology to the human places within it. It isn't just the conferences, those culminations of process and results offered by inspired presenters of the topic and day. It is also the personal history and memories. So, today I remember many things.

Mostly in Mexico, Guatemala, and Honduras, I recall dear Horst Hartung, Tony's other professional half for so many years and publications, who participated fully in the field and in lively interactions with our students.

At the old Palenque Round Tables in the summer up in the trees at La Canada, sitting next to the Brickers, three or four Millers, the Andrews, Tedlocks, Coes and Stuarts and David Kelley, Francis Robicek and Norman Hammond, Claude Baudez, Linda Schele, Doris Heyden, Ed Edmonson, Floyd Lounsbury, Gillet Griffin, Merle Greene, and on and on. This is such an incomplete list! (I also recall on another trip with our young family, a baby alligator wriggling around the lobby of the only hotel in town, the Hotel Ik.) The Brickers have gone on to provide rich ideas for all to ponder since those days. And, more recently, our pleasure was enormously extended as they hosted us at a Mellon Professorship at Tulane; for their good works and deeds, we will always be grateful.

I recall Davíd Carrasco at Boulder with his bright colleagues and students of the many Mesoamerican Archive sessions, eventually convening over other spaces and times, ceremonial Aztec or Maya, and otherwise at museums and campuses. We have since worked and traveled together in the field and will follow him and Lugene anywhere.

I'm remembering too the work with Gary Urton in Peru, at Nazca, mapping and measuring, mapping and measuring, but *always* starting at the truck stop with liquid instant coffee and keke in the dark dawn of 5:00 AM! We would let the air out of the tires for long days of desert driving. We would also listen patiently to the whisperings of La Dama Maria Reiche; and Gary was the voice of reason when the local Nazca police came in to "arrest" the Colgate professors and their team for "looting the pampa," they said. Later, Tom Zuidema took us everywhere: the rooftops of Cuzco, the steps of Ollantaytambo, to Pisaq and other exotic villages. But when he drove us for three days through the Andes' endless hairpin curves, I nervously shook in the backseat throughout the numerous flat tires and motor troubles. After the landslide, we moved ahead trying not to look over the right edge at the unfortunate vehicles down there. We did arrive at the Nazca Hotel, that desert oasis, but with just enough power in one VW beetle to push the other inside.

The wonderful Dumbarton Oaks meetings of all these years: I remember one when the Tedlocks presented a new performance piece to the workshop while in the rear of the room I busily knitted an afghan for Gary and Julia's expected baby. Elizabeth Boone always produced enlightened programming there as have Betty Benson and Jeffrey Quilter.

In New York City a long while ago I recall with enjoyment the beautiful American Museum opening of Suzy Milbrath's *Star Gods* show, entering into the dim halls filled with treasures that were each illuminated and enlightening.

In Mexico, I think of Clive driving one of our minibuses full of students plus equipment through Mexico City down and around the Puebla sites that year. I realized his British experience was driving from the, sorry, *wrong* side of the road, yet he managed to do it on the *right,* even with a nasty cold all month. Thanks again for this and much more work in those megalithic stony fields, at the Oxford conferences, and other thoughtful contacts since then.

And all over the globe was Ed Krupp, behind us or ahead of us, usually with a bus filled with Californians from the Griffith Observatory seeking out ancient astronomies (or just his special company). Not to mention, over the years and waves, sailing many seas in search of eclipses. Totality! Your star will never eclipse. (When is the next?)

But, Tony, I remember very early on one evening, as I was reading, you turning to me to say you needed to make a decision about continuing full-time research in astronomy or moving to anthropology/archaeology. We talked a long time about how life would change now in this career passion. Hats off here to Colgate for completely supporting a young faculty member's desire to move into a new area, discipline, and academic division. And so I've watched it develop and grow; been there on the ancient soils with your myriad students; photographed the magnificence left behind by the long-passed builders. From British Columbia to Bolivia, from the Orkneys to Sardinia: have transit, will travel! It has been and is still a thrilling ride and my admiration is complete.

Well, as I close, I realize I've left untold the tales you've told us all over the years: being stung "in the temple," fire ants up your pants, the boa constrictor looping down from the canopy as we searched for Nohpat, the Smiling Man, the Screaming Man, stick shifts that came out of the car floor, cracked car keys and the students' vast array of adventures from lost persons to lost car keys in the burrito wrapper, broken bones, and muy infermos ("¿dónde están sus clínicas?") to their later PhDs, weddings, and/or children.

I'm aware that these memories are very precious to *both* of us. The people attending this occasion are treasured, respected colleagues and friends and have enriched our lives. We are, indeed, privileged.

Yours, Lorraine

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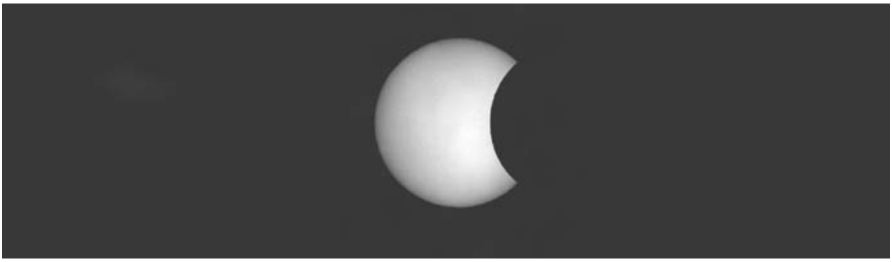
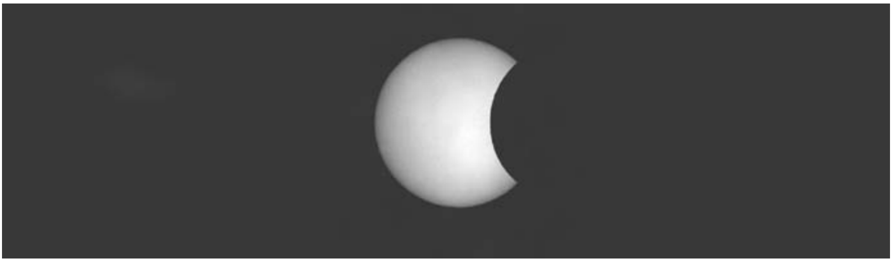


Acknowledgments

The editors and conference organizers heartily thank administrators and staff at Colgate University for their support in holding the symposium that has resulted in this book. In particular, we thank Diane Janney, Administrative Assistant in the Department of Physics and Astronomy at Colgate, whose help was critical to our efforts at organizing the symposium when neither of us was actually on campus. We thank the President of Colgate University, Rebecca S. Chopp, and the then Dean of the Faculty, Jack Dovidio, for financial support for the symposium. Additional financial support was provided in the form of a grant to Davíd Carrasco from the David Rockefeller Center for Latin American Studies at Harvard University. We thank Davíd Carrasco for his collegiality and help in various ways as we set out to organize the symposium and edit a volume celebrating Tony Aveni's work and career. Clive Ruggles wishes to thank the British Academy for supporting his attendance through an Overseas

Conference Grant. Finally, we are especially pleased to acknowledge the help of Lorraine Aveni, Tony's wife and our local "insider" during our attempt to organize this surprise symposium in honor of her husband.

CLIVE RUGGLES AND GARY URTON



Editors' Note

In a book as interdisciplinary and wide-ranging in approach as this one, the editors consider it seriously counterproductive to insist on consistent rules regarding such issues as orthography. Thus, for example, in referring to places or calendrical terms, some authors use colonial spellings because they work primarily with colonial documents, whereas others favor indigenous spellings. As a result, the reader will encounter, for example, Quiche, K'iche', and K'ichee'; both Ahau and Ahaw; both Yucatán/Yucatec and Yucatan/Yukatek; and both Cuzco and Cusco. They will also find differing attitudes to the use of the term "Maya" as opposed to "Mayan" and "Mayans." Each author has made their choices in the context of their own source material and disciplinary standpoint, and some have chosen to include an explanatory statement.

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CLIVE RUGGLES AND GARY URTON

Introduction

In the twenty-first century, it is possible to consider archaeoastronomy one of fifty "key concepts" in the development of archaeological thinking and method (Renfrew and Bahn 2005). This is a long way indeed from the position in the 1960s and 1970s, when exploring the associations between ancient monumental architecture and objects and events in the skies was largely the preserve of professional and amateur astronomers, undertaken mainly as an entertaining sideline and producing conclusions that were treated with incredulity (and often derision) by all but a handful of mainstream archaeologists (see Kintigh 1992; Aveni 1992). Many factors have effected this transformation, but a vital one has certainly been the rise, since the 1980s, of a set of new approaches to archaeological practice and interpretation identified collectively under the banner of interpretive (or, as at first, "post-processual") archaeology (Hodder 1986; Johnson 1999; Thomas 2000). By shifting the emphasis away from environmental/ecological determinism and toward issues of perception and cognition, the interpretive archaeology agenda has offered studies of ancient perceptions of the skies more solid theoretical underpinnings (Ruggles 2005a). These render obsolete (what to anthropologists always were) embarrassingly ethnocentric images of ancient astronomers and observatories, while insisting that the sky must be recognized as part of the total perceived environment. As a result, they necessitate the integration of the sky into broader studies of "landscape" perception and indigenous cosmologies. The "anthropology of astronomy" (Platt 1991) has found its time.

A related factor that has come to characterize the transformation in archaeoastronomy during the last four decades is what one might call its "social contextualization": the increasing awareness among its practitioners of the broader interpretive framework within which manifestations of sky knowledge in particular cultural settings need to be framed in order to have anthropological relevance and interest. Most would now accept without hesitation a definition of archaeoastronomy as, broadly speaking, "the study of beliefs and practices concerning the sky in the past . . . and the uses to which people's knowledge of the skies were put" (see Ruggles 2005b: 19). The definition is also extendable into the indigenous present by the inclusion of ethnoastronomy, so as to cover "cultural astronomy" (Ruggles and Saunders 1993) in its entirety. This process of social contextualization has raised a variety of issues relating to theory, method, and practice. Many of these arise because of the need to integrate disparate types of evidence, and differing techniques and methodologies, deriving from a diverse set of historical disciplines (including the history of science, history of religions, and art history) as well as cultural anthropology, archaeology, linguistics, and, of course, astronomy (Carlson et al. 1999).

The first stages in the development of tools and approaches for tackling some of these problems took place in the Americas during the 1970s. It was here, rather than among "Old World" archaeoastronomers prepossessed at the time with issues of data selection and statistical verification, that the broader agenda began to be followed in earnest (Aveni 1975, 1977, 1982; Williamson 1981; Aveni and Brotherston 1983). Although early developments in North America had tended to follow the prevailing paradigms for tackling prehistoric evidence in Britain and Europe—at its worst, "alignment hunting" entirely divorced from its social context (Aveni 1988)—in Mesoamerica it made no sense to study architectural alignments without also considering inscriptions and codices, iconography, and ethnohistoric accounts. In Maya studies, where the importance and complexity of calendrical and astronomical information was already evident from the historical sources, there was an especially promising interpretive context, subsequently strengthened even more following the general acceptance of Maya writing as a readable hieroglyphic script (Coe 1992; Montgomery 2002) containing rich resources of historical information (e.g., Martin and Grube 2000). Archaeoastronomy became an integral part of Maya studies, providing key insights into the nature of Maya sky knowledge and its social application (e.g., Aveni 1992). The wider "cultural astronomy" agenda was also relevant in the Americas from the outset (Aveni and Urton 1982; Chamberlain et al. 2005), since demonstrable threads of continuity meant that modern ethnography could still give valuable insights into historical and even pre-Conquest practices (e.g., Broda, Iwaniszewski, and Maupomé 1991; Urton 1981; Milbrath 1999; Tedlock 1999).

Despite the process of maturation that has resulted in the broad acceptance of cultural astronomy, both globally and particularly within the Americas, its impact remains patchy among specialists within the different fields upon which it impinges. There are a number of reasons for this, not least the echoes of a less disciplined past that continue to reverberate to this day and the continued assaults from popularizers bent on sensationalism. Accordingly, we perceived a strong need for a collection of papers that would demonstrate, at an appropriate scholarly level, the relevance of cultural astronomy today to broader social questions, especially where these sit at the interface between cultural anthropology, history, and archaeology. This volume aims to fulfill that need. It arises from a symposium held on October 10–12, 2003, at Colgate University, Hamilton, New York, to celebrate and honor one of the field's leading proponents—Anthony F. Aveni.

Tony Aveni is one of the world's great interdisciplinarians, having contributed to a variety of fields of study during his forty-year academic career. He is widely acknowledged as America's leading archaeoastronomer as well as the founding father of Mesoamerican archaeoastronomy (e.g., Milbrath 1999: 8; Broda 2000: 233). And it is no coincidence that the process of transformation that has permitted and characterized the development, maturation, and acceptance of archaeoastronomy during the past four decades mirrors Aveni's personal development in a very direct way. Over the years, he has moved from studying "ancient astronomy" to broader issues of cosmology, perception, and indigenous concepts of space, time, number, and other related concepts. He has characterized this himself as a move from studying the "how" to studying the "why" (Aveni 2001: 7). Rather than remaining the astronomer working on the fringes of anthropology, he has constantly moved forward, ensuring that his work is increasingly contextualized in anthropological and archaeological theory and practice, with the result that he has created entirely new ways of comprehending ancient cultures through their knowledge and perceptions of the skies. It is particularly appropriate that he occupies the cross-faculty post of Russell B. Colgate Professor of Astronomy and Anthropology at Colgate University.

The studies that make up this book reflect this progression of ideas and methods and in a number of cases have been directly influenced by it. The symposium was intentionally a low-key affair rather than a high-profile adulation: an exchange of ideas among close friends and colleagues with academic interests that meshed with Aveni's own. This book was intended from the outset to provide a set of published papers that would knit together to form a cohesive whole. Hence the inclusion of the chapters by Edward Calnek and by John Justeston and David Tavárez, none of whom was at the workshop. The various papers approach issues relating to cultural cosmologies from a variety of disciplinary standpoints, while highlighting the anthropological and cultural component of Aveni's overall contributions to the field of archaeoastronomy.

The first six papers concern Mesoamerica. This geographical and historical focus not only reflects Aveni's principal (though not sole) focus of interest over the years but also makes sense because the richness of the archaeological, historical, and indeed ethnographic record in this area continues to provide particularly strong exemplars and case studies of the application of cultural astronomy to broader social questions.

The opening chapter demonstrates how historical and linguistic evidence relating to indigenous ritual calendars existing in early colonial times may be combined effectively in order to reach conclusions about the earlier spread of calendar reforms. There exists an extraordinarily rich collection of colonial transcriptions of the indigenous Zapotec ritual calendar as it existed in the northern Sierra of Oaxaca, Mexico, near the end of the seventeenth century. More than a hundred local versions were recorded from towns to the northeast of the city of Oaxaca. Justeston and Tavárez use these records to identify a range of statements (some of which are reported here for the first time) that combine to establish, quite definitively, a single correlation between dates in the colonial Zapotec and Gregorian calendars.

It is tempting to imagine the indigenous 260-day cycle—the "ritual calendar" or "sacred almanac," a common feature of Mesoamerican calendars—to have been synchronized across Mesoamerica and to have extended without adjustment from Postclassic (AD 900–1500) into colonial and even modern times. However, if variations did exist from one place to another, and if adjustments and reforms were made from time to time, then this information promises insights into a range of social processes that, directly and indirectly, led to the formation of different variants and gave rise to particular adjustments.

Justeston and Tavárez argue that their correlation for the colonial Zapotec ritual calendar is unlikely to be valid for the time of the earliest Zapotec inscriptions and conclude that the ritual calendar in this region must have undergone an adjustment. They suggest that this happened after AD 1000 as a result of cultural influences from Nahua peoples following military successes even before the rise of the Mexica (Aztecs). This could explain why the colonial Zapotec ritual calendar, along with indigenous ritual calendars among a variety of modern-day Maya communities farther south, are found (when extrapolated back in time) to be synchronized with the traditional Aztec 260-day cycle.

Meanwhile, Calnek, in the following paper, addresses the question of whether different calendars could have been in use concurrently in the Aztec capital, Tenochtitlan, and its sister-city, Tlatelolco, at around the time of the Conquest. By reexamining a particular Aztec text, the Codex Borbonicus, Calnek reopens a debate that had seemed to be cut and dried ever since a suggestion by Paul Kirchhoff in the early 1950s had been forcefully rejected by Alfonso Caso a decade later. Kirchhoff had argued that Tenochtitlan and Tlatelolco operated 260-day sacred almanacs that were twenty days out of step with each other, but Caso held that the 260-day cycle was inviolable. Caso's view was supported by the impressive consistency of the 260-day counts in Maya and Aztec calendars recorded at the time of the Conquest, a consistency that extends, as already mentioned, to surviving indigenous calendars in modern Maya communities.

Calnek argues, however, that a nineteen-month year evidenced in the Codex Borbonicus actually demonstrates that a new calendar was adopted in Tenochtitlan while the original one was retained in Tlatelolco. He concludes that a calendar reform was instituted in 1507 at Tenochtitlan, which resulted in the calendar at the Aztec capital being adjusted whereas Tlateloloco maintained the traditional Aztec calendar.

These two papers clearly demonstrate how studies of calendars and correlations can have a key role in moving us toward a less idealized conception of the Mesoamerican calendar, taking greater account of how its endless cycles were actually manipulated in practice. This emphasis on practice resonates with a number of recent investigations concerning what is undoubtedly the most valuable source of information regarding astronomical knowledge in the entire Mesoamerican world—the Maya Dresden Codex. In moving beyond the mere content, impressive as it is, of the astronomical tables within this book, Maya scholars face challenging questions concerning when and how the tables were actually compiled and used. It is generally accepted that the famous eclipse and Venus tables functioned primarily as divinatory almanacs, although there has been more debate as to whether they were effective as actual ephemerides generating predictions of empirically observable events. If so, then corrections would have had to be applied to the table before it could be recycled and re-used after a 104-year run, and this fact adds further complexity to the interpretation.

Harvey and Victoria Bricker reexamine the issue of when the Venus table in the Dresden Codex was actually used, based on a new analysis of how the events predicted in the table correlated with actual observable phenomena. Their argument is predicated on the assumption that the table was indeed used to predict actual observable events: as they point out, the iconography of the table makes it clear, for example, that the day of heliacal rise (first predawn appearance) of Venus was regarded as a time of significant danger. But whereas previous scholars have sought the closest correlations between predicted and actual events, the Brickers argue that if the purpose of the table was to forewarn of impending danger so that action could be taken to avoid it, then the predicted event must *precede* the actual one, and by no more than a few days. Thus, they conclude that the Venus table was created about a century earlier than previously thought, placing its origins in the Terminal Classic period (with a starting date of AD 934), with revised versions being used during the Early Postclassic.

Dennis and Barbara Tedlock's paper is also concerned with the Dresden Codex, but with twelve almanacs that precede the Venus and eclipse tables. In these almanacs, the lunar goddess ("Moon Woman") engages in a series of face-to-face encounters with other characters. The almanacs are interpreted as chronicles recording Moon Woman's passage among various celestial deities populating the sky and thus tracking the actual movements of the moon in relation to various asterisms. The Tedlocks offer us a closely argued interpretation of these tables in which the counterparts of Moon Woman are variously described as her herald, meaning that they rise ahead of the moon; as a burden she carries on her back, meaning that the stars in question appear above the horizon just after moonrise; and as having her as their wife, meaning that they appear alongside the moon. In formulating details of Moon Woman's passage through the stars, the Tedlocks provide identifications of deities with asterisms that draw on their extensive knowledge of Maya written sources, ethnohistory, and ethnography, bringing in evidence from the Dresden Venus table, almanacs in other codices, Classic period Maya art, Maya vocabulary from colonial times, the Popol Vuh, and astronomical practices among contemporary Maya groups.

The Tedlocks are concerned with an aspect of Maya astronomy that is poorly understood, namely, the use of the "fixed" asterisms to provide spatial referents in relation to which the motions of the sun, moon, and planets could be perceived and described. Although it may be clear that specific asterisms are being named in inscriptions and texts, identifying them is a process fraught with complexities, mainly because of the breadth of choice available in the sky. It is notoriously easy to obtain impressively good fits for suggested identifications of asterisms by making arbitrary choices; without independent verification, this information proves little or nothing about what was actually significant to the Maya, as is evident from some of the widely differing interpretations of the same sources. It is only by carefully combining and integrating evidence from multiple sources that the Tedlocks have been able to produce a plausible and supportable case for their interpretation of the Dresden lunar almanacs. In passing, they also offer us a definitive choice between two different methods that have been suggested for reading the text in the Dresden lunar almanacs, and hence for interpreting the given dates and time intervals. Only one of these methods permits an astronomical interpretation of these intervals.

Up to this point the contributors have been concerned with the calendar and the interpretation of astronomical texts in terms of perceived celestial events and relationships, focusing on both temporal and spatial aspects. Susan Milbrath combines all of these approaches in a radical reexamination of the astronomical imagery contained in pages 29–46 of the Codex Borgia, a key document from the Postclassic period in central Mexico. This sequence of pages describes the passage of Venus through the underworld. Milbrath argues that earlier attempts to provide a "literal" interpretation of the pages in question in terms of the 584-day synodic cycle of the planet do not fit the evidence. Her contention is that these pages actually depict Venus events in the context of the festival cycle of a single year. However, as we have no direct knowledge of the festival cycle before the time of the Conquest, support for the idea can only come from combining strands of indirect evidence.

The pages in question contain iconographic representations surrounded by day signs. According to Milbrath's analysis, the images depict Venus events in the context of successive twenty-day "months" (*veintenas*) within the 365-day cycle ("vague year"). The images contain iconography interpreted as relating to rituals performed as part of the festival cycle as well as astronomical imagery. One of them shows gods attacking sun disks with knives and appears to represent an eclipse event. The sequence of images shows that this event occurred six "months" earlier than a fire ceremony, and post-Conquest accounts attest that fire ceremonies only occurred in certain veintenas. These constraints suggest that the festival calendar recorded on these pages relates to the year 1496, a year that could have been all the more significant, Milbrath contends, because the new Venus cycle began roughly at winter solstice, added to which there was a dramatic solar eclipse. If Milbrath is right, these pages represent a "literal" (in other words, a historical) record of actual events in a particular year, the cycles of the seasonal calendar, and the associated festivals, providing the backdrop against which the various celestial events were perceived. In addition, the day signs record intervals of time that relate not only to the eclipse interval but also quite possibly to visible events in the synodic cycles of Mercury and Venus.

Clemency Coggins's paper, although also about Mesoamerica, spans the whole of Mesoamerican history right back to the Middle Formative period in the first millennium BC. It traces the theme of basic systems of bodily measurement and their relationship to the calendar, a topic given poignancy by the extraordinary persistence of the Mesoamerican calendar's broad structural characteristics through the turbulent history of Mesoamerican city-states. According to Coggins, this persistence reflects a deeper cognitive framework in which there are ingrained relationships between body, geometry, time, and space. In support of this idea, Coggins considers various apparent representations of the twenty-day count found within monuments and on portable artifacts.

This study introduces a broad swathe of evidence deriving from the material rather than the historical record—built architecture, natural features, symbols, spatial and numerical relationships—which includes as just one part the orientations and architectural alignments that have come to epitomize archaeoastronomy as practiced in prehistoric contexts around the world. It has been a major part of Aveni's contribution, through much of his work in Mesoamerica, to set an example whereby such evidence is neither ignored nor overstressed but simply considered in due proportion within the broader context. Something that has intrigued Aveni greatly over the years is the symbol known as the pecked cross or pecked cross-circle.

The pecked crosses provide a central plank of Coggins's argument. These pecked crosses, she argues, provide evidence of the persistence of a ritual from the time of the foundation of Teotihuacan until a millennium or more later, reflecting the importance of the number twenty in laying out both the city itself and outlying sites. More generally, and drawing on a variety of other evidence, she argues that, through Mesoamerica and from Formative until colonial times, the human body was understood as providing the fundamental count of twenty that underlay not only the conception and expression of numerals but also the calendar (i.e., time), the measurement of length and distance, and even orientation. The fundamental significance of the number twenty was metaphorically expressed in a variety of ways.

In the study of the landscape situation, orientation, and especially the numerological/calendrical symbolism of the pecked cross-circles, we see, as with the work of the Tedlocks on the identification of named asterisms in the Dresden lunar almanacs, critical approaches being applied to the sorts of problems that can so easily attract wild speculation and that many serious scholars might abandon as hopeless. The way forward can only be through meticulous scholarship and the consideration of the widest possible range of historical, ethnographic, and archaeological evidence.

Gary Urton's paper also uses the investigation of numerological relationships as a means to explore the possible storage of calendrical and other information. In shifting the focus to the Inka world, we encounter a context where information was recorded in a very different form from the inscriptions and books of Mesoamerica. Here, where the most highly valued medium was cloth rather than stone or parchment, it is not immediately evident that it was even possible to record and display complex calendrical, or calendrically related, information. And yet, Urton argues, such information was recorded just as keenly; it was simply expressed in a different, and less durable, material form.

The use of the knotted string devices known as *khipus* to record calendrical information is a topic that Urton has written about extensively elsewhere. Here, however, he is concerned with a very different medium: large tapestry mantles divided into squares bearing geometrical designs known as *tukapus*. In this paper he examines a particularly impressive rectangular mantle, strikingly patterned, arguing that it was actually designed and produced as a commemorative five-year calendar. The calendrical nature of the design is revealed in the spatial arrangement of the squares themselves; the different tukapus, Urton suggests, could have represented around 26 distinct entities (such as individuals or kinship groups), showing how they assumed particular roles or performed particular actions on particular dates. The "haphazard" nature of the distribution of these symbols among the pattern suggests that this temporal pattern was historically rather than structurally defined.

Remaining in the Inka world, Tom Zuidema elaborates on his work with Aveni concerning the "ceque calendar," examining possible connections between lunar observations and the observations of sunrise and sunset on the dates of zenith and antizenith passages, respectively. Zuidema has long claimed that such connections served as the foundation for a calendar based on direct observations supported by a tightly integrated system of ritual movements within the landscape of the Cusco valley. Here he argues that the year in Cusco was divided into two periods of unequal length: one when the sun was said to be low and the (full) moon high and the other when the sun was high and the moon low. This basis, he suggests, led the Inka to construct a calendrical system that was quite distinctive from others on the two American continents, although it also contained some features similar to Mesoamerican calendars, such as the use of twenty-day periods.

The remaining papers in this volume reflect not so much the cultural focus of Aveni's interests but the pivotal contributions he has made to method and practice in cultural astronomy. Aveni single-handedly pioneered, during the 1970s, what subsequently—by his own nomenclature (Aveni 1989a)—became known as "brown" archaeoastronomy,[1] an approach that sought to embed studies of monumental alignments in a solid context of cultural evidence deriving from firsthand written sources (inscriptions and codices), ethnohistory, and ethnography. It would be a decade or more before the other, "green" arm of the discipline—focused on prehistoric Europe and hence devoid of written, historical, and ethnographic evidence of any conceivable relevance—fully embedded its own alignment studies within the broader context of archaeological evidence and theory, thereby facing its own new methodological issues (Ruggles 1999, 2000).

One of the reasons why these approaches remain so different is that in the Mesoamerican context the historical evidence not only exists but dominates. One only has to look, for instance, at the well-known example of the alignment of the Governor's Palace at Uxmal (Aveni 2001: 283–288) for confirmation: the idea that this one-off alignment relates to Venus[2] is rendered plausible, indeed likely, by Venus iconography on the building itself (Aveni 1997: 139–142) together with a broad range of evidence testifying to the general significance of Venus in Maya society (Milbrath 1999: 157–217) and indeed throughout Mesoamerica (e.g., Carlson 1993, 2005; Šprajc 1996). In the absence of such evidence, and given that the alignment was not repeated elsewhere, it would have been unthinkable to claim with confidence that this particular building was deliberately aligned upon an extreme rising or setting point of Venus.

Clive Ruggles's paper on ancient Hawaiʻi presents a case study where archaeological, and particularly archaeoastronomical, evidence has to be considered alongside evidence from "oral literature"—stories, creation myths, formal chants, and accounts of former practices recorded after European contact. Although abundant, these represent evidence of uncertain provenance: they have to be treated with due caution but cannot simply be ignored. Ancient Hawaiʻi, then, represents a methodological "halfway house" between the green and brown approaches. How do we best combine oral evidence relating to navigational astronomy, calendrical practices, the significance of specific places, and the function of various types of temple and shrine (*heiau*) with data on the form, spatial layout, location (within the natural and cultural landscape), and astronomical potential of heiau remains so as to gain new insights into religious practices and cosmological principles? Tackling these questions has produced some important new results: for instance, in remote districts of Maui and Molokaʻi evidence emerges of four distinct types of temple orientation that can be linked to cardinal directions and calendrical events as well as to agricultural practices and the four principal Hawaiian gods.

In a volume focused mainly on New World cosmologies, the inclusion of a contribution on church orientations in medieval England might seem particularly incongruous. However, as we seek to improve methodologies for combining historical evidence and alignment data in different cultural contexts, the paper by Stephen McCluskey sheds important new methodological light as well as addressing a set of questions that have remained surprisingly neglected until recently: who determined the orientation of a medieval church, how did they do it, and what were the criteria they used? For a long time the matter seemed trivial—churches being assumed, simply, to face east—although more specific ideas surfaced from time to time. Chief among them was the idea that churches faced sunrise on a particular day: perhaps the day that construction began, the feast day of the church's patron saint, Easter Sunday in the first year of construction, or the equinox as determined according to the Julian calendar. Although some of these ideas might hold true in certain localities and epochs, none of them fits a broader range of the data. Instead, as McCluskey finds, what we actually have is a set of diverse local practices that, when examined more closely, can reveal elements of social interaction (between landowners, local priests and craftsmen, and ordinary villagers) that underlay the practical implementation of liturgical norms.

In addition, as McCluskey points out, we now know from the work of Aveni and others that in Mesoamerica numbers and dates were not abstract entities and measures of time but symbols laden with cosmic meaning. This is a theme that McCluskey finds he can tease out in a very different context. Drawing on historical sources, such as Bede of Jarrow, he suggests a paradigm shift in which we might view church orientations upon sunrise on specific days in a similar light, those days having ritual, eschatological, and numerological significance. In other words, this example shows how broad inferences from work in the Americas can have interpretive influence much farther afield.

This observation applies equally well to the theme addressed in the final paper, by Edwin Krupp. In Mesoamerica, as elsewhere, the primary motivation for acquiring astronomical knowledge—even where taken to the extraordinary levels of detail and complexity evident in the Dresden Codex—is frequently astrological (Thompson 1972: 77; Aveni 2001: 173). More generally, sky knowledge was typically interwoven with the broader ability to access supernatural power from the spirit world and from powerful forces of nature. The specialists concerned often considered themselves, and were considered, as operating not so much in the realm of science as in that of magic. Yet we should not see an inherent dichotomy between these realms so much as different (and not necessarily exclusive) cultural perceptions of ways of perceiving the cosmos. Studying perceptions of the history and meaning of occult magic offers, in other words, the opportunity for broader insights into the cultural context of different perceptions of reality (Aveni 1996). Picking up on this theme, Krupp examines the roots of the modern conception of magicians, sorcerers, and wizards and the place of astrological lore and astral symbolism in the processes that came to form and shape that image in the nineteenth century.

Just as this book starts in the intellectual heartland of cultural astronomy—Mesoamerica—and broadens both geographically and thematically, so studies of cultural perceptions of the skies have broadened dramatically over the past forty years from a narrow prepossession with "alignment studies" of little interest to anthropologists at large to a situation in which serious anthropologists generally acknowledge the importance of perceptions of the sky to ancient, historical, and modern indigenous societies. Nowadays they are seriously interested in how the sky influences broader cosmologies and the relevance of such studies to wider cultural questions. Aveni's career has not only reflected but helped to propel this transformation, and his work will continue to inspire those who seek to understand how perceptions of the sky have influenced, and can influence, human thought and action. Archaeoastronomers and anthropologists researching the myriad ancient and modern cultures around the world owe Tony Aveni a deep debt of gratitude.

NOTES

1. The expressions "brown archaeoastronomy" and "green archaeoastronomy," coined by Aveni (1989a), derive from the colors of the covers of two volumes arising from the first Oxford International Symposium on Archaeoastronomy held in 1981. The brown volume (Aveni 1982) contained papers relating to the New World whereas the green volume (Heggie 1982) covered the Old World.

2. This statement disregards arguments about its specific directionality (Šprajc 1993: 272–273; Aveni 2001: 286), which are irrelevant to the point being made here.

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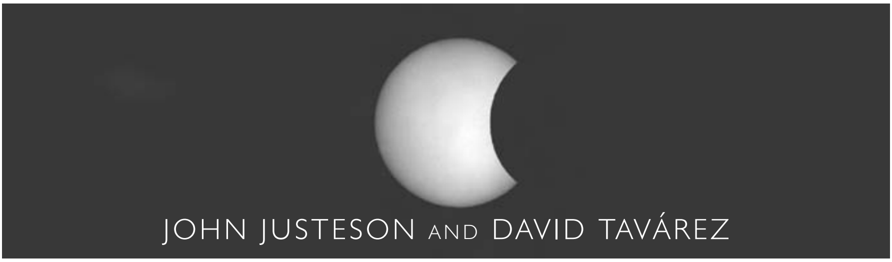
CHAPTER ONE



JOHN JUSTESON AND DAVID TAVÁREZ

The Correlation between the Colonial Northern Zapotec and Gregorian Calendars

INTRODUCTION

This paper provides evidence for the correlation between dates in the Gregorian calendar and dates in the Zapotec calendar, as it was in the northern Sierra of Oaxaca near the end of the seventeenth century.[1] It concerns specifically the correlation of two calendrical cycles that are not only found in the Zapotec calendar system but that are widely distributed in Mesoamerica: the 260-day ritual calendar and the 365-day calendar (the VAGUE YEAR).

Based on the data provided by Córdova (1578a: 204–212), the sixteenth-century Zapotec ritual calendar can be seen as a permutation of two independent cycles, each of which advances once a day: a thirteen-day cycle (the TRECENA, referred to by Córdova as the ⟨cocii⟩), whose successive days are named by successive numerals from 1 to 13; and a twenty-day cycle (the VEINTENA), whose successive days are named by a fixed sequence of roots, mostly of

TABLE 1.1. Colonial Zapotec day names, mostly as extracted by Kaufman (2000a) from Córdova (1578a), and from calendars reported by Alcina Franch (1993) for the Villa Alta and Choapan regions of Northern Zapotec. Capital *E* transcribes a letter that appears sometimes as ⟨e⟩ and sometimes as ⟨I⟩; *EE* is for ⟨ee⟩ varying with ⟨ii⟩. The symbol = joins the compounded units within a compound word. Meanings are due to Kaufman, informed by Urcid (1992, 2001). Kaufman's reconstructed meanings are sometimes used in this paper to label veintena positions. Our only departure from Kaufman's results is in treating spelling variations of 'Wind' and 'Reed' as reflecting a shift of underlying *e* and *E* to *a* after augments ending in *-l(aa)* rather than a variant *=laa*. These names do not occur with the classifiers that appear with some of these roots in their ordinary meanings, for example, **kwe+* in proto-Zapotec **kwe+ tzina* 'deer.'

	Córdova, Arte	*Colonial Northern Zapotec*	*Meaning in colonial Zapotec*	*Original meaning in Mesoamerica generally*
1	=chiilla	=chila	cayman	cayman
2	=ii	=ee	wind	wind
3	=EEla	=Ela	night	night
4	=Echi	=Echi	big lizard	lizard [esp. iguana]
5	=zii	=çee	??	snake
6	=laana	=lana	smelling like fish, meat	death
7	=china	=tzina	deer	deer [not brocket]
8	=laba	=laba	??	rabbit [not hare]
9	=niça	=niza	water	water
10	=tella	=tela ~ =dela	knot	dog [maybe coyote]
11	=loo	=lao	monkey	monkey [esp. howler]
12	=piia	=biaa	soaproot	tooth or twist
13	=ii	=ee	reed	reed
14	=Eche	=Etzi	jaguar	jaguar
15	=nnaa	=ina	corn	eagle
16	=loo	=lao	crow	sun or buzzard
17	=xoo	=xoo	earthquake	earthquake
18	=opa	=opa	root of 'cold' and 'dew'	flint
19	=aappe	=Epag	??	storm
20	=lao	=lao	face	macaw

words that are drawn from ordinary vocabulary for a variety of plants, animals, and forces of nature. The names of days in the colonial Zapotec veintena are given in Table 1.1. Córdova displays a complete 260-day cycle of the calendar, broken up into numbered trecenas; this organization in trecenas is attested in a number of screenfold documents, and is ethnographically attested—for example, in (K'ichee' Mayan) Chichicastenango (Bunzel 1952: 283).

In these respects, the Zapotec ritual calendar was similar to others throughout Mesoamerica. But the data provided by Córdova show that in the sixteenth century it also differed from those documented in other parts of Mesoamerica, in at least three ways.

(1) The numerals of the trecena, which are fully spelled out, follow rather than precede the day names. This was first pointed out by Whittaker (1983: 127), who noted the agreement between this word order and that in most Zapotec hieroglyphic inscriptions.

(2) Each day name recorded by Córdova is preceded by one of eleven orthographically distinguishable words, often referred to in current literature as "prefixes" or "numerical prefixes": see Table 1.2. In order to avoid overinterpreting their grammatical and semantic function, these words can be referred to as augments (this terminology was suggested to us by Terrence Kaufman). It cannot be definitively determined whether these augments are separate words that combine with the day name to form a compound; however, because the day names never appear without them, and they never appear without the day names, Kaufman provisionally treats them as prepounds (preposed compounding elements). That the augment attaches to a root rather than to a classifier + root (e.g., to something like *=e:7* rather than something like *p+e:7* 'wind') presumably reflects the close syntactic relation of augment and day name.

The augments *correspond* to the numeral coefficients that follow the day names and are generally predictable from them, according to the analyses of Seler (1904) and subsequent investigators:[2] for any coefficient, from 1 to 13, the same augment is normally used—that is, they are taken to repeat in a thirteen-day cycle. However, the augments are not known to be numerals in any form of Zapotec, nor in fact in any other Mesoamerican language. Whittaker (1983) recognized the variable presence of the syllable *la* at the end of most augments; Kaufman treats this *la* as a suffix. Kaufman recognized systematic variation in the forms of the augments depending on whether the following day name began with a vowel, with *l,* or with a consonant other than *l.* Although the augments corresponding to most coefficients are distinguishable from one another, there are fewer than thirteen orthographically distinguishable forms. Whittaker recognizes just nine forms, treating augments corresponding to 2, 5, and 9 as equivalent to one another and augments for 8 and 11 as equivalent. We adopt Kaufman's (2000a) analysis of Córdova, with eleven forms; he distinguishes the augment corresponding to 5, which does not take *-la* before the day name ⟨lana⟩, from that corresponding to 2 and 9, which often shows *-la* or *-lo*; and he distinguishes that for 8 from that for 11, based on their prevocalic forms (*nel=* versus *l=*).

(3) The colonial Zapotec 260-day count had four major subdivisions of 65 days each, called ⟨cocijo⟩ (pZap[3] **ko+ se7yu* 'thunder, lightning', also

TABLE 1.2. Colonial Zapotec day name augments. *C* labels forms extracted by Kaufman (2000a) from Córdova (1578a). *N* labels forms extracted by Justeson from Alcina Franch (1993) and from Oudijk's transcriptions of the calendars (Oudijk 2005), analyzed following Kaufman's treatment; rare forms (some, possibly, errors in the manuscripts) are in square brackets. The symbol 0 indicates that the day name appears without an orthographically recoverable augment. Forms with *yo=* and *yo-lo=* may have originated in a reduction of *beyo=la* from three to two syllables; if so, it was extended to the most similar forms, for which Córdova has *be-la=* or *bel=* , and sporadically elsewhere. Córdova's presentation contains a number of discrepancies that are probably errors; but several cases of *kka-la=* corresponding to 8 and 11, and of *kwa-la=* corresponding to 9, may be alternatives to (*ne-*)*l=* and *be-la=* .

	Basic phonemic shape	*Corresponding trecena numerals*	*Before* l	*Before other consonant*	*Before vowel*
C	*gyag= ~ gyaj=*	1	*gyaC=*	*gya=*	*gyag=*
			gyaj=	*gyaj=*	*gyaj=*
N	*yag=*		*yag= ~ yagy*	*yag=*	*yagy=*
					[*~ yag=*]
C	*be-la=*	2	*be-la=*	*be=*	*be-l=*
N	*yeo-lo=*		*y(e)o(-lo)=*	*y(e)o(-lo)=*	*y(e)o-l=*
C	*be-la=*	9	*be-la=*	*be=*	*be-l=*
N	*yo-lo=*		*yo(-lo)=*	*yo(-lo)=*	*yo-l=*
C	*beo-la=*	3	*beo-la=*	*beo=*	*beo-l=*
N	*yeo-lo=*		*y(e)o=*	*y(e)o(-lo)=*	*y(e)ol=*
			[*~ ka=*]	[*~ kka-la=*]	
C	*bel=*	5	*be=*	*be=*	*bel=*
N	*yo-lo=*		*yo=*	*yo(-lo)=*	*yol=*
C	*kka-la=*	4	*kka-la=*	*kka=*	*kka-l=*
N	*(k)ka-la=*		*(k)ka(-la)=*	*[(k)ka-]la=*	*((k)ka-)l=*
			[*~ yo=*]	[*~ yo=*]	
C	*kwa-la=*	6	*kwa-la=*	*kwa=*	*kwa-l=*
N	*kwa-la=*		*kwa(-la)=*	*kwa=*	*kwa-l=*
C	*billa=*	7, 10	*billa=*	*bil(la)=*	*bill=*
N	*bila=*		*bi(la)=*	*bila= ~ bela=*	*bil=*
C	*nel=*	8	*ne=*	*ne=*	*nel=*
N	0-*la=*		0=	0= ~ 0-*la=*	0-*l=*
			[*~ (y)a= ~ na=*]	[*~ ya= ~na=*]	
C	0-*l=*	11	*ne=*	*ne=*	0-*l=*
N	0-*l=*		*na= ~ ya= ~* 0=	0-*la=*	0-*l=*
			[*~ yo=*]	[*~ a= ~ yo=*]	[*~ yo-l=*]
C	*bino=*	12	*bino= ~ bina=*	*bino=*	*bin=*
N	*bene=*		*bene=*	*bene=*	*ben= ~ bin=*
C	*beze=*	13	*beze=*	*beze=*	*bez=*
N	*yeze=*		*yeze=*	*yeze=*	*yiz=*

> meaning "Dios de las lluuias" according to Córdova [1578b: 141r]; also referred to by Córdova as ⟨pitao⟩ 'god'). Each was composed of five trecenas, numbered first through fifth (Córdova 1578a: 202, 203–204). The 65-day unit is referred to in the remainder of this chapter as the COCIYO. There are parallels to this quadripartite subdivision in pre-Conquest codices from several Mesoamerican culture areas (Urcid 2001: 90); Michel Oudijk (personal communication to Thomas Smith-Stark, 2005) points out in this connection the appearance of the storm god with each of the four quarters of the 260-day ritual calendar on page 27 of the Borgia Codex (Anders, Jansen, and García 1993: 167–174). Only in the Zapotec system, as far as we know, are these subdivisions enumerated or recognized terminologically.

Córdova provides no data on the 365-day calendar. In Mesoamerica generally, the 365-day year is composed of eighteen months of twenty days each, followed by a group of five days that ends the year. We refer to these days as the NAMELESS DAYS—notwithstanding the fact they have names in some traditions—following the most widely shared expression designating them. Caso (1928, 1947) showed that this calendar is attested in the hieroglyphic inscriptions of Monte Alban, in the year-bearer system. In Mesoamerica generally, the year was named for the day of the ritual calendar on which a cardinal day of the vague year fell: in some areas it fell on the first day, and in others it fell on the 360th day. In several Mesoamerican languages, this day is referred to by an expression that means something like "the ruler of the year"; Mesoamericanists refer to it using a Mayan version of this expression, the YEAR BEARER. Many Zapotec hieroglyphic inscriptions, including most on non-portable objects, record the names of the years during which the events that they relate took place. Especially during the Late Preclassic period, a day in the vague year was referred to by specifying both the date on which it fell in the ritual calendar and the name of the year within which it occurred (always in association with the day in the lunation [Justeson and Kaufman 1996–2000]); in the Classic period, day names within the year are rarely, if ever, specified. In colonial Zapotec documents known to us, day names and year names are rarely found together.

The same cardinal position in the year is reached every 365 days, and the same position in the ritual calendar is reached every 260 days. The least common multiple of these intervals—when the same ritual calendar date appears in the cardinal position in the year, and thus names the year—amounts to 52×365 (= 73×260 = 18,980) days. As a result, there are just 52 distinct named years; the 52-year period is referred to by Mesoamericanists as the CALENDAR ROUND. This period is discussed in more detail on p. 35 following.

No evidence of the Zapotec ritual calendar other than Córdova's 1578 description survives from the sixteenth century. However, documents dating from the end of the seventeenth century show that local Zapotec COLANÍS (ritual calendar specialists)[4] had continued to maintain the formal constructs of the Zapotec 260-day calendar, and to use it for divination, for propitiation, and to give calendrical names to newborns.

After Córdova, the earliest evidence for the transcription of this calendar comes from the activities of Diego Luis, a former town official for the township of San Miguel Sola and an influential colaní who was investigated by parish priest Gonzalo de Balsalobre for divination, propitiation, and possession and distribution of clandestine ritual texts in 1635 and 1654 (Berlin-Neubart 1988; Tavárez 1999). According to trial records, Diego Luis stated that the 260-day count that he had transcribed into small booklets had a quadripartite division, and that it was divided into thirteen veintenas, each of which was ruled by one of thirteen deities (AGN Inquisición 437-I no. 3). In accordance with common idolatry extirpation procedures, these transcriptions of the ritual calendar were burned by Balsalobre.[5]

Nevertheless, there exists an extraordinarily rich collection of colonial transcriptions of the 260-day calendar from Zapotec towns in Villa Alta, an *alcaldía mayor* located to the northeast of Oaxaca City. Between September 1704 and January 1705, the elected authorities of at least 105 Zapotec, Chinantec, and Mixe communities from Villa Alta and Nexapa registered communal confessions about their local ritual observances before a representative of Oaxaca bishop Friar Ángel Maldonado in exchange for a blanket immunity (*amnistía general*) from idolatry proceedings (Miller 1991, 1998). Many of these officials also surrendered booklets (*cuadernos*) containing alphabetic texts in various forms of colonial Northern Zapotec, some of them several. All told, 103 separately bound booklets were turned in. Contained within 99 of them, among other writings, were 103 full or partial copies of the 260-day Zapotec ritual calendar. The remaining four booklets were transcriptions of four separate song cycles of ritual songs that were performed to the beat of a wooden cylindrical drum, the ⟨nicachi⟩; two of them celebrate local accounts of cosmological and mythohistorical foundational events, and the remaining two were devoted to Christian entities (Tavárez 2006).

These texts were spared from the flames owing to a conflict between the bishop and the Dominicans of Oaxaca regarding the creation of new curates, which led Maldonado to submit a dossier to the Council of the Indies containing the collective confessions and the booklets. Eventually, these documents were incorporated into the holdings of the Archive of the Indies in Seville as *legajo* (bundle) 882 from the Audencia of Mexico (AGI México 882).[6]

Most of these Northern Zapotec calendars contain a complete list of the 260 day names, in order, always starting with 1 Cayman (spelled ⟨yagchila 1⟩, or the like). The spellings of the day names vary, but they can be orthographically equated with those given by Córdova; see Table 1.1. As in Córdova's presentation, most days in the sequence of 260 are explicitly grouped into trecenas; in Booklet 91, as in Córdova, they are explicitly numbered from 1 to 20 (only 5 is missing). In some manuscripts, the 65-day cociyos appear; they are introduced with a label like ⟨cozio⟩, ⟨gocio⟩, ⟨gociio⟩, or other orthographic variants corresponding to Córdova's ⟨cocijo⟩ for the quarters of the ritual calendar. The day names are almost always spelled with their augments; see Table 1.2. Most of the augments are essentially the same as in Córdova, but the forms corresponding to *beyo-la=, be-la,* and *bel=* are all replaced by *yo-lo=* (*beyo-la* often by *yeo-lo*), leaving just nine distinct augments. In general, these calendars agree with Córdova in placing the numerals of the trecena (always written with Spanish numeral signs) after the day names. Many calendars also contain auguries for each day, as stated by Córdova; these auguries recur at predictable intervals.[7]

The geographic origins of these 103 booklets span the province of Villa Alta. Their sources include all three major Zapotec sociopolitical groups in the region: Cajonos in the southwest, Nexitzo in the northwest, and Bijanos in the north and northeast. These divisions also correlate with three of the main linguistic subgroups of the Northern Zapotec branch of the Zapotec language group, and features diagnostic of these linguistic divisions are found in the booklets.

Nonetheless, the local provenance of each calendar, or the colaní who allegedly had it in his possession, is rarely made explicit. Alcina Franch (1966, 1993) proposes a place of origin for each published calendar based on the post-1960s order of binding of the collective confessions and calendars of legajo 882; but linguistic criteria and annotations found in the calendars strongly suggest that the place of origin cannot be systematically assigned by binding order alone. Even though it may be possible to propose a local origin for various calendars based on the information and document description detailed in the 1704–1705 collective confessions, for most these proposals are not secure since the confessions do not systematically mention calendar page length and other relevant details. Since these booklets have not yet been the focus of a systematic dialect and paleographic analysis, no specific source is attributed in this paper to the documents discussed herein, with the exception of Booklets 81 and 94 (see pp. 42 and 55 following). Sometimes, however, Tavárez assigns a plausible regional source for the documents based on an isogloss that is systematically represented in hundreds of colonial Northern Zapotec documents. Zapotec speakers from Bijanos and Nexitzo towns use ⟨tz⟩ in spelling certain lexical items like ⟨titza⟩ ('word') and ⟨tzela⟩ (a coordinating conjunction), but Cajonos Zapotec speakers render these words with ⟨ch⟩ as in ⟨ticha⟩ and ⟨chela⟩. This diagnostic feature reflects a retention of proto-Zapotecan[8] **tz* (both single and geminate) in Bijanos and Nexitzo Zapotec and a shift of **tz* to *ch* in Cajonos Zapotec, according to Kaufman (1994–2004 and personal communication, 2005). These three forms of colonial Northern Zapotec are also distinguished by other phonological, morphological, and syntactic characteristics, which however have not been the subject of systematic investigation.

Alcina Franch (1966, 1993) produced a scholarly analysis of these documents, and published and discussed twenty-two of them, along with a facsimile of one full calendar (Booklet 85). Alcina Franch's publications summarized the ritual practices described in the collective confessions, proposed a generally accurate list of the augments and of the twenty underlying day name forms in these calendars, and provided a broader scholarly audience with access to these important texts. The correlation was worked out initially from data relevant to the correlation problem that were recognizable from Alcina Franch's (1993) presentation. Because Alcina Franch and his collaborators did not have extensive practice in transcribing or interpreting colonial Zapotec texts and had little knowledge of any Zapotec language, some of their transcription choices are inaccurate or incomplete. As a result, the primary textual data for this paper are direct transcriptions by Tavárez from a microfilmed reproduction of the corpus. Michel Oudijk has generously shared with us and many other researchers his "quick and dirty" transcriptions of the whole of AGI México 882 (Oudijk 2005). Several additional statements relevant to the correlation can be recognized in Oudijk's data, which we present in Tavárez's transcription.

Several of the manuscripts mention one or more dates in the Gregorian calendar. Booklet 85 (pp. 25–38 following) aligns selected dates in the 365-day Zapotec year with their position in a Spanish calendar and mentions the year 1696 at the end. Booklet 27 (pp. 38–42) aligns a portion of a Spanish calendar with the first cociyo of a Zapotec ritual calendar and includes four statements of correlation between a Gregorian date and a ritual calendar date; the Spanish year is not specified. Booklets 85 and 27 together suffice to work out the correlation of the Gregorian calendar with the colonial Sierra Zapotec calendar.

Booklet 81 (pp. 42–47) has two statements of correlation between Gregorian dates and a ritual calendar, which are explicitly stated to be the dates of eclipses; these two statements are inconsistent, but the discrepancy is unambiguously correctable, and by itself Booklet 81 suffices to establish the correlation. Booklet 63 (pp. 47–55) identifies nineteen Zapotec ritual calendar dates in the Spanish year, in two cases with the year specified; seventeen of these dates are consistent with one another and are sufficient to establish the correlation, and the other two are correctible. The correlations established from Booklets 85 and 27, from Booklet 81, and from Booklet 63 are described in the sections that follow. The results are identical.

Partial support for the same correlation comes from Booklet 94 (pp. 55–58). It provides two parallel statements of correlation, which however are mutually inconsistent; the first and more explicit statement agrees with the correlation established from Booklets 27, 63, 81, and 85.

Booklets 51, 62, and 88 associate dominical letters and/or Spanish day names with ritual calendar dates. These statements do not include enough information about the Spanish dates to provide independent evidence concerning a correlation. However, using the correlation established by the other calendars, they yield a date or range of dates for each of these calendars.

Many of these correlational statements are recognizable in Alcina Franch's transcriptions; the correlation was initially worked out from these statements, which are reported in the following sections. Other correlational statements are reported here for the first time. This paper uses all these records to establish the correlation of the colonial Northern Zapotec calendar with European chronology.

BOOKLET 85

Just one of the calendrical manuscripts from legajo 882—the first calendar bound in Booklet 85—presents detailed data on the internal structure of a 365-day Zapotec year. This Villa Alta Zapotec calendar was published, in transcription and facsimile, by Alcina Franch (1993), who provides a fairly thorough discussion of it.

A page of Booklet 85 is transcribed in Table 1.3; to this transcription we add a final column that gives the distance from the date with which it is associated to the next date in the transcription. This transcription agrees with Alcina Franch's in all important details except two. First, Alcina Franch read the first date as ⟨25 Febrero⟩. It actually reads ⟨23 Febrero⟩, as was recognized independently

TABLE 1.3. The 365-day year, transcribed from a photocopy of the original; this transcription differs in some respects from that of Alcina Franch (1993: 389). Spaces transcribed in Zapotec forms are larger than spaces not transcribed; forms that could be transcribed with spaces are ⟨too huà⟩, ⟨ti na⟩, and ⟨qui cho lla⟩.

Tablas i

e	23	Febrero	1	toohuà	+20
d	15	março	2	huitao	+20
c	4	Abril	3	tzegag	+20
b	24	Abril	4	lohuee	+20
A	14	marioz	5	yag queo	+20
g	3	jonio	6	gabe nà	+20
f	23	jonio	7	gola goo	+20
e	13	jollio	8	cheag	+20
d	2	Agosto	9	gogaa	+20
c	22	Agosto	10	go naa	+20
b	11	Sentibre	11	gaha	+20
A	1	Octobre	12	tina	+20
g	21	Octobre	13	zaha	+20
f	10	nobiebre	14	zahi	+19
d	29	nobiebre	15	zohuao	+20
c	19	Decienbre	16	yetilla	+20
A	8	Enero	17	yecho	+20
g	28	Enero	18	go hui	+20
f	17	febrero	19	quicholla	+6
e	23	febrero	20	queai nij	
		1b 1696 años			
vigillia Samathie cij làçà tohuà					

by Smith-Stark (2002); this identification is proven by a comparison of the second digit with all other instances of ⟨3⟩ and with all instances of ⟨5⟩ in the manuscript (Figure 1.1). This result is required in any case by the occurrence of this date with the dominical letter *e* (see pp. 27–28, following). In a handwritten note in Justeson's possession, which appears to date from around 1978, Lounsbury analyzed the dominical letter data based on Alcina Franch's (1966: 131) transcription. Concerning the initial date, he wrote: "The first day number is wrong. February 25 is not an *e*. February 25 to March 15 is 18 days, whereas *e* to *d* is 20 days. Thus the day *letters* are correct while the first day-of-the-month number is wrong; it should be February 23, which *IS* an *e*" (unpublished handwritten note, in materials bequeathed to Justeson). The second difference of detail is that Alcina Franch mistakenly transcribes the dominical letter *f* as *F*; the importance of this error is that the distinction between capital and small letters is meaningful in some versions of the dominical letter system.

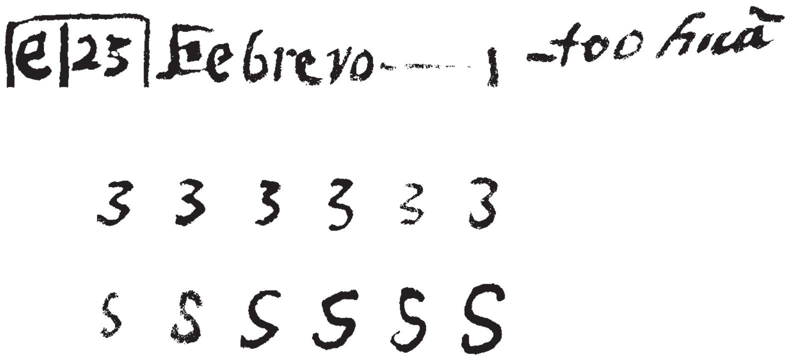


Figure 1.1. The date 23 Febrero in the calendar of Booklet 85. All comparative forms for the numeral ⟨3⟩ come from the same page as the European date. There are only two examples of ⟨5⟩ on this page, which are presented first; the other four instances of ⟨5⟩ come from the two immediately following pages.

Dominical Letters

The system of dominical letters involves the use of the letter *a* or *A* for whatever day of the week was the first day of the year. Thus, if a year begins on Saturday, as it did in 1695, then *a* means Saturday in all of its occurrences in that year. Similarly, the next six letters, *b* through *g,* stand for the remaining days of the first week of the year; in 1695, *b* was Sunday, *c* was Monday, and so forth. Projecting backward from the recorded dates, it can be confirmed that January 1 corresponded to the dominical letter *A* in both European years involved in Booklet 85.

In the standard European system of dominical letters, the letter corresponding to Sunday was capitalized. This convention is the source of the term "dominical": a particular letter corresponds to Sunday—to *domingo,* "the Lord's Day." Under this system, when two successive years, or parts of them, are transcribed, as in the calendar of Booklet 85, different letters should be capitalized in the two years. In this calendar, however, *A* is always capitalized. Accordingly, only the correspondence to the first day of the year can be assumed to be encoded; the day corresponding to Sunday is not marked. In the three other calendars from this collection that make use of dominical letters—Booklets 27, 51, and 88—it is again the letter *A* that appears capitalized, and in the case of Booklet 51 it can be shown that that day designated Monday; the simplified system was evidently in general use by the producers of these manuscripts. This reduced system appears in other colonial Mesoamerican calendrical texts as well. Kubler and Gibson (1951: 20) showed that the Tovar calendar used the capital *A* for Tuesday; although the year to which the calendar pertained is not specified, *b* was used for ember days, which only occur on Wednesdays.

Several other well-known Mesoamerican calendars also make use of capital *A* in their dominical letters. These include the Mayan year displayed in Landa's *Relación de las Cosas de Yucatán*; the Book of Chilam Balam of Kaua (Bricker and Miram 2002); the Q'eqchi' calendar from Lanquín (Gates 1931); de Gante's (1553) *Doctrina Cristiana en Le*[*n*]*gua Mexicana*; the Codex Mexicanus (Ms. 20, Fonds Mexicain, Bibliothèque Nationale); and a Matlatzinca calendar (included in Ms. 381, Fonds Mexicain, Bibliothèque Nationale, a seventeenth-century miscellany that first surfaced in Lorenzo Boturini's collection of historical manuscripts [Caso 1945; Barlow 1951; Tavárez 1999]). Apart from Landa's calendar, which is generally attributed to the year 1553, these manuscripts provide no evidence concerning the day of the week to which the dominical letters pertain, and Landa's year 1553 began on a Sunday; so it is not known whether or not these documents use the reduced system.[9] James Fox (personal communication to Justeson, 1981) has stated that the dominical letters in all of the Mesoamerican calendars that he has seen capitalize the dominical letter *A*.

Accordingly, although we have not made an exhaustive search for evidence on the point, it appears that the use of a capital *A* in the dominical letters, regardless of what day of the week begins the year, was the standard or at least predominant system used in Mesoamerica during the sixteenth and seventeenth centuries, as suggested to us independently of each other by Fox and Bricker.

Correlating the Zapotec and European Years

During a leap year, February 29 is not associated with any dominical letter. As a result, and because the first day of the year is always marked *A,* the dominical letter associated with a given day of the year is always the same. Table 1.4 displays the sequence for any European year; dominical letters for dates appearing in Booklet 85 are highlighted; all of them agree with the dominical letters appearing in association with the same dates in Booklet 85.

The first year is almost surely not a leap year. On the assumption that it is an ordinary year, each of the first eighteen Spanish dates precede the next Spanish date by twenty days, except that the fourteenth span, from November 10 to November 29, is nineteen days long. The final span, of six days, makes up for this puzzling shortfall, yielding a total span of 365 days from the beginning of one year to the beginning of the next. The effect is that each of the first four-

TABLE 1.4. The standard dominical letter sequence in a European year. Dominical letters for European dates appearing in Calendar 85 appear in boxes; every one agrees with those in the source. In a leap year, February 29 has no assigned letter.

	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
1	A	d	d	g	b	e	g	c	f	**A**	d	f
2	b	e	e	A	c	f	A	**d**	g	b	e	g
3	c	f	f	b	d	**g**	b	e	A	c	f	A
4	d	g	g	**c**	e	A	c	f	b	d	g	b
5	e	A	A	d	f	b	d	g	c	e	A	c
6	f	b	b	e	g	c	e	A	d	f	b	d
7	g	c	c	f	A	d	f	b	e	g	c	e
8	**A**	d	d	g	b	e	g	c	f	A	d	f
9	b	e	e	A	c	f	A	d	g	b	e	g
10	c	f	f	b	d	g	b	e	A	c	**f**	A
11	d	g	g	c	e	A	c	f	**b**	d	g	b
12	e	A	A	d	f	b	d	g	c	e	A	c
13	f	b	b	e	g	c	**e**	A	d	f	b	d
14	g	c	c	f	**A**	d	f	b	e	g	c	e
15	A	d	**d**	g	b	e	g	c	f	A	d	f
16	b	e	e	A	c	f	A	d	g	b	e	g
17	c	**f**	f	b	d	g	b	e	A	c	f	A
18	d	g	g	c	e	A	c	f	b	d	g	b
19	e	A	A	d	f	b	d	g	c	e	A	**c**
20	f	b	b	e	g	c	e	A	d	f	b	d
21	g	c	c	f	A	d	f	b	e	**g**	c	e
22	A	d	d	g	b	e	g	**c**	f	A	d	f
23	b	**e**	e	A	c	**f**	A	d	g	b	e	g
24	c	f	f	**b**	d	g	b	e	A	c	f	A
25	d	g	g	c	e	A	c	f	b	d	g	b
26	e	A	A	d	f	b	d	g	c	e	A	c
27	f	b	b	e	g	c	e	A	d	f	b	d
28	**g**	c	c	f	A	d	f	b	e	g	c	e
29	A		d	g	b	e	g	c	f	A	**d**	f
30	b		e	A	c	f	A	d	g	b	e	g
31	c		f		d		b	e		c		A

teen Spanish dates is that of the first day of one of the first fourteen months of the Zapotec year; the next five Spanish dates correspond, respectively, to the final days of months 14 through 18 of the Zapotec year; and the final date is the first day of the next Zapotec year. If instead we were to suppose that the first year is a leap year, the first span would be twenty-one days long. This interpretation would make the first Spanish date correspond to the first day of the first

Zapotec month; the next thirteen dates would be for the second day of each successive month from the second to the fourteenth; the next five dates would be for the first day of months 15 to 18 and for the first of the five nameless days; and the last date would be the second day of the next Zapotec year. Such a result would be so peculiar that the first year seems almost certain to be an ordinary year of 365 days.

The date 1696 appears at the base of this calendar, suggesting that the Zapotec year with which it is associated included part of the year 1696. If the Spanish year during which the Zapotec year begins was not a leap year, 1696 must have been the Spanish year in which that Zapotec year ended; in fact, the date 1696 occurs at the end of the calendar, not at its beginning. Evidently, then, the first day of the Zapotec year fell on February 23, Gregorian, in both 1695 and 1696.[10]

If February 23 fell on the first day of the year, then the first fourteen dates all correspond to the first day of their respective Zapotec months in the year 1695. Starting on November 29, the recorded dates move to the last day of the month: the first and last days of the fourteenth Zapotec month are recorded, followed by the last day of the fifteenth through the eighteenth Zapotec months. No day is recorded among the five that end the Zapotec year; after the last day of the eighteenth month, the next date to be recorded is the first day of the next Zapotec year. The peculiarities begin with November 29. It is difficult to entertain a hypothesis that a computing error is involved; even if the colaní were not fully conversant with the Spanish calendar, the change from November 10 to November 29 seems pretty obviously to be a shift of 19 rather than 20 days.

Two observations provide a plausible explanation for this apparent shift. The first fourteen Gregorian dates are those of the first day of the first fourteen Zapotec months during a Zapotec year that began on February 23, 1695. The next five Gregorian dates are those of the first day in each of the last five Zapotec months in the next Zapotec year, which began on February 23, 1696 (the final date recorded in the manuscript). These observations suggest that the Spanish dates might have been assigned to Zapotec months by drawing their Gregorian starting dates from two successive Zapotec years.

Such a process would have begun with a Zapotec colaní writing down the months of a Zapotec year, one that began in 1695; alongside the first day of each Zapotec month he placed the dominical letter and date in the Spanish calendar. This process continued until the return of the year-bearer day, on the first day of the fourteenth month (the return of the year bearer had a special ritual significance in some Mesoamerican traditions; see Lincoln 1942). At this point, the Spanish annotations ceased. The next Zapotec year then began, again on February 23. The colaní, or perhaps another who inherited his materials, completed the annotation of the full Zapotec year with Spanish dates corresponding to the first day of each of the remaining months. Because 1696 was a leap year and the fifteenth Zapotec month was late in the year, the Spanish dates of the beginnings of each Zapotec month were one day earlier than during the previous Zapotec year.

There is other evidence that some Zapotec calendar notebooks had this sort of annotation history. There is independent evidence that some data from the Zapotec year of 1696–1697 was used in this table, since the manuscript appears to give February 23 as the first day of the two successive Zapotec years at issue. There is also detailed evidence from Booklet 62 that Spanish calendrical annotations (days of the week) were systematically added to a Zapotec calendar during three successive passes through the ritual calendar, and evidence from Booklet 63 for the sporadic addition of several Spanish calendrical annotations from 1691 to 1695.

The use of this kind of alignment of parts of two successive Zapotec years with Spanish dates entails either that it was not understood that this practice might introduce a discrepancy, or that the discrepancy was not a cause for concern. There is evidence for this sort of disconnect in Diego de Landa's representation of the Yucatec 365-day year. In Landa's manuscript (cf. Landa 1959), the Yucatec year is laid out from January 1 to December 31. The beginning of each Yucatec month has the month name recorded, along with a glyphic spelling for the month's name. Then there is a list of the days of the ritual calendar that occur in that month, in sequence, along with their numerical coefficients and dominical letters. The Yucatec calendar starts on January 1 with 12 Reed (Yucatec *b'e7n*) on the tenth day of the ninth month, Ch'en. The ritual calendar dates follow in sequence until they reach 7 Night on the last day of the last month. Then no ritual calendar dates are provided for five days (the "nameless days"), although the dominical letters are given, taking us through 12 Rabbit. The next day is the first day of the new Yucatec year, 1 Pop, but the day name instead of 13 Water is 12 Iguana. Then the ritual calendar dates again run in sequence until the equivalent of 11 Soaproot on December 31.

Since 12 Reed (January 1) is the day after 11 Soaproot (December 31), Landa's calendar must have been taken from a record of the days starting with the first day of the Yucatec new year on July 16 (12 Iguana), passing through December 31 (11 Soaproot) and then January 1 (12 Reed), through the last day of the Yucatec year on July 15 (12 Rabbit) of the following Spanish year. The section from July 16 to December 31 was transposed with that from January 1 through July 15 to get his Mayan year.

On the surface, the Zapotec words that are aligned with European dates in Table 1.2 appear to be names of or references to the twenty-day months of the colonial Zapotec calendar, as Alcina Franch (1993: 185) assumed and as most subsequent commentators have accepted. There are two potential problems with this identification. First, if our hypothesis that the Gregorian dates in this table come from two different Zapotec years is not correct, two different forms are given for the name of the fourteenth Zapotec month. It might be considered that, as in ancient Lowland Mayan usage, the day on which a month had ended (elapsed time) is also the day on which the next month begins (elapsing time). Second, the date February 23, 1696, should be the first day of the first month of the new year, with ⟨toohuà⟩ expected as the name of the first month, but this does not appear; rather, the date occurs with the Zapotec phrase ⟨queia nij⟩.

Nonetheless, there is substantial evidence in favor of treating the Zapotec words in this list as names of months.[11]

(1) For the most part, they occur at intervals of twenty days, beginning with what is presumed to be the first day of the year. The only seeming exception, before the five days ending the year, is an interval of nineteen days between the fourteenth and fifteenth dates, and this discrepancy is illusory if we are correct in proposing that the dates for the alignment come from two successive Zapotec years.

(2) The sentence at the bottom of the page of month dates states that ⟨vigillia Samathie cij làçà tohuà⟩, which may be glossed as 'the vigil of the feast of Saint Matthias [is] during/at the beginning of tohuà': *vigillia Samathie* is Latin for 'the vigil of the feast of Saint Matthias';[12] the rest of the passage is in Zapotec, for which see Note 24. Until 1971, the feast of St. Matthias fell on February 24 in normal years, and on February 25 in leap years. The vigil of a saint's feast took place the night before, which would have been the evening of February 23 in 1695. ⟨toohuà⟩ is listed alongside February 23 (of 1695), which corresponds to the first day of the first Zapotec month in the 365-day count.

Several of the Villa Alta collective confessions collected in 1704 assert that various local colanís had identified the feast of St. Matthias as one of the main occasions when collective ceremonies should be carried out. The admonition to perform collective ceremonies on St. Matthias's day was reported by town officials from Juquila (AGI México 882: 1144r), Xogochi (ibid.: 1456r), Xozaa (ibid.: 1512v), and San Pedro

Yagneri (ibid.: 1542r). Although none of these ceremonies is described in detail, none of these four communities had St. Matthias as their patron saint. It therefore appears that colanís employed this holiday as an expedient Christian correlation for observing the beginning of the Zapotec year, which began on the feast of St. Matthias from 1689 to 1692, and on the vigil of that feast from 1693 to 1696. Further evidence of such a practice with respect to saints' days is provided by Tavárez and Justeson (n.d.).

(3) We suspect that the word ⟨toohuà⟩, which marks the beginning of this 365-day year, represents the word 'mouth' (pZap **tyo7wa*). The orthographically equivalent word ⟨tòhua⟩ ~ ⟨tòua⟩ ~ ⟨tòa⟩ 'mouth' was used in colonial Valley Zapotec to refer to the beginning of anything and to the entrance to or front of some things, according to Córdova (1578b: 29v, 56v, 64v, 67v, 113v, 115v, 174v, 175r, 196v, 248v, 327v, 327v–328r). This interpretation seems consistent with its use to mark the beginning of the Zapotec year.[13]

(4) Urcid (2001: 87–88) finds that the names ⟨huitao⟩ and ⟨gohui⟩ end in words for 'great' and 'small', respectively. Something of the sort is found in pairs of month names in other Mesoamerican calendars, such as the Nahua and Mixe calendars, although normally in pairs of successive months.

(5) Alongside the date on which the ninth month begins, the word ⟨gogaa⟩ is written. This expression recalls Córdova's ⟨cogaa peo⟩ "agora nueue meses" ('nine months ago; nine months have passed'), where ⟨peo⟩ (for something like *be7yo7*, pZap **kw+ e7yo7*) means 'moon, month' (Córdova 1578b: 14r; 1578a: 188, 190); also ⟨cogaa yza⟩ "agora nueue años" where ⟨yza⟩ (for something like *yiza* [pZap **yisa*]) means 'year'. This interpretation fits the context of ⟨gogaa⟩ if the Zapotec forms make up a Zapotec month list: ⟨gogaa⟩ can be analyzed (Kaufman, personal communication, 2004) as consisting of the completive aspect marker *ko* + the word 'nine' (pZap **kä7*), literally meaning "it became nine." No other word in the list, however, provides a numerical description of the position of the month.[14]

(6) One final line of evidence requires more discussion. The phrase ⟨queai nij⟩ is placed alongside February 23, 1696. This date is the first day of the next Zapotec year, although it is treated by previous commentators as having been intended to correspond to the last five days of the year. We have no definitive interpretation for the meaning of this expression. One possibility is that it is one element of a couplet formula that refers to the nameless days, the verb *yeni* 'to be angry'; *ki-yeni* 'will be angry' would be in the potential aspect. The connection to the

nameless days makes this interpretation appealing but ⟨queai nij⟩ would be an orthographically deviant way to spell the vowels of both the prefix and the first syllable of the verb root. A possible alternative analysis that is consistent with colonial Northern Zapotec orthography is that it spells *y-a +ni* 'it will ripen' (for the orthographic issues, see Tavárez and Justeson n.d.), but we know of no specific evidence relating this meaning to its calendrical usage.

In spite of uncertainty over the meaning of this phrase, the seven other calendrical contexts of this or a closely similar phrase suggest that it is specific either to dates near the end of major time periods or to short spans that constitute the ends of major time periods. Six of these instances are found in the 260-day calendars of four other booklets and are restricted to just two dates in the ritual calendar. All four booklets have this expression as an annotation alongside the day 7 Storm (perhaps to be analyzed as *ki-yeni +e* 'it will become angry' or *y-a +ni +e* 'it ripens for it'):

Cal.	*day name*	*comment*
13	bilapag	quiani hehe
34	bilapag	queanihuee
36	bilapag	queanihehe
84	bilapag	queani huee

This date is the fifty-ninth of the ritual calendar. It falls seven days before the beginning of the second cociyo on 1 Death—that is, in the middle of the last trecena of the first cociyo. Two of these calendars have a second instance of this expression in parallel annotations alongside the day 1 Rabbit:

Cal.	*day name*	*comment*
13	yaglabaa	queani yogo coççio yezaha
36	yaglabaa	queani yogo cozio

This date is the 248th of the ritual calendar; it falls thirteen days before the beginning of the next ritual calendar cycle, at the beginning of the last trecena of the ritual calendar as a whole. These parallels suggest that this expression refers to ending periods within major calendrical cycles, including the 65-day period, the 260-day period, and, in the case of Booklet 85, the 365-day year.

The Year Bearers

Several booklets contain a section at the beginning or end of the manuscript that provides the names—the year bearers—of a complete cycle of the 52 successive Zapotec years of the calendar round (Alcina Franch 1993: 183–185). Full or partial lists of year bearers are found in Booklets 5–8, 17–27, 29–32, 37–39, 41, 42, 45–49, 52, 55, 56, 58, 59, 62, 66, 71, 74–77, 82, 85, 88–92, 94, 95, and 97–99. The days that serve as year bearers are Wind, Deer, Soaproot, and Earthquake. Typically, the year bearers are listed at the end of the document, usually just after the 260 days of the ritual calendar. In every case, they are listed in the same sequence, beginning with ⟨Yagxoo⟩—1 Earthquake.

The 52 years are subdivided structurally into four successive groups of thirteen years: 1 Earthquake to 13 Earthquake; 1 Wind to 13 Wind; 1 Deer to 13 Deer; and 1 Soaproot to 13 Soaproot. This quadripartite structural division is reflected in two ways. (1) Usually, the 52 year bearers are listed on four separate pages, each with the names of thirteen successive years. (2) Often, each group of thirteen years is labeled as a ⟨pije⟩ or ⟨biye⟩ 'calendar cycle'; in Booklet 91, the four thirteen-year sequences are preceded by ⟨biye 1⟩, ⟨biyee 2⟩, ⟨biyee 3⟩, and ⟨biyee 4⟩, indicating that each group of thirteen years constitutes one of four specific components of the 52-year cycle, in a fixed sequence within that cycle. In discussing the Zapotec thirteen-year cycle, Urcid (2001: 84) points out that this structural subdivision was also known among the Aztecs and that its status as a formal calendrical unit was terminologically recognized (referred to as *tlalpi:lli*). Colby and Colby (1981: 47) allude to such a cycle among the modern Ixils.

The identification of Wind, Deer, Soaproot, and Earthquake as the year bearers provides partial evidence for historical continuity from ancient times. The essentials of the hieroglyphic representation of ancient Zapotec year bearers was worked out by Caso (1928, 1947); Urcid (1992, 2001) definitively established that it was the day names Wind, Deer, Soaproot, and Earthquake that were represented as year bearers in hieroglyphic inscriptions, going back to the earliest occurrence of a year bearer on a dated Preclassic Zapotec text (on Monte Alban Stela 12). Later, seemingly in connection with external influence in some communities in the Valley of Oaxaca, the days House, Rabbit, Reed, and Flint began to be recorded as year bearers; the use of the sign for 'house' shows the foreign origin of this system (see p. 67, following). The data from AGI México 882 show that the indigenous Zapotec tradition continued, at least in this respect, in some communities in northern Oaxaca.

Throughout Mesoamerica, there is reasonably close agreement with respect to the day of the veintena that was celebrated on any given day. Two systems are known. Among Nahuas in the Valley of Mexico and among Mayans in the highlands of Guatemala, the days of the veintena were synchronous; the

Mayan system continues to the present day. Thompson (1960: vi, 303–304, 310) eventually concluded that this same system was in use among Lowland Mayans, but this determination was an effort to make Lowland Mayan data conform to the Nahua and Guatemalan systems on the *assumption* of a strict synchrony of all Mesoamerican calendars. Others, such as Lounsbury and Schele, have held to Thompson's original correlation, which put day names in the lowlands two days later than they fell in the highlands, in agreement with (among other things) Landa's equation of 16 July (1553) with the first day of the year. The epi-Olmec correlation, which is secured by an explicit record of the occurrence of a solar eclipse, is offset by eighteen days from the Nahua system and by twenty days from Thompson's original Lowland Mayan correlation; given Calnek's results on the Aztec calendar reform of 1507–1508 (see following), the twenty-day offset is more likely to be correct and thus argues against synchrony. The Mixe calendar is in collapse, and is not a reliable source of data; its lack of synchrony with the Aztec and other systems led Thompson (1972) to abandon the hypothesis of synchrony, although he seems never to have reevaluated the change of calendar correlation that he based on that hypothesis.

Among the Aztecs and in the Guatemala highlands, February 23, 1695, fell on the seventeenth day, Earthquake; the 360th day of this Zapotec year would have fallen on February 17, 1696, on the day Crow. The veintena of the epi-Olmecs and perhaps of some Lowland Mayans fell two days earlier, which would yield Zapotec Corn for February 23, 1695, and Jaguar for February 17, 1696. Because the calendars of legajo 882 give Wind, Deer, Soaproot, and Earthquake as the Zapotec year bearers, the only viable alternative consistent with known placements of the veintena is for the colonial Zapotec year bearer to have fallen on the first day of the year, and specifically that the day Earthquake fell on February 23, 1695. Justeson and Kaufman (1996–2000) show that the Preclassic Zapotec year was also named for its first day.

Although there was considerable uniformity about which of the twenty named days fell on a given European date in the sixteenth century, there is less uniformity about the numerical coefficient in the trecena. A number of Mesoamerican traditions assigned different numbers from the trecena to the same day in absolute time, although the day within the veintena was always on or about the same day.

The most important example for now is the discrepancy between the Aztec ritual calendar at Tenochtitlan and that at Tlatelolco. Calnek (this volume) has been able to show, building on work by Caso and Kirchhoff, that Tlatelolco and Tenochtitlan differed in this way. He shows that, in the European years 1507–

1508, there was a nineteen-month year in Tenochtitlan, one beginning and ending in the month Izcalli, and that this 19-month span is actually recorded in the Codex Borbonicus. As a result of this localized change, some native years in the area began on Izcalli, while others, like that at Tenochtitlan, ended with that month. Another feature of the Borbonicus record is that the sequence of year names was not affected. The only way that the sequence could have been preserved is if the name of the 380th day was the same as was expected for the 360th day; Calnek's hypothesis is that the coefficients of one month were repeated exactly in the next at some point during that year. Maintaining the year name sequence intact produced a twenty-day shift backward in the sequence of numeral coefficients in the trecena; the same trecena date now fell twenty days later in Tenochtitlan than it did in Tlatelolco. The months, however, were synchronous in the two areas, except that the five days that end the year followed Izcalli in Tenochtitlan and preceded it in Tlatelolco; thus, there is a five-day offset during the twenty-five days that followed what was originally the final month of the year.

This change was not an isolated historical occurrence. Justeson and Kaufman (1993, 1996; see also Kaufman and Justeson 2001) have shown that epi-Olmec ritual calendar dates fall twenty days earlier than the corresponding ritual calendar dates among Lowland Mayans, with the corresponding difference that the patron of the month that ended the Mayan year is the one that began the epi-Olmec year. Accordingly, the relation of the Mayan system to the epi-Olmec parallels that of Tenochtitlan to Tlatelolco. As in these cases, the months were synchronous in the two systems, except that the five days ending the year follow the Mayan ⟨Cumku⟩ but they precede the corresponding epi-Olmec month. This shift could have resulted from a Lowland Mayan introduction of a nineteen-month year at some point during the Preclassic. However, the same difference would result if the epi-Olmecs had shortened the year by a month and skipped ahead twenty days in the trecena to maintain the sequence of year names.

However it was achieved, similar sorts of calendar change must have taken place repeatedly in Mesoamerica, given, for example, the large number of different trecena positions used by different Nahua groups in the Valley of Mexico. An effect of the change, the placement of the five year-ending days between different months, is reflected by the many differing positions of these days in the month sequence of different Mayan communities.

Accordingly, it cannot be assumed that the coefficient of the day Earthquake on February 23, 1695, was 11, as it was in the Guatemala highlands and in

Tlatelolco. However, data from other Villa Alta manuscripts show that the trecena position on that date was indeed 11.

BOOKLET 27 FROM VILLA ALTA

Booklet 27 was composed by a speaker of Nexitzo or Bijanos Zapotec. It gives a complete 260-day ritual calendar. The days of the first cociyo—the first five trecenas—are lined up with the numbered days of months in an unspecified European year and with the dominical letters associated with those days; the European data continue for four more days, until the dominical letter *A* is reached.

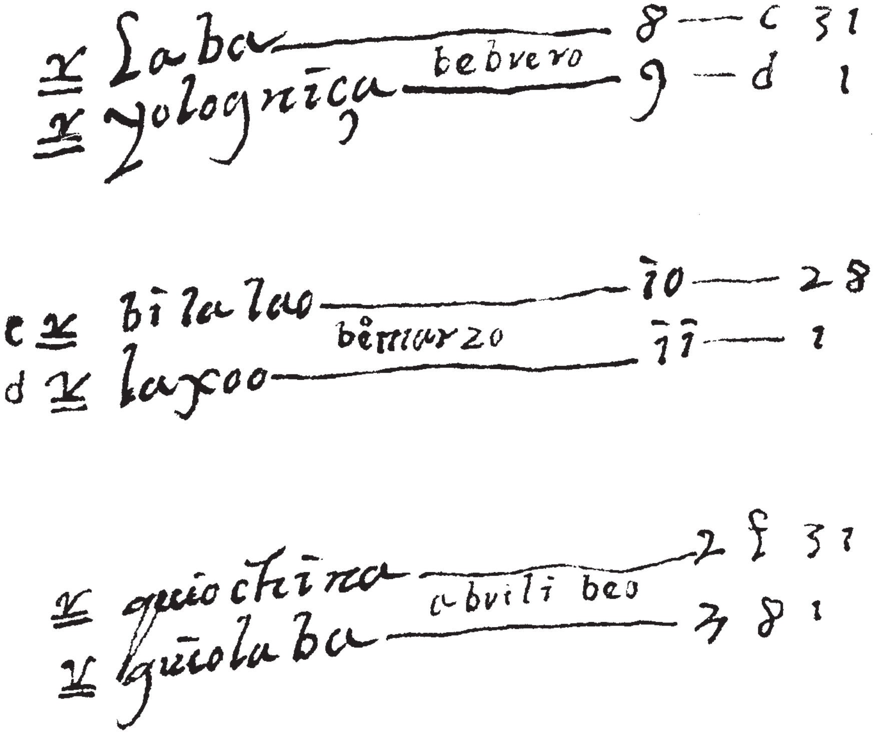
The day ⟨yagchila 1⟩ (1 Cayman), which begins the ritual calendar, occurred on January 24, assigned the dominical letter *c*; with this assignment, January 1 would have been associated with the letter *A,* as expected. February 28, aligned with ⟨bilalao 10⟩ (10 Crow), is followed by March 1, aligned with ⟨laxoo 11⟩ (11 Earthquake), so the year in question was not a leap year.

Three correlation statements are provided by the names of the European months that began during the first cociyo. The beginning of each month name is specified after the line corresponding to the last day of the prior month, centered on a horizontal line that joins the augment–day name compound to the trecena numeral (see Figure 1.2). In the transcription, we treat them as part of the same line of text. Dominical letters are associated with each line; on some pages, they are at the beginning of the line; on others they immediately precede the numeral recording the day of the month, which ends each line.

dominical letter	*day name*	*European month*	*trecena numeral*	*dominical letter*	*day of European month*
	yologniça 9 Water	bebrero 1 February	9	d	1
d	laxoo 11 Earthquake, month of March, 1	beo marzo	11		1
	quiolaba 3 Rabbit, month of April, 1	abrili beo	3	g	1

These three correlation statements are mutually consistent: any one implies the other two. To facilitate comparison with the correlation statements in Booklet 85, they may be summarized by the equation of ⟨yolaoo 5⟩ (5 Monkey) with February 23 of this unspecified European year.

Given that February 23 fell on the Zapotec day Earthquake in 1695, the years in which the day Monkey fell on February 23 can be determined. When



x Laba 8 — c 31
febvero
x yologniça 9 — d 1

c x bilalao 10 — 28
bemarzo
d x laxoo 11 — 1

x quiochina 2 f 31
abvili beo
x guiolaba 3 g 1

Figure 1.2. Sections of the first cociyo of the calendar in Booklet 27 that show the change of month in the European calendar.

365 days passed between successive occurrences of February 23, the day in the ritual calendar changed, but it remained in the same one of the following five "series":

Series I	Cayman, Death, Monkey, Crow
Series II	Wind, Deer, Soaproot, Earthquake
Series III	Night, Rabbit, Reed, Flint
Series IV	Iguana, Water, Jaguar, Thunderstorm
Series V	Snake, Knot, Corn, Face

For example, since February 23 fell on the day Earthquake in 1695, in Series II, it must have remained in Series II in 1696; specifically, February 23, 1696, must have fallen on the day Wind. When 366 days intervened between successive occurrences of February 23, the day name would pass from one series to the next; for example, from the day Wind, in Series II, in 1696, February 23 would have passed to Series III (on the day Night) in 1697. Only after five years of 366 days had intervened would the day return to the original series. If the Series I day 5 Monkey that occurred on the February 23 date of Booklet 27 was earlier than 1695, the shift to a day (Earthquake) in Series II on February 23, 1695, requires that the number of intervening 366-day years must be one more than a multiple of five (i.e., there must be 1, 6, 11, 16, 21 [etc.] such years). If the Gregorian date of Booklet 27 was later than 1695, then the shift from a day in Series I on February 23, 1695, to a subsequent day in Series II on February 23 would have to have taken four more than a multiple of five years of 366 days.

The year in which this took place can be narrowed down by considering other evidence for the date of the manuscript. The whole collection of manuscripts had been gathered together in connection with the extirpation of idolatrous practices by January 1705 (and a note in the margin if Booklet 27 indicates that the communal confession with which it was associated took place in Villa Alta on November 27, 1704), so Booklet 27 dates no later than January 1705. Alcina Franch (1993: 25) notes that most of the booklets bearing Spanish dates come from the last years of the seventeenth century. The handwriting in this booklet is similar to that appearing in other Villa Alta documents dated from the early seventeenth to the early eighteenth century; given an increase in idolatry eradication measures in Villa Alta after 1660, which would have threatened the preservation of early seventeenth-century calendars, and the relatively good physical state of the paper when this booklet was archived, it is likely that Booklet 27 was composed during the second half of the seventeenth century. Apart from leap years, the day Monkey occurred on February 23 only twice between 1650 and 1705: in 1671 and in 1690. Its last prior occurrence on February 23 was in 1629, well outside of the paleographic limits, so 5 Monkey can be securely equated with February 23 of either 1671 or 1690.

One further correlation statement, not transcribed by Alcina Franch, occurs in this part of the manuscript (Figure 1.3):

dominical letter	*day name*	*trecena numeral*	*day of European month*
	naa tza tomigo 19 lao beo brero ribee gosii ʔto ʔhueag now is the day Sunday, 19 in the month of February . . .[15]		
A	qagchina 1 Deer	1	19

Within the paleographic limits of the manuscript, and excluding leap years, February 19 fell on a Sunday in the years 1651, 1662, 1668, 1673, 1679, 1690, and 1702. Since the manuscript's alignment of the days of the year with the days of

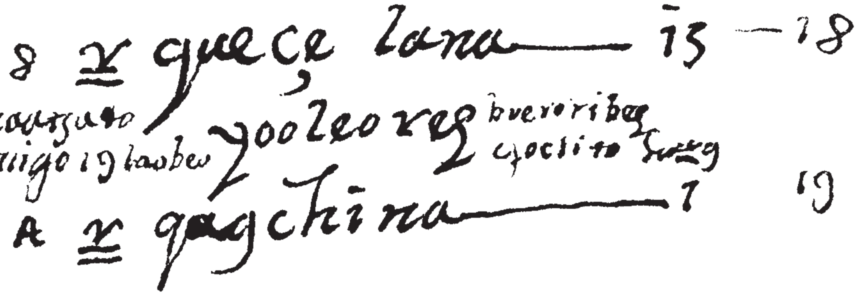


Figure 1.3. The correlation of the day 1 Deer with Sunday, February 19, in Booklet 27.

the veintena occurred only in 1671 and 1690, the year associated with the first cociyo of this calendar must have been 1690.

The rationale for the Sunday, February 19, annotation is different from the others in this part of Booklet 27, which mark the beginnings of successive months in the Gregorian calendar. What the annotation addresses explicitly is seemingly the fact that a new trecena begins on this date (see Note 15). However, it has a less commonplace significance: because the distance from February 19, 1690, to the beginning of the year on February 23, 1695, is 5 more than 5×365 days, 1 Deer turns out to be the first of the nameless days that preceded the Zapotec new year in 1690. Although the Zapotec annotation does not appear to address this issue explicitly, this seems almost sure to be the main rationale for the annotation; the colanís' attention to such dates is reflected by the reference to the first of the nameless days preceding each of two successive Zapotec years, 5 Earthquake and 6 Wind, in Booklet 94 (see pp. 55–58, following).

This interval of 5 + 5×365 days leads from the first of the nameless days on 1 Deer in 1690 to the first day of a Zapotec year on 11 Earthquake in 1695. This assignment of February 23, 1695, to 11 Earthquake completes the solution to the correlation of the Northern Zapotec ritual calendar—assuming that the ritual calendar was synchronous throughout this area, or, more particularly, that Booklets 27 and 85 used synchronous ritual calendars.

The layout of all of these correlational statements suggests that they were added after the Zapotec calendrical data had been written out. The addition is most obvious in the last case, in which the correlational statement is split on either side of the augury that precedes the third trecena.

Although the annotations from the first cociyo of Booklet 27 are continuous, and the dominical letters show that they pertain to a single European year, the later annotations are few and disconnected. Two provide Spanish dates. (1) On 2 Soaproot, 106 days after the February 19 record, an annotation gives the date as day 20 in February. February 20, 1691, falls 260 + 106 days after February 19, 1690, so these records are consistent. (2) A second record provides independent evidence for the correlation. The comment ⟨asobcione⟩ is associated with the day 7 Flint. According to the correlation otherwise established for this calendar, the day 7 Flint fell on August 14, 1689; this was the date of the vigil of the feast of the *Asunción de la Vírgen María*. (In Booklet 63 [see pp. 47–55], other Spanish ecclesiastical feasts are shown to be given as annotations for the Zapotec day on which the vigil of the feast fell.)

BOOKLET 81, OF SAN JUAN MALINALTEPEC, CHOAPA

Booklet 81 was surrendered by a resident of the Bijanos town of San Juan Malinaltepec. The equivalence of 11 Earthquake with February 23, 1695, can be worked out entirely from the annotations aligned with a part of the ritual calendar in this booklet (AGI México 882: 1370r; our Figure 1.4). Alongside a sequence of six days in the Zapotec ritual calendar are comments in Zapotec that are accompanied by Spanish dates. Although the transcription by Alcina Franch (1993: 379–380) is incomplete and in some respects inaccurate, the correlation can nonetheless be worked out purely on the basis of his transcription of the Spanish data, which Justeson in fact did in July 2000. However, the correlation can be established more straightforwardly from the Zapotec glosses, using Tavárez's more reliable transcription of the original document (see Table 1.5).

Our results on this manuscript are reported in detail elsewhere (Tavárez and Justeson n.d.). In that work, we report in some detail on the inferences that led to the establishment, reading, and interpretation of the correlation statements—originally on the basis of Alcina Franch's transcriptions of the Spanish dates, and ultimately on the more accurate transcriptions presented here, including the interpretation of the Zapotec data.

Two types of data are provided within the space occupied by the annotations on Booklet 81. The annotations occur on evenly spaced lines running alongside the days from 2 Jaguar (written ⟨yolatzi⟩) to 7 Storm (written ⟨bilapag⟩). Fit between these lines are auguries, using the same vocabulary as in auguries occurring earlier and later in the manuscript, but written somewhat smaller and at angles to fit into the space left by the annotations.

The Zapotec text of the first annotation begins directly opposite the Zapotec day 2 Jaguar and ends opposite 4 Crow. It reads:

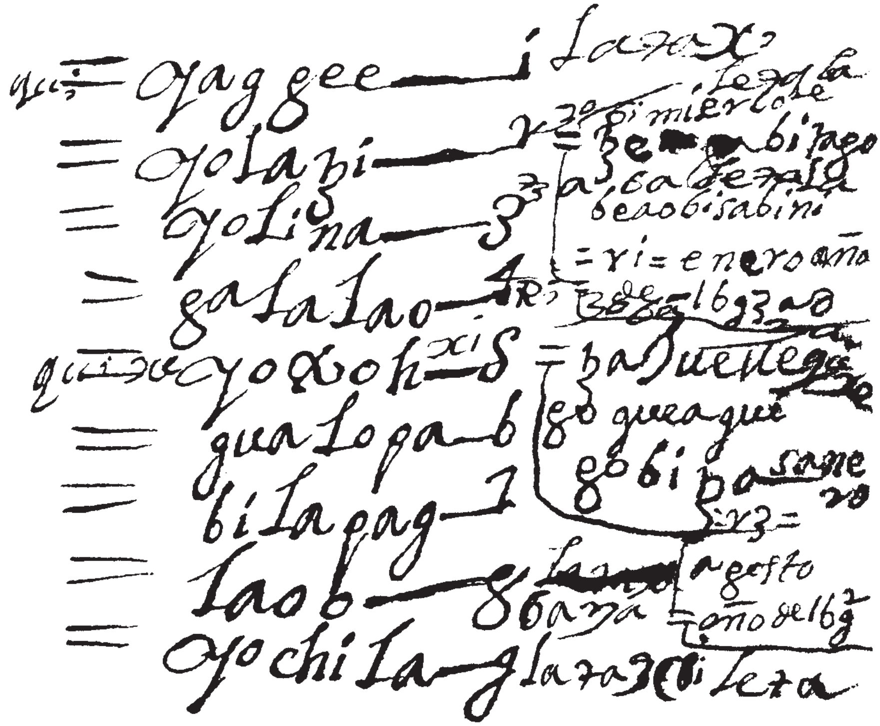


Figure 1.4. The correlation statements from Booklet 81.

Zapotec annotation:

miercole	tza	niga	bitago	beoo	bisabini	
miercoles	tza	niga	bi-t-ago	beyo	bi-sabi	+ni
Wednesday	day	here	CMP2a-NACT1-eat	moon	CMP2a-float.in.air	it

Spanish annotation:

2i	enero	año	de	1693
21	enero	año	de	1693
21	January	year	of	1693

Wednesday. On this day, the moon got eaten [eclipsed]. It floated in the air.
January 21, year of 1693.

The verb ⟨tago⟩ ‘to get eaten’ in the eclipse statement (pZap, pZn[16] **t.aku* ‘to get eaten’) is a non-active intransitivization of **aku* ‘to eat’ (Zoogocho *agw*). Throughout Mesoamerica, an expression like “moon gets eaten” or “sun gets eaten” is used to refer to lunar and solar eclipses (Smith-Stark 1994); forms making use of descendants of pZap (and pZn) **t.aku* ‘to get eaten’ are reported from several dialects of Zapotec, including by Córdova (1578b: 150v).

TABLE 1.5. Transcription of folio 4r, Booklet #81 of AGI México 882 by David Tavárez. The transcription differs at several points from that provided by Alcina Franch (1993: 379–380). The word ⟨quixe⟩, or orthographic variants of it, mostly appears in these manuscripts at stations in a seven-day cycle, on the first day of the ritual calendar and at multiples of seven days thereafter. The words ⟨qui⟩ and/or ⟨quixe⟩ in the left-hand column may pertain to the page adjoining on the left.

laoyoo [5th trecena]

?	*Day name*	*Trecena #*	*4 places*	*Eclipse notes*	*7-day count*
qui	yag gee	1	lataxi letaba		
				miercole	
	yolatzi	2	z^{o}bi	= tza ~~niga~~ bitago	
	yolina	3	tzaba letala	beoo bisa bini	
				= 2i = enero año ^{de} 1693 a^{o}	
	galalao	4	Rizobaya		
quixe	yoxoh	5	xi	= tza Jueve goqueaqui	quixe
	gualopa	6		gobitza sanero	
	bilapag	7	~~Lataxi~~ baya	=23= agosto = año de 169^{2}	
	laoo	8			
	yochila	9	lata x ~~zob~~ i leta		

This statement is a factual report of a total eclipse of the moon that took place in and around Villa Alta on Wednesday, January 21, 1693; the period of totality lasted from about 9:10 PM to 10:45 PM.

The second annotation begins immediately after the first, directly opposite the Zapotec day 5 Earthquake, and ends opposite 7 Storm:

Zapotec annotation:

tza	Jueve	goqueaqui	gobitza	sanero
tza	jueves	go-que-aqui	gobitza	sa nero
day	Thursday	CMP1-NACT2-burn	sun	at first

Spanish annotation:

23	agosto	año	de	169^{2}
23	August	year	of	1692

It was on a Thursday, previously, [that] the sun burned [eclipsed].
August 23, year of 1692.

It also uses a verb relating specifically to eclipses, a metaphor that to our knowledge is restricted to Zapotec. The verb ⟨goqueaqui⟩ in this sentence spells something like *go-y-ayi*—a non-active intransitivization of a verb 'to burn', in the incompletive aspect. This use of ⟨que⟩ and ⟨qu⟩ for *y* is very common in AGI México 882 and is due to a sound change that affected Northern Zapotec;[17] for detailed discussion, see Tavárez and Justeson (n.d.). This prefix *y-* derives a stem meaning 'to catch fire' from a root meaning 'to burn'. This derived verb is widely attested in Zapotec:

pZap **ko-y-ä7ki7*	'to catch fire'	Kaufman 1994–2004
Córdova ⟨coyàqui⟩	"Encenderse algo en el fuego"	Córdova 1578b: 161r
Juchitan *gu-y.a7ki*	'quemarse; quemar y levantar llamarada'	Kaufman, Pérez, and Feke 1995–2004

The uses of the Juchitan *y.a7ki* show it to be a non-active intransitive verb 'to burn' whose subjects are things that are burning or have burned. With this meaning, ⟨goqueaqui gobitza⟩ would be read literally as "the sun burned." This appears to be precisely the intended interpretation for this verb; a non-active, intransitive verb meaning 'to burn' is the standard expression for the eclipsing of both the sun and the moon in various forms of Zapotec, including Zaniza (Operstein and Bakshi 1995–2003) and Zoogocho (Long and Cruz 1999: 107).

Chronologically, this report is not accurate. There are three errors:

(1) The second annotation, referring to August 1692, begins with a reference to ⟨tza Jueve⟩ 'the day Thursday'. August 23, 1692, was in fact a Friday. The phrase ⟨sa nero⟩ 'at first' indicates that the eclipse of the sun had occurred before the previously mentioned eclipse of the moon (on January 21, 1693). The last time before January 21, 1693, that August 23 fell on a Thursday was in 1691.

(2) No eclipse of any sort took place on August 23, 1692; in fact, this date was eleven days after new moon and three days before full moon.

(3) The interval from August 23, 1692, to January 21, 1693, is just 157 days, whereas the distance from 5 Earthquake to 2 Jaguar is at least 257 days.

The internodal eclipse cycle averages 173.31 days; since $3 \times 173.31 = 519.93 \approx 520 = 2 \times 260$ days, eclipses regularly occur on new moons (for solar eclipses) and full moons (for lunar eclipses) around the same part of the ritual calendar at intervals of about 520 days. It is therefore plausible that the second statement refers to an actual solar eclipse on or near 5 Earthquake, which preceded an eclipse of 2 Jaguar, January 21, 1692, by a little less than a multiple of 520 days.

This problem has a definite resolution: a total solar eclipse was visible on the morning of August 23, 1691, in the Villa Alta area, with the face of the sun completely covered around 9:39 AM. This day was a Thursday, as the statement indicates, and it occurred 517 days before January 21, 1693; 5 Earthquake occurs 517 days before 2 Jaguar. With a correction of 1692 to 1691 in this statement, all other features of this eclipse record are therefore correct. Since solar eclipses are rare events, and total solar eclipses are extremely rare, there seems no room for doubt that the intended referent of this statement was the total solar eclipse of August 23, 1691. As stated, the subsequently mentioned solar eclipse serves as background for the following lunar eclipse. See Tavárez and Justeson (n.d.) for further discussion.

The most straightforward interpretation of the eclipse records of Booklet 81 is therefore that 2 Jaguar fell on January 21, 1693, and that 5 Earthquake fell on August 23, 1691.[18] Counting forward by 763 days from 2 Jaguar brings us to a day 11 Earthquake on February 23, 1695—the same correlation established independently from the data in Booklets 85 and 27.

Given this result, these eclipse records would also establish that the day of the ritual calendar did not change between about 9:30 AM and 9:30 PM; had they done so, the solar eclipse should have been associated with the Zapotec day 6 Flint. The likely times for the change are therefore midnight and sunrise; neither noon nor sunset is consistent with these data.

This consequence, however, is inconsistent with Córdova's (1578a: 212) statement that "contauase el dia del medio dia, hasta otro medio dia"—that is, the day of the ritual calendar changed at noon. Such a timing for the change of days is otherwise unattested, to our knowledge, anywhere or at any time in Mesoamerica; yet Córdova's statement is so explicit that there can be no question of confusion here. We raise two alternative explanations for this inconsistency.

(1) Córdova's statement may not have been valid for the seventeenth-century Northern Zapotec calendars under discussion here; this conclusion is the more straightforward from the pattern of alignment of the eclipse statements of Booklet 81 with Zapotec day names.

(2) If the day changed at noon (or sunset), the intended alignment of the eclipse annotations with the day names must not have been as it appears. In this case, the morning of January 21, 1693, fell 517 days (Zapotec or Gregorian) after the morning of August 23, 1691, but another Zapotec day began between the morning and evening of January 21, when the lunar eclipse occurred. Counting from noon to noon, there would therefore be 518 rather than 517 Zapotec days between the solar eclipse on a January morning in 1691 and the following lunar eclipse on an August evening in 1693.

> This would mean that the intended association of the Zapotec day with the eclipse annotation is reflected in the spatial arrangement in only one of the two cases. Evidence discussed above shows that the lunar eclipse statement was written down first and that the solar eclipse annotation was added afterward, so the apparent alignment of 2 Jaguar with January 21, 1693, must have been laid out as intended; the intended solar eclipse correlation would be with the morning of 4 Crow rather than with 5 Earthquake. This interpretation is feasible in that the annotation aligned with the day 2 Jaguar occupies the entire space down to and including 4 Crow, so that the solar eclipse annotation would have had to be placed in the remaining space, which began opposite 5 Earthquake.

The data from Booklets 27 and 81 therefore establish a specific correlation of the Northern Zapotec and Gregorian calendars in the case of afternoon and early evening events. Our two alternatives disagree by one day for morning events and cannot be clearly resolved for late evening and predawn events. Consequences of the two alternatives are addressed further in the discussion of Booklet 63 that follows.

EVIDENCE FOR THE CORRELATION FROM UNPUBLISHED DOCUMENTS

The discussions so far have been based almost exclusively on the twenty-two calendars published by Alcina Franch (1993). His transcriptions, although flawed in some respects, made it possible to recognize the presence of correlational data and to work out the correlation presented here. Useable evidence for a correlation also comes from three unpublished booklets in AGI México 882.[19] Most of the statements discussed below we originally found in transcriptions of these calendars that were generously provided to us by Michel Oudijk. Our analysis is based on Tavárez's transcriptions from copies of the original manuscripts.

Booklet 63-2

The second calendar bound in Booklet 63, Booklet 63-2 (AGI México 882: 1195r–1204v) has not been previously published. The main body of the calendar was written by a speaker of Nexitzo or Bijanos Zapotec.

This calendar proves to be remarkable for the correlation problem. Of the 260 days of the ritual calendar, at least twenty-two are provided with a Spanish equivalent of one sort or another that is clear enough for us to read: with a day of the week, a day in the month, a year, the feast of a saint, and sometimes a combination of two or more of these traits. Nineteen of these statements provide data that are useable for establishing a correlation between the Zapotec and Gregorian calendars. We address these instances not in their order in the manuscript but in an order convenient to the exposition.

(1) A user of this calendar—in a hand that is different from that of the main text—wrote ⟨1693 a[ñ]os matía⟩ alongside the entry for the day 10 Rabbit. The reference is to the feast of San Matías in 1693. In the seventeenth century, the feast of San Matías fell on February 24 (except in leap years, when it fell on February 25). The equation of 10 Rabbit with February 24, 1693, completely determines the correlation between the colonial Northern Zapotec ritual calendar and the Gregorian calendar, independent of the considerations of the earlier sections. This correlation is exactly equivalent to the equation of 11 Earthquake with February 23, 1695.

(2) Another European date, September 24, is written opposite the next day, 11 Water. No year notation is provided, but clearly the instance of September 24 that is associated with 11 Water cannot be for the day after February 24, 1693. This pair of annotations recalls another, the pair of eclipse annotations in Booklet 81: these annotations, also in different hands, were for 1692 and 1693; although referring to the same part of the ritual calendar, they were tied to nearby recurrences of those dates two ritual calendar cycles apart. It is therefore supportive of the correlation proposed here that, in the era from which these manuscripts come, September 24 fell on 11 Water just once, in 1691—519 days before notation for the feast of San Matías in 1693.

(3)–(8) Six dates in the vicinity of 11 Water are readily linked to it through annotations that are nearby in the Gregorian calendar:

13 Snake	August 31
+2 days	+2 days
2 Deer	September 2
+ 12 days	+12 days
1 Storm	September 14
+ 10 days	+10 days
11 Water	September 24
+2 days	+ 3 days
13 Monkey	September 27
+ 5 days	+5 days
5 Crow	October 2
+32 days	+ 31 days
11 Rabbit	November 2

The date September 27 occurs opposite a date that itself is only two days after the September 24 date; the next annotation, October 2, is consistent with this shift, after which the last annotation reverts to the original alignment of Gregorian with Zapotec days. On the seeming one-day discrepancy here and in some other items, see the discussion at the end of this section. That September 27 was the intended annotation is suggested by its correct identification as a Thursday; however, this conclusion is not definitive, since the assignment of Zapotec days to the Spanish week is not reliable in this calendar (they are correct in items 6, 12, and 17 and incorrect in items 13 and 16).

(9) Five days after the correlation of 1 Storm with September 14 [1691], the day 6 Iguana has the annotation April 11. Given the five dates just discussed, the day 6 Iguana would have corresponded to September 19 in 1691, so this date, if correct, must pertain to a different year. In fact, under this same correlation, 6 Iguana fell on April 11 in 1695.

(10) The day 4 Soaproot has the (marked out) annotation ⟨17 de agosto⟩; this agrees with the correlation of 6 Iguana with April 11, since 4 Soaproot follows 6 Iguana by 138 days, and August 17 follows April 11 by 138 days.

(11) Eleven days later, alongside the day 2 Night, is the annotation ⟨1695 a[ño]s lagulasion Sa[n]Ju°⟩. August 29 was the feast of the martyrdom of St. John the Baptist; this feast is sometimes referred to in Spanish almanacs as "la degollación de San Juan," and this seems to be what was intended here (for further discussion, see Tavárez and Justeson n.d.). This annotation accords with the correlation otherwise supported for this booklet, which, in 1695, places 2 Night on August 28. It also provides independent support for the plausibility of assigning some dates in this calendar to 1695, and thus for the correlation inferred for items (9) and (10).

(12) The day 13 Face has the annotation ⟨lataniti nij miercoles bijzaa jueves—[torn] lao xilaa vispere S[an] P[edr]o Apostoles S[an] Pablo⟩. The annotation refers to a celebration on a Wednesday and Thursday, on the vespers of Sts. Peter and Paul. The joint feast of these saints occurs on June 29. Vespers are celebrated a little before sunset of the afternoon before a feast, in this case on June 28. According to the correlation otherwise characterizing our data, the evening of 13 Face would have fallen on Wednesday, June 27, 1691; so the reference to vespers relates to the late afternoon of Thursday, the last mentioned weekday, rather than to Wednesday or to both Wednesday and Thursday. Under either model for the timing of the change of the Zapotec day, this reference would make sunset on Thursday, June 28, 1691, fall on the

Zapotec day after 13 Face, namely 1 Cayman. The statement must be interpreted as referring to an observance that took place across two days, beginning on the last day of the ritual calendar, 13 Face, and ending on the first day of the next pass through the ritual calendar—a celebration of the change of cycle.

(13) Between the records for 6 Water and 7 Knot is the annotation ⟨29 nobiembre sabato sa[n] gregorio⟩. November 29 is indeed the feast of San Gregorio Taumaturgo. This annotation is in a different hand from that of the calendar and from those of the earlier annotations. Given the equation of February 24, 1693, with the day 10 Rabbit in this calendar, and eight other equations in the same calendar that are equivalent to it, the day 6 Water would fall on November 29 only in the year 1686 (7 Knot would not fall on November 29 in any year from 1650 to 1702). The correlation of this date with the Spanish week is off by one day, with November 29, 1686, falling on a Friday rather than a Saturday. This discrepancy raises a question: is the error simply in the assignment of the day of the week, or is the entire annotation mistakenly assigned to this position?

In addressing this question, we may also ask why the feast of San Gregorio would be selected for special attention in Booklet 63; unlike the feast of San Matías, it is not singled out for special attention in the testimony accompanying the calendars. The answer would appear to be that the date was not selected in honor of the saint. Rather, it is striking that on this specific date—November 29, 1686—the moon rose in eclipse in the Sierra Zapoteca, with 29 percent of the moon's disk in the umbra; the moon was completely within the penumbra for half an hour and remained partially in eclipse for nearly two hours. This association can hardly be a coincidence. We therefore conclude that this annotation must indeed correctly equate 6 Water with the evening of November 29, 1686.

(14) The annotation associated with the day 6 Rabbit (spelled ⟨Cua laba⟩) is difficult to transcribe in its entirety, since it has been crossed out and the available copies from the microfilm include some dark spots. The main part of the annotation, which appears below the day name, is ⟨prōsesiō naa tza martes Cualaba . . .⟩ 'procession; now (the) day (is) Tuesday, 6 Rabbit'. Surrounding the "item mark" that precedes the day name is a ⟨mar es⟩, also seemingly marking the day as Tuesday.

Within the temporal range of the other chronological annotations in this calendar, 6 Rabbit fell on a Tuesday afternoon and evening only on January 7, 1687 (the feast of St. Julian and St. Theodore); January 1, 1692 (the feast of St. Mary, the Mother of God); and December 25, 1696 (the Nativity). In principle the annotation might refer to any of these three dates.

The date 6 Rabbit does not seem to have an outstanding significance within the ritual calendar, and none of these dates coincides with a structurally important point, such as new year, in the 365-day calendar. As for civil ceremonies, a procession might well have been held on January 1 in connection with the installation of the officers of the cabildo.

The most straightforward remaining possibility is that the festivities were directly associated with an ecclesiastical feast; if so, those for the Nativity or St. Mary are the two strongest candidates. The procession would suggest that the observances may have been tied to a feast with local significance. Since there is no evidence that the feast of the Nativity was commemorated in colonial Zapotec towns with a public procession, a reasonable conjecture is that the annotation refers to the feast of St. Mary, which fell on Tuesday, January 1, 1692. Whether the annotation was for a civil procession or one associated with a patron saint, January 1, 1692, is therefore by far the most likely alternative.

Finally, if the festival of 6 Rabbit was held in honor of St. Mary, there is circumstantial evidence that would associate this correlation statement with the Nexitzo Zapotec town of Santa María Zoogochi (or Xogochi, using the colonial spelling), which would probably have held a public festivity to commemorate its patron saint in 1692. There were at least three Zapotec-speaking towns whose patron saint was St. Mary that signed a collective confession in Villa Alta: Santa María Zoogochi (Nexitzo), Santa María Yahuivé (Bijanos), and Santa María Yaglina (Cajonos). The annotations in Calendar 63 were written by a speaker from either the Bijanos or Nexitzo districts, which rules out Yaglina as a town of origin. Whereas the Yahuivé confession does not mention the surrender of a calendar, Zoogochi's confession states that "a book of said heathen rituals" that belonged to the local ritual specialist Domingo Morales was presented to the ecclesiastic judge in January 1705, and that at least three other local specialists also possessed books (AGI México 882: 1456v). Therefore, if the statement discussed above does refer to the feast of St. Mary on January 1, 1692, then it is likely that it was written by Domingo Morales or one of the other specialists from Santa María Zoogochi.

(15) The day 3 Water is accompanied by an augury followed by the Spanish annotation ⟨saltacio⟩. This annotation is a reference to *la exaltación de la Santa Cruz,* whose feast is celebrated on September 14. The day 3 Water fell on the vigil of that feast, September 13, in 1693.

(16) Alongside the day 3 Cayman is the annotation ⟨pascua nabidaa⟩ 'feast of the Nativity'. Given the correlation previously established for this particular calendar, 3 Cayman would have fallen on December 24, 1695. This annotation is the one immediately before that of the first of the 1695 dates, the equation of 6 Iguana with April 11.

In three of the remaining correlation statements, (17)–(19), the Zapotec ritual calendar date appears to occur one day later than is indicated by the Spanish date. These items recall the one-day offset in the equation of September 27 with 13 Monkey, two days after the equation of 11 Water with September 24; and they raise the possibility that the annotations were meant to pertain to the next Zapotec day, which is demonstrably true for some of the auguries in other manuscripts.

(17) The most complete correlation statement in Booklet 63 apart from item (1) is the annotation ⟨6 otobre 93 a[ño]s domingo⟩ above the Zapotec day 1 Reed. According to the correlation supported by items (1)–(5) and (7)–(13), 1 Reed actually fell on October 7, 1693. The agreement is too close to be a coincidence.

There is one further discrepancy that is not explained by this one-day difference. The Spanish annotation assigns this day to a Sunday. However, the assigned Spanish date, October 6, 1693, fell on a Tuesday, and the day 1 Reed on a Wednesday. We do not know how to account for this discrepancy; one possibility is that the days of the week were (mis)calculated and projected backward. In any case, since the day of the week does not match the Spanish date, this discrepancy does not pertain to the correlation question.

The previous Zapotec day is assigned to Saturday. This assignment is consistent with the attribution of Sunday to 1 Reed, and no doubt relates to this attribution. However, no Spanish month or year position is given, so we are not in a position to treat this information as a useful correlation statement.

(18) The day 3 Monkey is accompanied by the annotation ⟨sabato 13 marzo 169 a[ño]s⟩ (there may be a final digit after the ⟨9⟩). According to the correlation, 3 Monkey fell on March 14, 1694; in that year, March 13 fell on a Saturday.

(19) The day 5 Reed is accompanied by the annotation ⟨andres apostolo latacgsii⟩. The feast of St. Andrew the Apostle fell on November 30; 5 Reed fell on December 1 in 1694. This annotation is for the day after 4 Soaproot, correlated with August 17, 1695, and ten days before 2 Night, correlated with [August 28,] 1695.

(20) Another annotation is crossed out and is not clear in our photocopy. Oudijk (2005) transcribes ⟨28 (de josi juebi)⟩ above 1 Knot. The Zapotec day 1 Knot does not occur on the 28th of any European month during the second half of the seventeenth century. In the decade 1686 to 1695, which is the range of the recoverable dates of Booklet 63, 1 Knot is calculated to fall on a Thursday in 1686 (April 4), 1691 (March 29), and 1696 (March 22).

We know the time of day associated with five of the correlational annotations in this corpus (materials in brackets are inferred, and do not appear in the text):

Annotation		*Gregorian date*	*Association*
Booklet 81			
2 Jaguar	evening	Wednesday, January 21, 1693	lunar eclipse
4 Crow or 5 Earthquake	morning	Thursday, August 23, 1691	solar eclipse
Booklet 85			
11 Earthquake	sunset	[February 23, 1695]	vigil of San Matías
Booklet 63			
13 Face–1 Cayman	sunset	Wednesday–Thursday, [June 28, 1691]	vespers of San Pedro and San Pablo
6 Water	evening	Saturday [*sic*], November 29 [1686]	San Gregorio [lunar eclipse]

All of the sunset and evening annotations agree with the correlation adduced above, as do the five annotations in Booklet 27, the first Zapotec new-year annotation in Booklet 94, and eight or nine other annotations in Booklet 63:

Booklet 63-2		
10 Rabbit	[February 24], 1693	San Matías
13 Snake	August 31 [1691]	
2 Deer	September 2 [1691]	
1 Storm	September 14 [1691]	
11 Water	September 24 [1691]	
11 Rabbit	November 2 [1691]	
6 Iguana	April 11 [1695]	
4 Soaproot	August 17 [1695]	
6 Rabbit	Tuesday [January 1, 1692?]	procession

Five annotations in Booklet 63 associate a Zapotec day with a date one day later in the Gregorian calendar than would be suggested by the above records:

13 Monkey	Thursday, September 27 [1691]	
5 Crow	October 2 [1691]	
3 Water	[September 14, 1693]	la exaltación de la santa cruz
3 Cayman	[December 25, 1694]	pascua navidad
2 Night	[August 29, 1695]	la degollación de San Juan Bautista

The September 27 and October 2 dates are just five days apart in both the ritual calendar and the Gregorian calendar, and are successive annotations in a closely packed sequence of seven that occur in the same part of the same (Zapotec and Gregorian) year; they cannot be considered independent events. Booklet 63 therefore yields just four independent examples of this departure.

The three remaining annotations associate a Zapotec day with a Gregorian date one day *earlier* than usual:

1 Reed	Sunday [*sic*], October 6, 1693	
3 Monkey	Saturday, March 13, 169[4]	
5 Reed	[November 30, 1694]	San Andrés

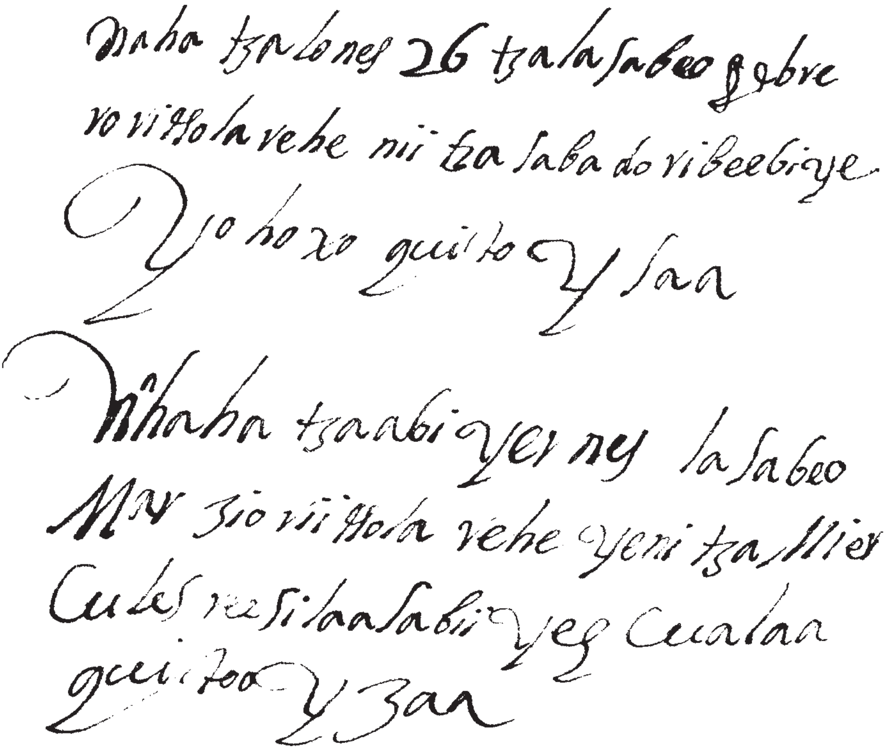
The days 3 Monkey and 5 Reed are just two days apart, and the records pertain to the same (Zapotec and Gregorian) year; they are unlikely to be independent of one another, so we have in effect just two distinct instances of this pattern.

The more numerous set of annotations with Gregorian dates a day later than usual would correspond to predawn or morning events if the Zapotec day changed at noon. This is the strongest evidence we have that the day changed when it did for the colanís interviewed by Córdova. If instead the Zapotec day changed around midnight or dawn, the three examples that are annotated with ecclesiastical feasts can be explained as intended references to the vespers of these feasts. Because such an explanation does not account for the two annotations that specify the Gregorian date rather than an ecclesiastical feast, postulating a change of the day at noon may be more satisfying.

This observation, however, does not settle the issue. A change at midnight or sunrise may allow a more straightforward interpretation of the apparent alignments of eclipse annotations with ritual calendar dates in Booklet 81. In addition, because the September 27 and October 2 dates are unlikely to be independent examples of seemingly late Gregorian dates, there is effectively just one unexplained instance here. One example is not enough to refute a midnight or sunrise hypothesis—especially when both this and the noon hypothesis leave two independent instances of the opposite departure unexplained.

Finally, it would be possible to account for the three annotations with uncharacteristically early Gregorian dates under a hypothesis that the day changed late in the evening but before midnight—say, around 10:00 PM. In this case, these annotations could indicate late-night events, and the late Gregorian dates could be treated as references to vespers.

Accordingly, it does not seem possible at present to reliably resolve either the timing of the change of day or the reasons for the one-day differences in the



naha tzalones 26 tzalasabeo febre
ro rittolavebe nii tza sabado ribeebiye.
Quiyo hoxo quitoo Ysaa
Nhaha tzaabiyer ney lasabeo
Mar zio riittola vehe yeni tza Mier
Cules retilaasabiiyeg Cualaa
quitoo Yzaa

Figure 1.5. New-year statements on page 1526r of AGI México 882, Booklet 94.

way Gregorian dates are assigned to Zapotec days with the evidence we have so far recognized in this corpus.

Booklet 94, of Yagneri, Yagavila

Two passages that equate European and Zapotec dates occur in a booklet identified as belonging to Juan de Santiago from the Nexitzo town of Yagneri (Booklet 94, according to Alcina Franch's numeration; AGI México 882: 1526r). These passages constitute the entirety of the page on which they occur, which is displayed in Figure 1.5. The following transcription and translation provides a guide to our analysis, and is formatted to display in parallel the structural similarities of these two passages:

naha	tza	lones	26	tza	lasa	beo	febrero	rittola
naa	tza	lunes	26	tza	lasa	beyo	febrero	ri-ttola
now	day	Monday	26th	day	period[20]	month	February	HAB-be.incapacitated[21]

rehenii	tza	sabado	ribee	biye	Yohoxo	quito	Ysaa
re-yeni	tza	sabado	ri-bee	biye	yo=xoo	qui-to	yiza
HAB-be.angry[22]	day	Saturday	HAB-seat.oneself	cycle	AUG5=Quake	POT-one	year[23]

Now on the day Monday, day 26 in the period of the month February, one is incapacitated, one is angry. On the day Saturday the cycle 5 Earthquake seats itself; it will be one [Zapotec] year.

Nªhaha	tzaa	biyernes	lasa	beo	Marzio	riittola
naa	tza	viernes	lasa	beyo	marzo	ri-ttola
now	day	Friday	period	month	March	HAB-be.incapacitated

reheyeni	tza	Miercules	reesi	laasa	biiyee	cualaa	quitoo	yza
re-yeni	tza	miercoles	ree-si	lasa	biye	cua-l=aa	qui-to	yiza
HAB-be.angry	day	Wednesday	HAB-take[24]	period	cycle	AUG6=Wind	POT-one	year

Now on the day Friday in the period of the month March, one is incapacitated, one is angry. On the day Wednesday, the period of the cycle 6 Wind takes its period [begins]; it will be one [Zapotec] year.

The equation of February 26 with a Monday in association with a specific Zapotec year raises the possibility of testing the colonial Zapotec calendar correlation.

In each passage, two days are mentioned in association with the name of the European weekday on which they occur; in each case, the first of the two days is associated with the name of the European month in which it occurs. In each passage, a second European weekday is associated with the name of a Zapotec day—in each case, consistent with the name of a Zapotec year. This Zapotec date in each case is followed by an annotation 'it will be a year', indicating that the reference is to the span of the coming year. The first passage makes it clear that the Zapotec day is indeed a year bearer, and the beginning of the new year: it states that on a Saturday the year *yo=xoo* 'seats itself'. This seating metaphor for the beginning of a year is well known from Lowland Mayan sources. From the confessions of legajo 882, we know that the colanís performed special ritual observances in association with the beginning of the Zapotec year.

The Zapotec year *yo=xoo* that is mentioned in the first passage is Earthquake; with the augment ⟨Yoho⟩, its trecena coefficient must be 2, 3, 5, or 9. The second passage gives the year unambiguously as 6 Wind, the year immediately after 5 Earthquake. This suggests that these passages concern two successive 365-day years, 5 Earthquake and 6 Wind—the fifth and sixth years of the calendar round.

According to the correlation proposed here, there was only one year 5 Earthquake between 1650 and 1704; it began on Saturday, March 3, 1663, in agreement with the statement that the year 5 Earthquake seated itself on a Saturday. The preceding part of this passage refers to the events of 'the day Monday, February 26', and indeed February 26, 1663, did fall on a Monday. Furthermore, in 1663, Monday, February 26 would have been the first of the five days that ended the previous Zapotec year, 4 Soaproot, suggesting that the passages concern the end of one year and the beginning of the next; we know from the testimonials that the colanís performed rituals in association with the new year ceremonies. These facts support the calendar correlation proposed above.

The event of Monday, February 26, 1663, is referred to by a Zapotec couplet *ri-tola re-yeni* 'one is incapacitated, one is angry'. We propose that this couplet refers to the nameless days, the five-day period that ends the year. This conclusion is supported by a closely similar semantic association for these days that is found in Sahagún's discussion of the *nemontemi*—the five days that ended the Aztec year—and of the month preceding them.[25] It may be noted that the passage refers to the current date (⟨naha tza⟩) as this first day of the five days ending the year; from the vantage point of the statement, the new year's day is yet to come.

Structurally, the second passage is essentially the same as the first. It indicates that on the current date, a Friday in March, 'one is incapacitated, one is angry'—presumably again a reference to the five days that end the Zapotec year; and it states that on a Wednesday (five days later) the year 6 Wind will take its turn. It is structurally impossible for this statement to be correct, given that the preceding year started on a Saturday: corresponding dates in two successive Zapotec years must differ by just one day in the Spanish week. The year 6 Wind in fact began on Sunday, March 2, 1664.

Were this statement correct as written, the reference to a Friday in the five-day period ending the year 5 Earthquake could only refer to the last of these five days, which fell on Friday, February 29, 1664. This dating, however, conflicts with the written statement in that the Friday in question fell in February rather than March. The fact that the following Wednesday is exactly five days after Friday also suggests that this passage is intended to refer to the five days ending the year and then to the upcoming new year's day, just as in the first passage.

The precise agreement of the 5 Earthquake record with a correlation independently derived from three separate sets of data—Booklets 27 and 85, Booklet 81, and Booklet 63—cannot be a coincidence. This being the case, the unambiguous, parallel calendrical statement for the immediately following year, 6 Wind, must have a similar intended relevance in spite of its chronological discrepancy; in fact, the identification of the ambiguous *yo=xoo* with 5 Earthquake (rather than 2 Earthquake, 9 Earthquake, or [less likely] 3 Earthquake) hinges on such an interpretation for the unambiguous 6 Wind passage. The chronological discrepancy in the 6 Wind passage therefore does not constitute evidence against the correlation otherwise secured by the same calendar. The most plausible hypothesis that we can offer for the chronological discrepancy in the second passage is that these passages were partly calculated from or copied from an earlier annotation, and that the scribe failed to correctly update the Spanish data when writing the record for the year 6 Wind.[26]

Booklet 84

This booklet was composed in a Nexitzo or Bijanos town. Alongside the last day of the ritual calendar, 13 Face, is the notation ⟨A[torn]ril 1689 lao beo abirilis⟩ 'April 1689 in the month April'. This is not enough information by itself to work out the correlation, but it is consistent with the correlation established here: 13 Face fell in April (on the 28th) in 1689.

OTHER ZAPOTEC CALENDARS INCLUDING DOMINICAL LETTERS OR SPANISH DAY NAMES

The preceding sections show that five different calendrical manuscripts provide evidence for the correlation between the Zapotec and Gregorian calendars, and all five are consistent with a single correlation between the Gregorian calendar and an indigenous 260-day calendar. Four of the calendars, 27, 63-2, 81, and 94, were written by speakers of Nexitzo or Bijanos Zapotec, and these four provide independent evidence for the correlation of the trecena with the Gregorian calendar. Booklet 85 establishes the beginning of the 365-day calendar; with the correlation of the 260-day calendar and the consistent evidence for Earthquake as a year bearer from many of the manuscripts, Booklet 85 further demonstrates that colonial Northern Zapotec years were named for their first day. The more detailed of the two parallel correlation statements of Booklet 94 confirms the correlations both of the ritual calendar and of the beginning of the Zapotec year with the Gregorian calendar, notwithstanding the fact that the second of these parallel statements is inconsistent with the first. Booklet 84 provides supporting evidence in that the correlation correctly places an instance of 13 Face in April 1689.

Two other booklets transcribed by Alcina Franch (1993) associate dominical letters with ritual calendar dates, but specify no year, month, or day in the Spanish calendar; a third gives the days of the Spanish calendar, but no years, months, or dominical letters. Given the correlation of the European and

Zapotec calendars, the dominical letters can be used to provide an approximate date for the ritual calendar data presented.[27]

Booklet 51

Booklet 51, also composed by a speaker of Nexitzo or Bijanos Zapotec, begins with a sequence of fifteen days, beginning and ending with the dominical letter *A*. No ritual calendar dates are aligned with the first three days; *yag=chila*, the first day of the Zapotec ritual calendar, is aligned with the fourth position and is assigned the dominical letter *d*. The day 1 Cayman fell on the same day of the week as January 4 in nine out of fifteen instances between 1687 and 1697; the last previous year in which it did so was 1653, well before any of the manuscripts are otherwise dated, and it did not happen again until 1724, well after the manuscripts had been collected.

After these first twelve days of the ritual calendar, no more dominical letters are used. Starting with the fourteenth day of Booklet 51, the names of the days of the Spanish week are aligned with almost every day name whose trecena coefficient is 1 or 7. These annotations have the effect of assigning two Spanish day names to each trecena, one to its first day and another (the immediately preceding Spanish day) to its middle day.

Altogether there are thirty-seven Spanish day names aligned with Zapotec days in Booklet 51. Of the thirty-five such names that are aligned with a day having a coefficient of 1 or 7, all are mutually consistent in their placement. There are only three Zapotec day names with a coefficient of 1 or 7, after the group with the dominical letters, that are not aligned with a Spanish day name: 1 Deer, 7 Death, and 7 Crow. The case of 1 Deer was simply skipped, with no Spanish day name in the near vicinity. Spanish day names are aligned with the days 6 Snake and 6 Corn, which immediately precede 7 Death and 7 Crow. These are the only Spanish day names not aligned with a day name whose coefficient is 1 or 7, and the Spanish day name in each case agrees with the following day name, whose coefficient is 7, rather than with the day name it visually aligns with. Clearly, these Spanish days are in some way intended to correspond to 7 Death and 7 Crow.

The pattern of assignment of the Spanish day names allows us to assign 1 Cayman and January 4 to a Thursday. The only date between 1650 and 1703 when 1 Cayman and January 4 both fell on a Thursday was June 28, 1691, so we can now assign Booklet 51 to the 260 days from June 28, 1691, through March 14, 1692. (The day 1 Cayman that begins this period was the second day of the two-day festival of 13 Face to 1 Cayman that ended the calendar of Booklet 63; see pp. 49–50.)

Booklet 62

This calendar is laid out with days of the week alongside days with the trecena positions 13 and 1. The data are summarized in Table 1.6a, with the days being listed in order of the trecenas in which they occur. Zapotec days that begin a trecena are in the column on the left; those that end a trecena are in the column on the right; numbers in parentheses specify the position of the day in the 260-day cycle. The pages that held trecenas 3 and 4 are missing from Booklet 62; these trecenas are blacked out in Table 1.6a.

The Spanish days assigned to the days of this ritual calendar are not consistent with one another if it is assumed that they represent a single pass through the 260-day calendar. However, it can be shown that the data were likely assigned over a period of 482 days, spanning parts of three successive ritual calendar cycles. The sequence is explicated in Table 1.6b-1 through 1.6b-3.

The first pass through the ritual calendar (see Table 1.6b-1) appears to have begun in the eighth trecena, on 1 Soaproot. The first and last day of each trecena is marked with the Spanish day on which it fell during trecenas 8 through 10. Thereafter, only the final day of the trecena was marked, until the end of the twentieth trecena, when both the beginning and end of the trecena were so marked. The last day of every trecena was marked except for trecena 15, which was skipped.

In the second pass through the ritual calendar (Table 1.6b-2), the table shades out all of the dates that were already marked off and therefore unavailable. In this pass, the last day of each trecena continued to be marked through the end of trecena 7 (data for trecenas 3 and 4 are in italics to indicate that they are reconstructed in conformity with the overall pattern). From that point, the end of every trecena was already marked (except 15), and the beginnings of trecenas 8, 9, and 10 were already marked. Spanish days began to be marked again at the first opportunity, in the eleventh trecena. From that point on, the beginning of each trecena was marked with its Spanish day name through trecena 19; the beginning of the last trecena had already been marked in the first pass.

In the third pass (Table 1.6b-3), the unavailable dates are again shaded out. The first day of each trecena continued to be marked off in trecenas 1 through 5; again, reconstruction of data for the missing trecenas 3 and 4 is marked by italics.

This relatively straightforward model in effect accounts for almost all of the data. The residue consists of the beginning dates of trecenas 6 and 7: they are marked consistently with one another but inconsistently with any of the three passes for which we seem to have data.

The overall results are summarized in Table 1.6c. The dates marked during the first pass are in bold type in the heavily outlined area. Dates marked in the second pass run from the beginning to the end of the ritual calendar, on dates not already filled on the first pass; this pass uses bold type on a shaded background in a less heavily outlined area. Dates marked in the third pass run from the beginning of the ritual calendar to the fifth trecena in a lightly outlined area of the chart, with plain type on a shaded background. The data not accounted for under this model are not outlined and appear in light type.

The earliest date in Booklet 62 associated with the first pass through the ritual calendar was 1 Soaproot, marked as having fallen on a Friday; the latest date associated with the third pass was 1 Reed, falling on a Wednesday. The Spanish days of the week recur on a given ritual calendar date on every seventh occurrence of such a date, an interval of 1,820 (7×260) days. This yields the

TABLE 1.6. The sequence of three ritual calendars implicit in Booklet 62. See text for explanation of the formats. (a) Schematic representation of the ritual calendar dates that are correlated with days of the week.

	Spanish days associated with Calendar 62				
1	1 Cayman (1)	Sunday		13 Reed (13)	Thursday
2	1 Jaguar (14)	Saturday		13 Death (26)	Wednesday
3					
4					
5	1 Reed (53)	Wednesday		13 Snake (65)	Sunday
6	1 Death (66)	Friday		13 Flint (78)	Saturday
7	1 Storm (79)	Thursday		13 Monkey (91)	Friday
8	1 Soaproot (92)	Friday		13 Iguana (105)	Wednesday
9	1 Snake (104)	Thursday		13 Earthquake (117)	Tuesday
10	1 Flint (118)	Wednesday		13 Knot (130)	Monday
11	1 Monkey (131)	Wednesday		13 Night (143)	Sunday
12	1 Iguana (144)	Tuesday		13 Crow (156)	Saturday
13	1 Earthquake (157)	Monday		13 Water (169)	Friday
14	1 Knot (170)	Sunday		13 Wind (182)	Thursday
15	1 Night (183)	Saturday			
16	1 Crow (196)	Friday		13 Rabbit (208)	Tuesday
17	1 Water (209)	Thursday		13 Cayman (221)	Monday
18	1 Wind (222)	Wednesday		13 Jaguar (234)	Sunday
19	1 Corn (235)	Tuesday		13 Deer (247)	Saturday
20	1 Rabbit (248)	Sunday		13 Face (260)	Friday

TABLE 1.6b-1. Schematic representation of the sequence of annotations in three successive passes through the ritual calendar: first pass, beginning in the ninth trecena.

	first pass through Calendar 62				
1					
2					
3					
4					
5					
6					
7					
8	1 Soaproot (92)	Friday		13 Iguana (105)	Wednesday
9	1 Snake (104)	Thursday		13 Earthquake (117)	Tuesday
10	1 Flint (118)	Wednesday		13 Knot (130)	Monday
11				13 Night (143)	Sunday
12				13 Crow (156)	Saturday
13				13 Water (169)	Friday
14				13 Wind (182)	Thursday
15					
16				13 Rabbit (208)	Tuesday
17				13 Cayman (221)	Monday
18				13 Jaguar (234)	Sunday
19				13 Deer (247)	Saturday
20	1 Rabbit (248)	Sunday		13 Face (260)	Friday

TABLE 1.6b-2. Schematic representation of the sequence of annotations in three successive passes through the ritual calendar: second pass, beginning in the first trecena.

	second pass through Calendar 62				
1				13 Reed (13)	Thursday
2				13 Death (26)	Wednesday
3				*13 Storm (39)*	*Tuesday*
4				*13 Soaproot (52)*	*Monday*
5				13 Snake (65)	Sunday
6				13 Flint (78)	Saturday
7				13 Monkey (91)	Friday
8					
9					
10					
11	1 Monkey (131)	Wednesday			
12	1 Iguana (144)	Tuesday			
13	1 Earthquake (157)	Monday			
14	1 Knot (170)	Sunday			
15	1 Night (183)	Saturday			
16	1 Crow (196)	Friday			
17	1 Water (209)	Thursday			
18	1 Wind (222)	Wednesday			
19	1 Corn (235)	Tuesday			
20					

TABLE 1.6b-3. Schematic representation of the sequence of annotations in three successive passes through the ritual calendar: third pass, beginning in the first trecena.

	third pass through Calendar 62				
1	1 Cayman (1)	Sunday			
2	1 Jaguar (14)	Saturday			
3	*1 Deer (27)*	*Friday*			
4	*1 Face (40)*	*Thursday*			
5	1 Reed (53)	Wednesday			
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

following candidates for the dates of use of Booklet 62 in the period during which most of the other calendars seem to have been in use:

1 Soaproot, on a Friday	1 Reed, on a Wednesday
June 26, 1682	October 20, 1683
June 20, 1687	October 13, 1688
June 13, 1692	October 7, 1693
June 7, 1697	October 1, 1698

None of these candidates for the dating of the annotations to Booklet 62 seems to contribute to an explanation of the most important issues raised by this analysis: why the ends and only then the beginnings of trecenas in Booklet 62 would have been annotated with Spanish days, and why this process should have begun on 1 Soaproot. Concerning the dating itself, it is worth noting that in the five other Zapotec calendars equipped with Spanish calendrical annotations (in Booklets 27, 51, 63, 81, and 85), all contemporaneous annotations date between 1690 and 1696 (the 1686 date from Booklet 63 is a background reference linked to an eclipse in 1692).[28] This leads us to lean toward June 13, 1692–October 7, 1693, as being the period during which this calendar was annotated

TABLE 1.6c. Schematic representation of the parts of the calendar associated with each pass of annotation.

	structural summary: Spanish days associated with Calendar 62				
1	1 Cayman (1)	Sunday		13 Reed (13)	Thursday
2	1 Jaguar (14)	Saturday		13 Death (26)	Wednesday
3					
4					
5	1 Reed (53)	Wednesday		13 Snake (65)	Sunday
6	1 Death (66)	Friday		13 Flint (78)	Saturday
7	1 Storm (79)	Thursday		13 Monkey (91)	Friday
8	1 Soaproot (92)	Friday		13 Iguana (105)	Wednesday
9	1 Snake (104)	Thursday		13 Earthquake (117)	Tuesday
10	1 Flint (118)	Wednesday		13 Knot (130)	Monday
11	1 Monkey (131)	Wednesday		13 Night (143)	Sunday
12	1 Iguana (144)	Tuesday		13 Crow (156)	Saturday
13	1 Earthquake (157)	Monday		13 Water (169)	Friday
14	1 Knot (170)	Sunday		13 Wind (182)	Thursday
15	1 Night (183)	Saturday			
16	1 Crow (196)	Friday		13 Rabbit (208)	Tuesday
17	1 Water (209)	Thursday		13 Cayman (221)	Monday
18	1 Wind (222)	Wednesday		13 Jaguar (234)	Sunday
19	1 Corn (235)	Tuesday		13 Deer (247)	Saturday
20	1 Rabbit (248)	Sunday		13 Face (260)	Friday

1 Soaproot (92)	Friday	beginning of first pass
13 Reed (13)	Thursday	beginning of second pass
1 Cayman (1)	Sunday	beginning of third pass
1 Death (66)	Friday	not covered by this system

with Spanish day names; in any case, the early 1690s are the most frequent of the years in the contemporaneous annotations on the manuscripts reviewed in this paper.[29]

Booklet 88

Booklet 88 was composed by a speaker of Nexitzo or Bijanos Zapotec. In this booklet, every day of the ritual calendar is aligned with a dominical letter. The first day of the ritual calendar is aligned with the dominical letter *A*, corresponding to the same day as January 1 of the year within which it fell. This correspondence did not happen during the 1680s or 1690s, the period within which the other dated records originated. The only time during the second half of the seventeenth century when the first day of the ritual calendar and the first day of the Spanish year fell on the same day of the week was from July 29, 1666, to April 2, 1677; and this circumstance did not recur until November 11, 1707, after the collection of the calendars had been completed.

In Booklet 85 (see Table 1.2), the dominical letter sequence is reset during the twenty days between December 19, 1695 (*c*), and January 8, 1696 (*A*): were this not the case, the letter *b* would be assigned twenty days after a day assigned to the letter *c.* This interruption of the succession of dominical letters reflects the change from 1695 to 1696, since the letter *A* is assigned to January 1 of every year. There is no such resetting in Booklet 88. If this alignment was set in connection with a real year, all 260 days of the calendar must have fallen during the same Spanish year, which yields the following possible dates for Booklet 88:

April 8, 1672–December 23, 1672	in the year 1 Wind
February 12, 1675–October 29, 1675	in the years 3 Soaproot–4 Earthquake
April 2, 1677–December 17, 1677	in the year 6 Deer

Under this interpretation, Booklet 88 would be the earliest of the calendars presented by Alcina Franch to which a date can be assigned. However, as already noted (p. 63), the other Spanish annotations to Zapotec calendars in the AGI México 882 booklets all relate to the years 1690–1696. This raises two alternative hypotheses.

(1) Since Zapotec colanís made copies of earlier calendrical texts, it is possible that Booklet 88 is a thoroughly literal copy of an earlier calendar produced or annotated in the 1670s.

(2) The pattern of dominical letters in this calendar was laid out as a purely formal device: the canonical beginning of the dominical letter sequence, *A,* is aligned with the beginning of the ritual calendar. This hypothesis would account for the fact that there is no resetting of the dominical letter sequence.

THE ANTIQUITY OF THE ZAPOTEC CALENDAR CORRELATION, AND COMPARISON WITH OTHER CALENDARS

The year bearers of the seventeenth-century Zapotec years were maintained since the Late Preclassic period, probably from 200 BC or earlier. The interest in eclipses shown in Booklet 81 (also in Booklet 63; see Tavárez and Justeson n.d.) may continue a focus that goes back to the Late Preclassic: Justeson and Kaufman (1996–2000; see also Kaufman and Justeson 2004) show that the war dates on the tablets of Monte Alban Mound J all fall within a few days of eclipses—possibly, but not necessarily, of visible eclipses.

Nonetheless, it is unlikely that the correlation here established for the colonial Zapotec ritual calendar is valid for the time of the earliest Zapotec inscriptions. According to Justeson and Kaufman's analysis, the nodes fell around 7 Snake, 3 Soaproot, and 11 Flint around the time of the Mound J records; archaeologically, they are dated to the Monte Alban II period, no later than AD 200, and the sequence of dates spans about 125 years. The Mound J data would fit the correlation established here only if these records dated to the Early Postclassic period. Evidently, then, the ritual calendar was reset sometime after the creation of the Mound J tablets. Evidence presented in this section suggests that that resetting was due to the influence of Nahuas.

Caso's (1939) generally accepted correlation places the date 8 Wind of the Aztec calendar on November 9, 1519, in the Julian calendar; Calnek's demonstration (this volume) that a calendar reform was instituted in 1507 at Tenochtitlan secures Kirchhoff's identification of this date with the Tlatelolco system. This correlation places February 23, 1695, on the day 11 Earthquake, so the colonial Zapotec ritual calendar agrees with the traditional Aztec calendar, as maintained at Tlatelolco, and with that of Tenochtitlan before the reform. The same correlation was found in highland Guatemala. Modern K'ichee' and Ixil ethnographic accounts, projected backward, would place February 23, 1695, on 11 Earthquake, as do the sixteenth-century records of the *Annals of the Kaqchikels* (see Smith 2002, correcting Recinos 1950).

Thompson (1935) originally considered that dates in the Classic Lowland Mayan ritual calendar fell two days later. One of the clearest lines of evidence for this position is Landa's correlation of 12 Kan 1 Pop with July 16 of an unspecified year. It is widely accepted that the year in question was 1553.[30] Because the Classic period linkage between the ritual calendar and the days of the months differed by one day from the linkage that held in Postclassic Yucatan, the Goodman-Martínez-Thompson (GMT) correlation could put either the ritual calendar date or the month position on July 16, but the other would have to be off by one day. The original GMT correlation placed the first day of the Mayan year on July 16, 1553, and the ritual calendar date was thereby assigned to 11 Akbal (Night). Thompson later revised this correlation to agree with the Guatemalan systems under the hypothesis of pan-Mesoamerican synchronicity. Both alternatives have their supporters today, but it may be observed that under the revised correlation, July 16, 1553, fell on 13 Chicchan (Snake) in the ritual calendar (one day too late) and on the third day of the month Pop (two days too late). The ethnohistoric starting point for the Lowland Mayan calendar correlation is in fact inconsistent with the synchronicity hypothesis.

There are grounds for supposing that the highland Guatemalan calendars do not provide independent evidence for a pan-Mesoamerican synchronicity of the ritual calendar. Some of these calendars have borrowed Nahua month names (Miles 1957; Campbell 1977) from near the end of the Nahua year: in this instance, it is a calendar on which Nahua influence is reflected by the borrowing of Nahua month names and that shows the traditional Nahua correlation of the ritual calendar and the vague year with the European calendar. There is evidence for some antiquity to this influence of central Mexico on highland Guatemala. Selverstone (1995) has presented evidence relating the spacing of footprint symbols in the 260-day calendars of Borgia Group codices to modern K'ichee' rituals reported by Tedlock (1993: 191–196) but was undecided on the direction of spread of the calendrical constructs on which both were based.

The same may be true in the Zapotec case. Alcina Franch suggested that the word ⟨quicholla⟩ was the name of the last five days of the year and is a borrowing of the Aztec month name ⟨Quecholi⟩; against this proposal, however, see Note 11. Nonetheless, there is evidence for Nahua influence on the calendar systems of Oto-Manguean territory south of the Basin of Mexico. Pohl (cited in Boone and Smith 2003: 322) relates calendrical features of these and other Mexican codices to Nahua influence. In particular, the (Late Postclassic) Borgia Group codices, as well as Mixtec codices, use effectively the same signs for the day names as the Aztec manuscripts. The forms of every one of these signs is consistent with the Nahua name for the corresponding day and more generally with names found in the Basin of Mexico, but 'house' and 'flower' are inconsistent with their Mixtec names 'night' and 'macaw'. Because the names that motivate the sign forms are known only from the Basin of Mexico and traditions deriving from it[31] (Kaufman 2000a), this is most likely an innovation that spread from there to southern Mesoamerica. Early writing in the Mixteca used day signs deriving from the Zapotec tradition and iconically reflecting Zapotec day names 'night', represented by the face of an owl, and 'face', represented by a human face in profile. Another specific connection of Zapotec to Nahua calendrical practices is known from the work of Weitlaner (1958) on a southern Zapotec survival of the ritual calendar system. In the Loxicha area, the twenty named days are gone, but a cycle of 260 days is still produced by permuting the names of nine gods with thirteen numerals. The structure of this system has the peculiarity that two of the gods rather than just one are assigned to the first day; the first pass through the gods' names therefore lasts just eight days rather than the usual nine, yielding 260 days ($= 8 + 28 \times 9$) after 29 passes. A similar cycle containing the names of nine deities appears in a calendar from San Antonio Huitepec that may have been produced in colonial times (van Meer 2000). Caso (1965: 945) notes that the same structure was used to fit the Aztecs' nine-day cycle of the Lords of the Night into a recurring 260-day cycle, except that the pair of gods occupied the final day rather than the first day of the 260.

Nahuas do not appear to have had an impact on the vocabularies of other languages until about AD 1000 (Kaufman 2000b; Kaufman and Justeson 2006, n.d.), and this reflects the lack of any major cultural impact by Nahuas until that time. Afterward, Nahuas spread throughout the Basin of Mexico, and their military successes established pockets of Nahua language and culture in many other parts of Mesoamerica, before the rise of the Aztecs. It may have been this unparalleled international influence that provided the basis for calendar reforms that brought the calendars of the Postclassic Zapotecs, and perhaps of Mayans in the Guatemala highlands, into conformity with the Nahua calendar as it was in Tlatelolco and as it had originally been in Tenochtitlan.

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ABBREVIATIONS AND CONVENTIONS

References to archives use the following abbreviations:

AGI	Archivo General de Indias, Seville
AGN	Archivo General de la Nación, Mexico
AJVA	Archivo Judicial de Villa Alta, Oaxaca City

In text transcriptions, *X*[*n*] transcribes a letter *X* surmounted by a tilde; otherwise, square brackets enclose material that is not present in the text but that is to be understood by the reader (in abbreviations). In linguistic transcriptions, *7* transcribes a glottal stop.

Zapotec language data in their original orthographic form are presented in roman type, surrounded by angle brackets; renderings of Zapotec language data in modern linguistic garb, whether approximate or exact, are in italics; standard spellings of Spanish, Latin, and Nahuatl language forms, when treated as data rather than a language of description, are in italics.

The presentation of Zapotec sentences from the manuscripts contains three lines: first, a transcription of what is written; second, a morpheme-by-morpheme grammatical analysis of each word in the sentence; and third, a translation into English. (Spanish sentences are provided only in transcription and translation.) In translations, parentheses enclose optional elements; square brackets enclose comments. Because it is not possible to know the pronunciation of colonial Zapotec forms in complete detail, the morphological breakdown of transcribed material follows the orthography of the original rather than a phonetic or phonemic interpretation of it. Grammatical codes used in this paper are:

AUG2	day name augment for trecena positions 2, 3, 5, 9	*yo*(*-lo*)*=*
CMP1	completive aspect prefix	*go-*
CMP2b	completive aspect prefix	*b-*
NACT1	non-active derivational prefix	*t-*
NACT2	non-active derivational prefix	*y-*

In grammatical analyses, – marks the attachment of an inflectional affix, . (period) marks the attachment of a derivational affix, and = marks compounding.

Appendix numbers (in square brackets) in Alcina Franch (1993) for calendars cited in this paper are 7 [3]; 17 [6]; 20 [7]; 27 [8]; 29 [9]; 31 [10]; 39 [12]; 42 [13]; 45 [14]; 51 [15]; 62 [16]; 81 [17]; 85 [18]; 88 [19]; 90 [20]; 91 [21].

The word "Maya" comes from the Yucatec language, in which it referred to Yucatan and, as modifier, especially to the language and people of Yucatan.

It is unknown in any other Mayan language and so had no other authentic referent. It entered English as a word especially for the language but also for the people of Yucatan. "Mayan" was derived from this English word, used to refer to any language in the same family as (Yucatec) Maya and, by extension, as a modifying adjective in references to people speaking these languages and to their cultural practices. Every use of the word "Maya" to refer to any language other than Yucatec, to speakers of any other Mayan language, or to the cultural characteristics of the speakers of any other Mayan language is a deviation from historically justified practice—ultimately, a misusage.

We also avoid an affectation that developed in early academic anthropology: systematically using morphologically singular forms of count nouns to refer in the plural to members of certain ethnic groups, as in "the Olmec," "the Zapotec," or "the Maya." This usage effectively marks those to whom it is applied as having less humanity than Europeans, to whom it is *never* applied: on the one hand, it is ungrammatical to say, for example, "The Pict were immigrants to Britain"; and, outside of this pattern, in English nouns the use of a morphological singular form as the plural of a count noun is systematic only in references to animals, especially as game or food.

NOTES

1. This paper is one of a series of works on the Zapotec calendar on which the authors are collaborating. Authorship order is alternated in these papers; unless otherwise stated, it does not reflect differential contributions or senior vs. junior authorship. Justeson originally worked out the correlation, in the summer of 2000, using Alcina Franch's (1993) transcriptions of data from two independent sets of correlation statements: those from the Booklets 27 and 85 together and, separately, those from Booklet 81. Each set was sufficient to establish the correlation between the colonial Northern Zapotec ritual calendar and the Gregorian calendar. We began collaborating in April 2004 on the correlation statements in Booklet 81, initially to incorporate and address the content of the Zapotec portion of the correlation data from this booklet. Tavárez had long worked with Zapotec language data from AGI México 882, especially from the transcriptions of four songs that were played to the accompaniment of a horizontal wooden drum. At the beginning of our joint work, Tavárez undertook a new transcription and a preliminary analysis and translation of the Zapotec glosses in Booklet 81. We continued collaborating on this material, and on other data from throughout the collection, through July 2004 and in the fall of 2005. In the paper as it exists, Justeson remains primarily responsible for issues concerning the calendar and Tavárez for transcribing and reading the colonial Zapotec parts of the correlation statements. Early in our collaboration, however, each of us contributed new observations and interpreta-

tions both of calendrical data and of Zapotec annotations, and each of us found new correlation data in booklets not transcribed by Alcina Franch—Justeson in Oudijk's transcriptions (Oudijk 2005), and Tavárez in his copies of the documents. With a few exceptions on points of detail, both of us have evaluated and are responsible for all claims in this paper.

2. The data as recorded by Córdova (1578a) are more complex than this account suggests; as Whittaker (1983: 127) notes, many of the augments do not have their expected forms. In separate work, Justeson has identified evidence that about two-thirds of them are likely errors, understandable in terms of a hypothetical structure for the elicitation process; the other third of them could involve variant forms, although as yet no principles have been identified that would account for which specific items use these variants. Whether the discrepancies reflect an inadequate present-day understanding of the structure of the system or are errors introduced during the preparation of Córdova's data for publication cannot be fully resolved using internal evidence; nor do the later Villa Alta calendars resolve the issue, rarely having discrepancies that agree with Córdova's.

3. Proto-Zapotecan (pZn) is the last common ancestor of all forms of Zapotec and Chatino, while proto-Zapotec (pZap) is the last common ancestor of all forms of Zapotec.

4. For "Diuino," Córdova (1578b: 143v) gives ⟨colanij⟩, corresponding to a pZap *_ko+ lla+ ni,_ with accent on the last syllable (Smith-Stark, personal communication, 2005). This term literally means a "festival person," recalling the Mayan term *_7aj=q'i:nh_ for ritual calendar specialists. We use colaní as the Anglicized form of this term.

5. Following what had become a recurring procedure in idolatry trials involving calendrical or ritual texts, Balsalobre confiscated and carried out a public burning of these texts, which usually took place after exemplary physical punishment was visited upon their convicted author or owner (see, e.g., AGN Inquisición 456: 581v, 592v).

6. Alcina Franch's (1993) numbering of the booklets mostly agrees with the document register, but Booklet 81 (see following) is mistakenly referred to as Manuscript 82 in that volume. A concordance of his manuscript numbers and appendix numbers is provided in the Abbreviations and Conventions, above.

7. There were four basic auguries, which seem to have appeared on a four-day cycle, most of uncertain meaning: ⟨xi⟩, ⟨zobi⟩, ⟨tzaba⟩ (cf. pZap *_tzakwa7_ 'dirty, bad, ugly'), and ⟨niti⟩, in that order. Related are the 'houses' (⟨yoho⟩ ~ ⟨yoo⟩; pZap *_yo7o_) from which each trecena is said to emerge: ⟨yoholleo⟩ ~ ⟨Laoyoo⟩, the House of the Earth, in odd-numbered trecenas; ⟨yohoyebaa⟩, the House of the Upper World, in trecenas 2, 6, 10, 14, and 18; and ⟨yoho gabila⟩, the House of the Underworld, in trecenas 4, 8, 12, 16, and 20. The alternation is such that a trecena for the House of the Earth always occurs between one for the House of Heaven and one for the House of the Underworld. De la Cruz (2002) and Smith-Stark (personal communication, 2004) argue that these auguries have directional and perhaps color associations.

8. See Note 3.

9. Victoria Bricker (personal communication, 2005) reports that four Spanish *reportorios* in her possession all use the system in which *A* is the dominical letter that is capitalized; we do not know if there is evidence in these documents for the years to which the dominical letters pertain.

10. Cline (1975) reached the same conclusion, but his analysis was based on a misunderstanding of the dominical letter system.

11. We do not include among these lines of evidence Alcina Franch's proposal that the word ⟨quicholla⟩, opposite the date 17 Febrero, is a loan from the Nahua month name Quecholli because (a) the dates do not match; (b) the final vowels disagree; and (c) the word can be analyzed in Zapotec as consisting of the potential prefix ⟨qui⟩ on a verb root ⟨cholla⟩. (We can propose no evocative meaning for a colonial Northern Zapotec ⟨qui-cholla⟩. Without pressing the point, however, if ⟨cholla⟩ were a copyist's error for ⟨tholla⟩, we would have the same verb that serves in couplet with ⟨yeni⟩ to designate the nameless days in Booklet 94 (see p. 57), and it is this five-day group with which ⟨quicholla⟩ is associated.)

12. We are indebted to Thomas C. Smith-Stark for the translation of the Latin.

13. If ⟨toohuà⟩ is indeed the word 'mouth', the initial pZap **ty* of this word would be expected to show up with initial ⟨r⟩ in Bijanos and Nexitzo Zapotec and with initial ⟨ch⟩ in Cajonos Zapotec. The word is rare in colonial Northern Zapotec texts but does show up, rendered as ⟨roa⟩ ~ ⟨raha⟩ ~ ⟨ra⟩. Nonetheless, 'mouth' also shows up in these northern texts with initial ⟨t⟩, specifically in proper names of land plots such as ⟨Yoo Yabe Tohua⟩ (AJVA Civil 3: 3r) and ⟨Tuah Tohua⟩ (AJVA Civil 25: 28r); this is consistent with the possibility that ⟨toohuà⟩ in Booklet 85 may indeed be the proper name for the month that began the year. Justifying this possibility, which would require a satisfactory account for the spellings with ⟨t⟩, is beyond the scope of this paper, but such an account would have to involve issues of intergroup contact or the circulation of manuscripts among writers of Zapotec; such processes are plausible since they are almost surely the basis for colonial Northern Zapotec spellings of *y* as ⟨qu⟩ ~ ⟨que⟩ ~ ⟨qui⟩ ~ ⟨gu⟩ ~ ⟨gue⟩ ~ ⟨gui⟩ based ultimately on the correspondence of Northern Zapotec *y* to other Zapotec *k* before *i* and *e* (Tavárez and Justeson n.d.).

14. Based on a different interpretation of the word ⟨gogaa⟩, Urcid (2001: 87–88) suggests that it, and therefore perhaps other months, had an agricultural association. He notes that Córdova's (1578b: 400v) gloss for ⟨cociy cogaa⟩ refers to a period of rain and wind, concluding that this description is appropriate to the month of August: the ninth month runs from August 2 to August 22. This gloss, however, does not appear to be a literal meaning of the word ⟨cogaa⟩; it may therefore have been a reference to the seasonal association of ⟨cogaa⟩ during Córdova's time. In 1578, this part of the 365-day calendar would have taken place from September 1 to September 21. However, the period *cociy* is otherwise known only for the trecena; the twenty-day period was referred to as 'moon'. According to the correlation established in the rest of this paper, during the twenty-five years leading up to the 1578 publication of Córdova's *Vocabvlario,* the ninth *cociy*—1 Snake to 13 Earthquake—fell at approximately the same time of year

as ⟨gogaa⟩ did in 1695: it began in the Julian calendar on August 25, 1553; on August 19, 1558; on August 13, 1563; on August 6, 1568; on July 31, 1573; and on July 25, 1578.

15. The precise interpretation of ⟨ribee gosii ?to ?hueag⟩ is unclear, partly because the transcription itself is not secure, so we do not provide a translation in the body of our text. But ⟨ribee gosii⟩ seems to mean '(the) trecena seats itself' (cf. the similar phrase in Booklet 94, discussed below), and 1 Deer is indeed the beginning of a trecena (the third trecena). If ⟨hueag⟩ 'same' is the correct reading of the last word in this text, we have something like 'the same trecena is seated'. It is not obvious what this phrase would mean, but it may relate to the fact that the 1 Deer of February 19 was the second instance of the seating of this trecena during the Zapotec year to which the annotation pertains. Earlier on the same page we read ⟨marte tiola huegoti⟩ between the days 9 Wind and 10 Night; if 1 Deer is Sunday, then Tuesday (⟨marte⟩) would have fallen on 9 Wind.

16. See Note 3.

17. The same verb is spelled ⟨coyequi⟩ in Booklet 37 in relation to the burning of offertory candles.

18. This date makes it possible to identify the likely author of these annotations. Booklet 81 is one of only a handful in which the name of the owner of a calendrical booklet was recorded on the document's front or back cover after it was surrendered to ecclesiastical authorities at San Ildefonso de Villa Alta. The owner of this booklet is identified, in such a note, on the booklet's front cover: *Juan Matias es M*[*aest*]*ro* ('Juan Matias is a teacher [of idolatries]'). Providentially, he is also identified in the record of the proceedings of a communal confession at San Ildefonso on December 22, 1704. This confession was presented by the town officials of San Juan Malinaltepec, within the parish of Choapa, before Juan Gracia Corona, the resident secular priest of the parish of Santa Cruz Yagavila. During the proceedings, a native fiscal named Juan Matias pointed to a specific booklet and "said it was his, and that his father had left it to him about seven years before" (AGI México 882: 914r)—that is, around 1697. Hence, it is quite possible that the father of Juan Matias was the author of the annotations that are discussed in this section. (A fiscal was a native official appointed by the bishop to ensure that indigenous people observed Christian practices; some were in fact colanís.)

19. An annotation at the beginning of Booklet 49 correctly associates Sunday with October 4, 1693, but is not associated with a Zapotec date.

20. These passages parallel the majority of European dates appearing at the beginning of colonial Northern Zapotec documents in placing ⟨laça⟩ before the month name, yielding statements like ⟨naatza lones goxono tza lasa beo agusto 1640 anios⟩ 'Today on Monday, the eighth day of the period of the month of August of the year of 1640' (AJVA Civil 75: 11r). A morpheme spelled ⟨láça⟩ ~ ⟨làça⟩ is given by Córdova (1578b: 19r, 140r) as the root of verbs meaning something like 'to last a long time' or 'to take a long time' (see also fol. 18r) and of noun phrases referring to long periods of time or to a distant time (ibid.: 27v–28r, 30r, 148r, 158v, 276r, 394v, 401r, 420r); Córdova's ⟨coláça⟩, referring to things from long ago, has a cognate of the same meaning in Juchitan Zapotec *gu*+

lâ7sa, for example in *binní gu+ lâ7sa* 'gente que son dura para trabajar; los antepasados zapotecas; nombre que se atribuye a las figurillas de barro que hiecieron nuestros antepasados' (Kaufman, Pérez, and Feke 1995–2004) and 'los ídolos y demás objetos de barro o piedra hechos por los antiguos habitantes de la región, a quienes la leyenda atribuye el origen de la raza zapoteca' (Pickett 1971), and in Atepec Zapotec *lath·á* 'prehistórica, antepasada, prehispánica (gente)' (Nellis and Nellis 1983: 154). These entries support the view that ⟨laça⟩ in Córdova is an adjective meaning something like 'long (of time)' or a noun root meaning something like '(long) time'—from which is derived a versive verb of the same shape meaning 'to last for a (long) while'. Cordova (1578b: 424v) also gives ⟨laça⟩ for 'vez' in the sense of 'instance, occasion'; this form could be a reduction of ⟨li+aça⟩, with the same meaning, but note Zoogocho Zapotec *las* 'vez' in the sense of 'place, replacement'.

21. ⟨ttola, tola⟩ as a verb root is glossed in Córdova (1578b) with a range of meanings, all referring to incomplete control of one's faculties, including fainting, clumsiness, dizziness, dulled judgment, incompetence, stupidity, and incontinence. See, for instance, "Desatinarse o desatinado ser" (121r), "Desmayar" (129r), and "Embotarse el juyzio con vicios comer o beuer" (154r); cf. Zoogocho Zapotec *toll* in *ch-toll* 'estar echado, estar tirado (*persona, animal*)' as in *chtolle7 nyaze7 cosyiccjle yela7 borrašw cchen7* 'está echado allá donde se cayó de cabeza porque está borracho' (Long and Cruz 1999: 179).

22. ⟨ti-yeni-lachi-a⟩ is glossed in Córdova 1578b as "Enojado estar[,] assi amohinado" (170r) and "Exasperado estar co[n] vno[;] vide mohino" (193r). We would have expected ⟨ri⟩ rather than ⟨re⟩ for the habitual prefix.

23. For the ⟨qui⟩ + numeral + 'year' construction, compare Córdova's (1578b) ⟨Lào**quitòbi yza** yànna⟩ "en este año[:] futuro" (165r); ⟨**quitòbi-yza**⟩ "durar assi vn año" (148v); ⟨**Quitòpayza**⟩ "[Entrambos a dos] Años" (174v); ⟨**Quitàpayza**⟩ "Quatro años espacio dellos" (100v); ⟨Huazàbiti **quiròpayza , quiònayza**⟩ "falta p[ar]a dos años, p[ar]a tres, o assi" (194r), "Va p[ar]a dos años, para tres, &c" (419r). Northern Zapotec ⟨to⟩ corresponds to Córdova's ⟨tobi⟩.

24. ⟨reesi⟩ is here read as ⟨re⟩, a habitual prefix, plus ⟨si⟩ ~ ⟨çi⟩, a verb root that is glossed as "recebir o tomar," "tomado ser," and "lo que me da[n]" in Córdova (1578b: 345r, 404v, 405r). The expression ⟨çi laça⟩ appears to designate the beginning of time periods, as in a closely parallel passage ⟨natza miyecoles se lasa beo marso⟩ (AJVA Civil 44: 17r), which is glossed in Spanish as 'Today on Wednesday, the first day of March'. Since the year bearer is referred to as the ruler of the year, this phrase probably refers to 6 Wind beginning its period or span, just as the previous sentence had 5 Earthquake being seated in its office. We would have expected ⟨ri⟩ for the habitual prefix.

25. We are indebted to Joanna Sanchez for the following observations. Book 2, Florentine Codex (pages 157–158) describes the nature of the nemontemi and of the immediately preceding period. The following prohibitions during the nemontemi may indicate that people might be prone to such behaviors at this time: *yoan aiac huel oncan maoaia; . . . aiac maoaz* 'no one might then quarrel; none might wrangle' (corresponding to Zapotec ⟨yeni⟩); and *ano ac huel motlahuitequia, moticuiniaya, motepotla-*

miaya 'Nor should anyone fall, trip or stumble' (corresponding to Zapotec ⟨tola⟩ 'to be in a state of incapacity or diminished capacity'); the references to stumbling probably involve drunkenness, and suggest a particular type of diminished capacity. This period immediately follows the month Izcalli, at the end of which every fourth year there is general community drunkenness, notably including the children: "with ruddy faces, crying out, short of breath, with glazed eyes, all mingled with one another; there were disputes; all circled and milled about; becoming more intense, all crowded and pressed together, elbowing each other; all took one another by the hands; they were bemused; embracing one another firmly thus all entered their homes." It is the drunken dazes and disputes ending Izcalli that are proscribed for the nemontemi.

26. In fact, the five-day period began in March almost throughout the preceding calendar round (and for all preceding calendar rounds in the colonial period), but shifted to February in 1652, shortly before the current calendar round began in 1659. The error is therefore plausibly an updating from a record concerning a year in the preceding calendar round. The last prior occurrence of the year 6 Wind began on a Thursday (March 15, 1612), and the preceding five-day period on a Saturday in March; if this specific year was updated, the colaní erred in shifting these days backward by one day—the correct adjustment for *two* calendar rounds—and in failing to recognize that the year-ending days would no longer be starting in March. A plausible model for a copying rather than a calculating error is provided by the last previous year 5 Earthquake (but not 6 Wind); this year began on a Wednesday (March 16, 1611), and the five days preceding the year began on a Friday in March. Other years in the previous calendar round for which copied new-year statements could have yielded the incorrect record of Booklet 94 were 12 Soaproot in 1618, 6 Deer in 1625, 13 Wind in 1632, 7 Earthquake in 1639, or 1 Soaproot in 1646.

27. We are aware of one other correlational statement in this corpus, which however does not contribute either to the evidence for the correlation or to the dating of particular booklets. In parallel passages, Booklets 42, 89, and 90 record a historical event, "the coming of the word of God," as having occurred during a ceremony that took place on the days 4 Knot and 5 Monkey in a year 9 Wind. This "coming" might in principle be related to a variety of historical situations. In work to be reported elsewhere, we use the correlation to resolve the intended referent: a Spanish arrival in 9 Wind coincides with the mission of Olmedo, the first successful entry of missionaries into the Northern Zapotec area. The correlation statements provide a more explicit dating for this event than we have from Spanish sources.

28. There are other dates in the AGI México 882 corpus associated with a wider range of dates in the second half of the seventeenth century (as in the year-ending statements from Booklet 94), but none of these dates is associated with a Zapotec ritual or annual calendar.

29. Booklet 63 also equates the day 1 Reed with October 7, 1693 (see item 14 in the foregoing discussion). This may be seen as paralleling its equation of Thursday, June 28, 1691, with the day 13 Face, which is also the date of 13 Face in Booklet 51.

However, the equivalence of these dates may be fortuitous, since in Booklet 62 the significance of the date seems to be simply that it was the last ritual calendar date available for annotation with a Spanish day name.

30. Martínez Hernández, in a 1928 letter quoted by Tozzer (1941: n748), had argued that the capitalization of *A* in the dominical letters for this manuscript indicated that the year in question began on a Sunday, and this assumption was part of the argument for 1553 as the year to which Landa's Mayan year pertained. As noted in the section on Booklet 85, the capitalization of *A* among dominical letters in Mesoamerican colonial manuscripts indicates nothing about the day of the week with which the year begins. However, a correlation within a few days of the Goodman-Martínez-Thompson correlation is almost universally supported by Mayanists, and this correlation of the Mayan and European calendars imposes a date of 1553 for Landa's year in any case.

31. A recently discovered epi-Olmec text, on the inside of a Teotihuacan-style mask, uses a sign for the day House (Justeson and Kaufman n.d.). It is not clear whether the direction of influence here was from the Basin of Mexico to Veracruz, or the reverse.

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CHAPTER TWO

EDWARD E. CALNEK

Kirchhoff's Correlations and the Third Part of the Codex Borbonicus

INTRODUCTION

Probing the many possible (or impossible) permutations of the calendar has been among the "Great Games" played by Mesoamericanists since the late nineteenth century and, doubtless, by pre-Spanish astronomers and calendar priests as well. The principal structural characteristics of the calendar are well understood. Apart from a vocal minority still seeking a Mesoamerican variant of our own standardized leap year intercalations (Tena 1987; Mora Echeverría 1997), there is good agreement on most points, although strong disagreements remain on many others.

This paper focuses on Paul Kirchhoff's (1950, 1955) claim that different calendars were concurrently used in the Mexica (Aztec) capital, Tenochtitlan, and its sister-city, Tlatelolco. This claim was immediately rejected by Alfonso Caso (1967: 48) as circumstantially implausible and technically mistaken. Caso's

TABLE 2.1. Day-names of the Sacred Almanac (Nahuatl and English).

1	Cipactli	Alligator	11	Ozomatli	Monkey
2	Ehecatl	Wind	12	Malinalli	Grass
3	Calli	House	13	Acatl	Reed
4	Cuetzpallin	Lizard	14	Ocelotl	Jaguar
5	Coatl	Snake	15	Cuauhtli	Eagle
6	Miquiztli	Death	16	Cozcacuauhtli	Vulture
7	Mazatl	Deer	17	Ollin	Movement
8	Tochtli	Rabbit	18	Tecpatl	Flint-knife
9	Atl	Water	19	Quiahuitl	Rain
10	Izcuintli	Dog	20	Xochitl	Flower

TABLE 2.2. Tenochtitlan month names (Nahuatl and English [translations approximate]).

1	Atlcahualo	Water stopped	11	Ochpaniztli	Sweeping the road
2	Tlacaxipehualiztli	Flaying of men	12	Teotleco	The god arrives
3	Tozoztontli	Small vigil	13	Tepeilhuitl	Mountain festival
4	Hueitozoztli	Great vigil	14	Quecholli	Macaw
5	Toxcatl	Dry [thing]; drought?	15	Panquetzaliztli	Raising banners
6	Etzalcualiztli	Eating beans	16	Atemoztli	Water descends
7	Tecuilhuitontli	Little feast of lords	17	Tititl	Wrinkled?
8	Hueitecuilhuitl	Great feast of lords	18	Izcalli	Sprouting; rebirth?
9	Tlaxochimaco	Giving flowers	19	Nemontemi (5 days)	Empty or useless days?
10	Xocotlhuetzi	Fruit falls			

prestige at the time was sufficiently strong to relegate Kirchhoff's dual calendar hypothesis to a kind of "dustbin" of academic history. An enigmatic calendrical text found in the third part of the Codex Borbonicus (1974), however, justifies its resurrection. Before considering the merits of either interpretation, a brief review of the main structural characteristics of the Mesoamerican calendar system will be useful (see Caso 1967 and Edmonson 1988 for more detailed descriptions).

The basic components of the Mesoamerican calendar were a 260-day sacred almanac and a 365-day calendar year.[1] The first combined thirteen numbers, usually from 1 to 13,[2] with twenty day names (Table 2.1). The second consisted of eighteen 20-day months[3] plus five "extra" days, except during calendar reform years, as described in what follows. Months were individually named (Table 2.2), and their days numbered from 1 to 20.[4] The "extra" days were numbered from 1 to 5, completing what amounts to a vague solar year.

Calendar years were named for the almanac day falling on the first day of the first month throughout most of the Maya lowlands or the last day of the last month nearly everywhere else. The mathematically possible combinations were such that only four of the twenty almanac day-names could serve

TABLE 2.3. Year-naming sets from the Sacred Almanac.

I	Cipactli	Miquiztli	Ozomatli	Cozcacuauhtli
II	Ehecatl	Mazatl	Malinalli	Ollin
III	Calli	Tochtli	Acatl	Tecpatl
IV	Cuetzpallin	Atl	Ocelotl	Quiahuitl
V	Coatl	Izcuintli	Cuauhtli	Xochitl

TABLE 2.4. Year-beginning dates in nine calendars using Type III year-naming sets, AD 1369–1370 (based on Jiménez Moreno 1961).

Calendar System	*Year Name*	*First Day*	*Date*	*First Month*
Colhua I	6 Tochtli	11 Atl	Dec 13, 1369	Quecholli
Metztitlan	13 Tochtli	5 Atl	Jan 2, 1370	Panquetzaliztli
Mixtec	7 Tochtli	12 Atl	Jan 22, 1370	Atemoztli
Texcocan	1 Tochtli	6 Atl	Feb 11, 1370	Tititl
Mexica*	8 Tochtli	13 Atl	Mar 3, 1370	Izcalli
Cuitlahuac	2 Tochtli	7 Atl	Mar 23, 1370	Atlcahualo
Colhua II	9 Tochtli	1 Atl	Apr 12, 1370	Tlacaxipehualiztli
Matlatzinca	10 Tochtli	2 Atl	May 22, 1370	Hueitozoztli
Cuauhtlitlan?	4 Tochtli	9 Atl	June 11, 1370	Toxcatl

*Here, Jiménez Moreno accepts Caso's correlation.

as year-naming days in any given variant of the system. There were, accordingly, five possible name sets (Table 2.3). Of these, the most frequently used in Postclassic central Mexico was the third, which consisted of *Calli* (House), *Tochtli* (Rabbit), *Acatl* (Reed), and *Tecpatl* (Flint-knife). When the day names from each of the two counts, running concurrently, are combined, the result is a set of 18,980 uniquely named days, equivalent to 73 almanacs or a cycle of 52 calendar years.

We know that calendrical name sets were occasionally changed, but we do not know why or precisely when. One method was to shift the year-beginning date forward by one day; another was to shift from an initial to a terminal day-naming system, or vice-versa. More frequently, however, the month that began the year was changed, resulting in an immediate change of the year name and a change in the length of the year.

This practice was first identified by Jiménez Moreno (1940), who found that the calendar used in Yanhuitlan in the Mixteca began and ended two months earlier than in Tenochtitlan, thereby changing the numerical prefix of the year name. Years named 1 Acatl in the former were named 2 Acatl in the latter. The same investigator subsequently identified the additional calendars listed in Table 2.4 (Jiménez Moreno 1961). Edmonson (1988) has added several dozen more to the overall list. Although he grudgingly admitted that manipulations of this kind must have occurred, Caso (1967: 33) insisted that the 260-day almanac, once set in motion, was "absolutely independent of any other and developed in such a way that one *tonalpohualli* [i.e., Sacred Almanac] was immediately followed by another, identical to the first, and so on indefinitely, with no modification of the sequence because of any astronomical or natural phenomenon" (my translation). One consequence, as Munro Edmonson puts it, has been that "any particular [almanac] day has always had and still has the same position in the day count everywhere. When it was 6 Ik [6 Wind] in Tikal, it was 6 Ik in Nayarit and Costa Rica as well. Mistakes in the naming of the days are amazingly rare" (Edmonson 1988: 5).

Kirchhoff (1955) maintained, nonetheless, that Tenochtitlan's version of the Sacred Almanac lagged twenty days behind that used in Tlatelolco. Otherwise, he agreed that Caso's (1967: 42) approach, based on the following four procedural steps, was correct:

1. Find a general correspondence between the Aztec and European year.
2. Identify the first month of the year.
3. Establish a day-for-day correspondence with a day in the European year.
4. Identify the first day of the Mesoamerican year.

The first step is easily completed, since numerous sources indicate that 1519, the year of the Spanish invasion, was named 1 Acatl (1 Reed) in calendars used in Tenochtitlan and other central Mexican city-states (see Tena 1987: 37–44 for a comprehensive inventory of sources for this and the other dates falling within the period 1519–1521 cited in what follows). The second, however, poses greater difficulties. Virtually every pertinent source states that Atlcahualo (also called Cuauhuitlehua) was the first month of the year in Tenochtitlan. But Caso's interpretation of sources bearing on the dates of Cortés's entry in Tenochtitlan and final victory had convinced him that Izcalli, which precedes Atlcahualo in the month list, was the correct choice. The problems raised in this context are complex, so that Caso's circuitous route to a partially mistaken conclusion must be explained in some detail.

CORRELATION DATES AND THE CODEX BORBONICUS

Two key correlation dates were used by both Caso and Kirchhoff. The first is the date when Cortés entered Tenochtitlan; the second is the date of his final victory. The entry date, according to many sources, was November 8, 1519, but Cline (1973: 24–25) has shown that in every case this conclusion was based on a misinterpretation of a brief reference in Cortés's (1963) second *Carta de Relación*.[5] The corrected date is November 9, 1519. The corresponding date in Tenochtitlan's calendar, according to Sahagún (1950–1982, 12:80), was 1 Ehecatl (1 Wind), the ninth day of the month named Quecholli. But several other sources, including the *Anales de Tlatelolco* (Berlin-Neubart 1948) and Chimalpahin's seventh *Relación* (Chimalpahin Cuauhtlehuanitzin 1967), support an alternative date, 8 Ehecatl 9 Quecholli.

Caso (1967: 51–54) assumed that only one of the entry dates could have been correct.[6] He was convinced that the final victory date recorded by Sahagún conclusively resolved the issue. According to Spanish sources, August 13, 1521, was the date of Cortés's final victory. The interval between this and his entry date is 643 days. Sahagún's date for Emperor Cuauhtemoc's surrender to Cortés is 1 Coatl (1 Snake) in the year 3 Calli (3 House) (Sahagún 1950–1982, 12:122), which must have fallen on the second day of the month named Xocotlhuetzi. The interval between Sahagún's 1 Ehecatl and 1 Coatl dates, however, is 663 days, whereas that between 8 Ehecatl and 1 Coatl is 643 days, providing a precise correspondence. In Caso's (1967: 53) view,[7] this correspondence was sufficient to prove that 8 Ehecatl was correct and, thus, that 1 Ehecatl was probably the result of a faulty back calculation undertaken by Sahagún's Mexica collaborators several decades after the event.

Kirchhoff (1955), on the other hand, maintained that both 1 and 8 Ehecatl were correct but recorded in different calendars. Contextual evidence, he argued, indicated that the earlier 1 Ehecatl date derived from the Tenochcan calendar, whereas the 1 Coatl date derived from its Tlatelolcan counterpart. Caso vehemently rejected this possibility, largely because it violated the presumed inviolability of the almanac day count, and perhaps because he assumed greater unity between the Tenochcan and Tlatelolcan sectors of the pre-Conquest city than was actually the case. But rather than attempt a more direct refutation of Kirchhoff's hypothesis, he embarked on an ambitious but rather circuitous argument based on the following considerations (Caso 1967: 43ff.):

1. We must first be certain, he maintained, that our source deals specifically with the Mexica rather than some other group.
2. We must privilege pre-Hispanic sources, such as inscriptions, mural paintings, and pictorial manuscripts, over colonial period sources.

The Codex Borbonicus, he argued, met these criteria because it was unquestionably an Aztec text and, in his view, almost certainly pre-Hispanic.[8]

Caso draws our attention to the third part of the codex (pages 23–27), which represents ceremonies performed during each month of Tenochtitlan's calendar year. The problem posed by this section, however, is that the year in question seems to consist of nineteen rather than eighteen months, with Izcalli occupying both the first and the last positions. How was this to be understood? The first page of the series contained the name glyphs of two months—Izcalli and Atlcahualo. One or the other, he supposed, must have been the first month of the calendar year.

His discussion of the Borbonicus from this point proceeds as follows.

1. The first page contains glyphs for two months: Izcalli and Atlcahualo.
2. The glyph for Izcalli is placed just below a sign for the year 1 Tochtli (1 Rabbit).
3. A page depicting the month named Panquetzaliztli (sixteenth in the overall series) includes a glyph identifying the year as 2 Acatl, when a New Fire rite inaugurating a new 52-year cycle was performed.
4. At least eighteen of the codex's nineteen month glyphs must have belonged to this year.
5. The glyph for Izcalli is repeated at the end of the third part, just below a glyph for the year 3 Tecpatl (3 Flint-knife).

Paso y Troncoso (1979 [1898]), who first studied the codex, favored Izcalli as the first rather than last month of the year. Caso (1967: 45) agreed but cautioned that this could not be proved solely from evidence available in the Borbonicus. He relied instead on the equations

8 Ehecatl 9 Quecholli = November 9, 1519

and

1 Coatl [2 Xocotlhuetzi] 3 Calli = August 13, 1521

to resolve the issue. If his own terminal-day year-naming rule is correct, as is almost certainly the case, the combinations 8 Ehecatl 9 Quecholli and 1 Coatl 2 Xocotlhuetzi may occur only when Izcalli is the first month of the calendar year. On the other hand, the combination 1 Ehecatl 9 Quecholli may occur only in years in which Atlcahualo is the first month.

As already noted, Caso was absolutely convinced that the sequencing of almanac days was the same in all time periods and regional variants of the Mesoamerican calendar. More or less by chance, this assertion seemed to find strong support in an article by Eric Thompson titled "Maya calendars and the problem of the Aztec calendar," submitted to the 1955 *Mesa Redonda de Cronología* in México City, where Kirchhoff's paper had also been presented.

The essential point made in Thompson's article was that a number of mid-twentieth-century calendars used by Maya peoples, including the Chol, Jacaltec, Ixil, Quiche, Cakchiquel, and (Yucatec) Maya,[9] were in day-for-day agreement with the equation 1 Coatl = August 13, 1521. Caso (1967: 47–48) found the same to be true of calendars used in Tecamachalco and by Matlatzinca, Mije, and Puebla Popoluca communities. Thompson's conclusion was that the "absolute correspondence between the Maya and Aztec calendars makes it very unlikely that there would have been other central Mexican calendars that were not in agreement with [the formula 1 Coatl = August 13, 1521]" (Caso 1967: 48, abbreviated and translated by the author).

Caso (1967: 59) next turned to an incontrovertibly pre-Hispanic inscription commemorating the ruler Ahuitzotl's dedication of Tenochtitlan's greatly augmented Templo Mayor on the day 7 Acatl in the year 8 Acatl (1487). The month would have been Panquetzaliztli when Huitzilopochtli, the powerful war deity who resided in the Templo Mayor, was feted. If so, Izcalli once again must have been the first month of the year. Caso's argument on this point seemed to hang together very precisely and convincingly.

Kirchhoff nonetheless insisted that Sahagún's 1 Ehecatl 9 Quecholli entry date could not be dismissed simply because it was inconsistent with the 1 Coatl surrender date. He might have raised questions about when, how, and why such a radical departure from ancient calendrical tradition might have arisen. But instead he embarked on a sharply argued recapitulation of evidence suggesting that Sahagún's account of the Conquest was divided into two sections, the first compiled by Tenochcans and the second by Tlatelolcans. This was a plausible idea but inconclusive without additional supporting evidence.

Against Caso's reference to the Templo Mayor dedication plaque in support of his own correlation, Kirchhoff blandly replied that it must have been a Tlatelolcan and not a Tenochcan record of the event. Since its exact provenience is not known, however, his opinion on this point carries little weight.

Kirchhoff's argument faltered at this point. He might have reemphasized the virtual unanimity with which early post-Conquest sources identified Atlcahualo as the first and Izcalli as the last months of the calendar year at the time of the Conquest. He might then have considered the possibility, discussed later, that the Templo Mayor dedication plaque actually shows that the Tenochcan calendar could have diverged from an earlier calendar, still used in Tlatelolco, sometime after 8 Acatl, 1487. Unlike instances of calendar recalibration noted earlier, this modification shifted the year-beginning date forward by one month but without changing the name of the year. The method employed to achieve this result would have been comparatively simple. It was only necessary that the twenty day names of the almanac count during the first month, Izcalli, be repeated beginning with the first day of the next month, Atlcahualo. If the older calendar were retained in Tlatelolco and the new one adopted in Tenochtitlan, the result would be precisely that required by Kirchhoff's correlation hypothesis. It also happens to fit very well with the extended nineteen-month year of the third part of the Codex Borbonicus (1974: 23–37).

The Borbonicus is unusual among pictorial manuscripts dealing with the Mesoamerican calendar. The first section depicts 260 days of the sacred almanac together with their so-called companion deities. Part 2 represents the calendrical day names of each year in the 52-year cycle divided into two 26-year sections. Parts 3 and 4 taken together present the same series of year names but as a continuous series of 54 glyphs beginning with 1 Tochtli and ending with glyphs for 1 Tochtli and 2 Acatl repeated.[10]

Part 3 is made up of three years only—1 Tochtli (1 Rabbit), 2 Acatl (2 Reed), and 3 Tecpatl (3 Flint-knife). For reasons outlined previously, we may assign the entire series of nineteen month names, together with representations of their corresponding deities and religious ceremonies, to the year 2 Acatl. Since 2 Acatl was the year when the New Fire rite inaugurating a new 52-year cycle was performed, it would have been a logical choice for undertaking a particularly radical type of calendar reform. We know that Tenochtitlan's last (public) New Fire ceremony was performed in 1507. This was almost certainly the actual ceremony commemorated in the Borbonicus.

It should be emphasized that the codex itself shows no internal break that might have supported the view that either the first or last month glyph could be broken off and assigned to a different year. It is instead bracketed by representations of Xiuhtecuhtli, Lord of the Year, who faces inward at both ends (pages 23 and 37). This pictorial device, which patently emphasizes continuity rather than division, highlights the integrity of the nineteen-month series. A second device worth pointing out is that the codex substitutes a depiction of New Fire rites for those normally performed during Panquetzaliztli (page 34), when the deities Huitzilopochtli and Tezcatlipoca were feted. In contrast with the first, this second device points to the special character of the year in question.

CONCLUSIONS: CALENDAR REFORM

If my analysis up to this point is correct, we may reasonably conclude that the Borbonicus pointedly alludes to the implementation of a calendar reform that shifted Izcalli's position in the year from first to last and in which the Sacred Almanac was recalibrated so that there was no change in the name of the calendar year.

These points may be summarized as follows.

1. Part 3 of the Borbonicus depicts the one year in fifty-two when a New Fire rite was performed.
2. The last pre-Conquest performance of a New Fire rite occurred in 1507. This is the probable date of the year represented in the Borbonicus.
3. The length of this year was extended from eighteen to nineteen months by repeating the first month as the last.
4. The immediate effect of a transition of this kind would have been to change the beginning date of the calendar year from 1 Izcalli to 1 Atlcahualo.
5. The name of this year was 2 Acatl both before and after this change.
6. This result could have been achieved only by repeating the almanac day count of the first month (Izcalli) in the second (Atlcahualo).
7. The first month of the reformed calendar would be Atlcahualo.
8. The 1 Ehecatl 9 Quecholli date for Cortés's arrival in Tenochtitlan must have been expressed in the new calendar, and 8 Ehecatl 9 Quecholli in the old.

The new calendar, as Kirchhoff insisted, would have been adopted in Tenochtitlan whereas the original calendar was retained by Tlatelolco. This divergence may be surprising but was certainly far from impossible. The internal structure of the Tenochcan empire was based on a system of indirect rule, in which there was minimal interference with local religious custom and practice, so that there are no grounds for assuming, as a matter of course, that a Tenochcan calendar reform would have been forced on the Tlatelolcan (Calnek 1982; Carrasco 1996).

The question of why this or any other reform of the Mesoamerican calendrical system was undertaken is not easily answered. Edmonson (1988) explores the possibility that shifts from one year-beginning month to another functioned as a kind of anti–leap year system that corrected the imbalance between a 365-day calendar year and the true solar year (approximately

365.2422 days) accumulating over a period of about 82.5 years. But Edmonson's explanation seems improbable given the diversity of calendars concurrently used in pre-Spanish Mesoamerica. This region encompassed literally hundreds of independent or semi-independent polities with diverse histories of participation in empires, confederations, or sometimes relatively short-lived coalitions. No power, including the Aztecs, managed to impose absolutely uniform practices and procedures in all regions, whether applied to the calendar or any other category of religious belief or activity. There may well have been a lack of uniformity between Tenochtitlan and Tlatelolco both before and after 1507.

NOTES

1. The Nahuatl terms for these were *tonalpohualli* and *xihuitl,* respectively.

2. The numbers 2–14 were substituted at Teotihuacan and in the Codex Azoyu but functioned as if they were 1–13.

3. So called because their Nahuatl name was *metztli,* or "moon."

4. Lowland Maya calendars numbered the days of the months 0–19 instead.

5. Cline (1973: 25n25) notes that Cortés stated only that he was counting his expenses for the period from November 8 through the month of May 1520 and comments that November 8 is mentioned "only in passing and not necessarily or even inferentially as the date of entrance [to Tenochtitlan]."

6. See Caso (1967: 51–54) and Tena (1987: 37–44) for a comprehensive review of pertinent dates and sources.

7. Caso's calculations were based on the assumption that Cortés entered Tenochtitlan on November 8 rather than November 9, 1519.

8. At this point Caso attempted to refute Donald Robertson's arguments favoring a very early post-Conquest date for the Borbonicus.

9. According to Caso (1967:47), who cites an unpublished paper by J.E.S. Thompson, the (Yucatec) Maya calendar matches the others "with a correction of one day," but he does not explain whether this means it is one day ahead or one day behind.

10. It should be noted that pages are missing from the beginning and end of the Borbonicus, but their content is easily reconstructed, at least in general terms.

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CHAPTER THREE

HARVEY M. BRICKER AND VICTORIA R. BRICKER

When Was the Dresden Codex Venus Table Efficacious?

INTRODUCTION

Of the surviving Precolumbian Maya hieroglyphic books, the Dresden Codex (Codex Dresdensis 1975) is the one that gives the most information about astronomy, and one of the major astronomical instruments in the Dresden Codex is the Venus table, which occupies six consecutive pages, D.24 and D.46 to D.50 on the obverse side of the codex. (There is no interruption in the sequence; a faulty nineteenth-century pagination scheme for two parts of the codex that had been torn apart caused the page after D.24 to be called D.46.) This table has been studied for more than a century, and it is probably the best known and most cited part of any of the Precolumbian Maya books. The first page, D.24, contains a preface or introduction (Figure 3.1), and the remaining five constitute the table proper (e.g., D.50, shown in Figure 3.2). The table is richly illustrated, containing the most artistically elaborate and colorful series

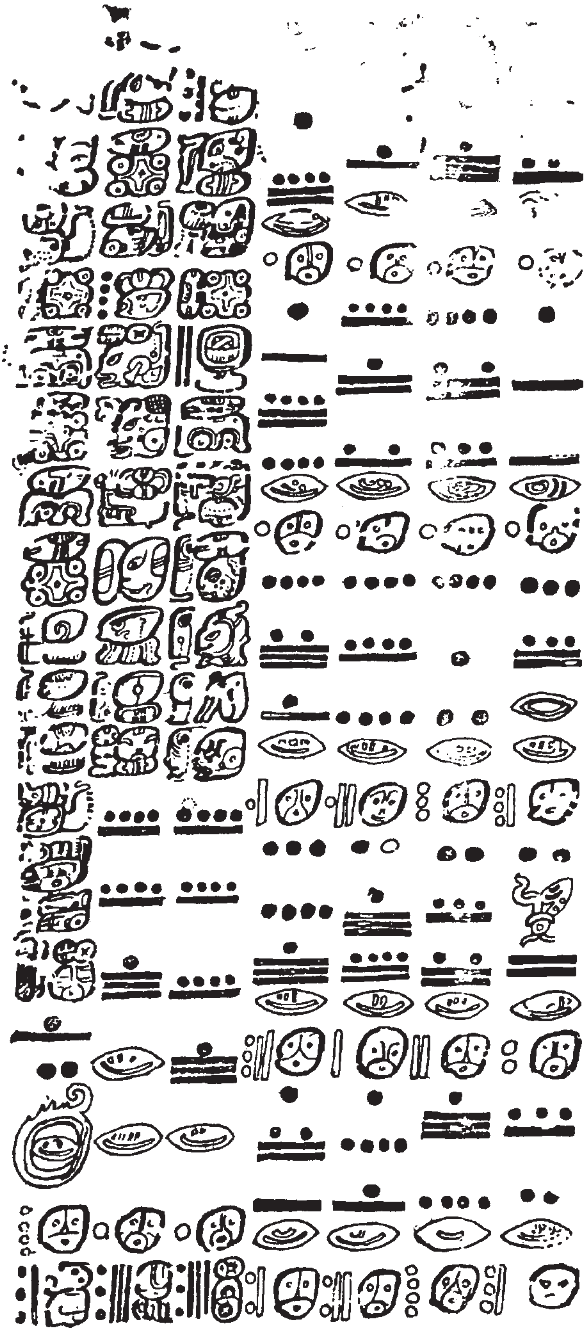


Figure 3.1. The introduction to the Venus table, on page D.24 of the Dresden Codex (modified after Villacorta C. and Villacorta 1976: 58).

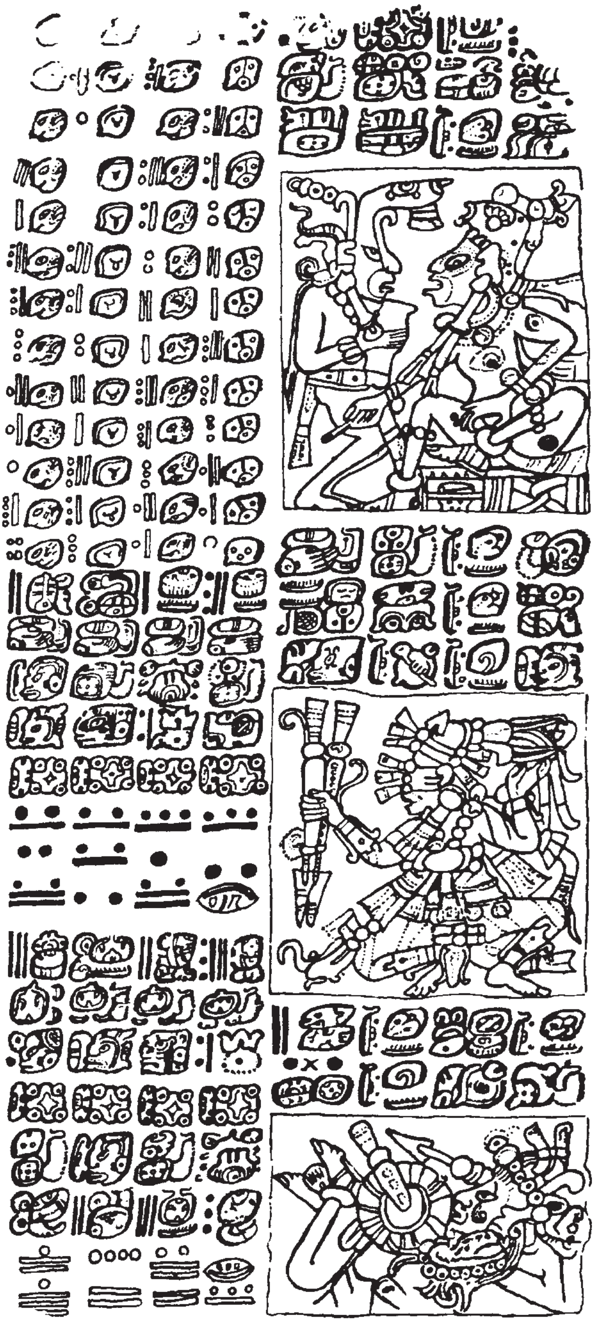


Figure 3.2. The last page of the Venus table, on page D.50 of the Dresden Codex (modified after Villacorta C. and Villacorta 1976: 110).

of pages in the Dresden Codex. There are extensive textual passages in the Venus table, some of them consisting of as many as 12 glyph blocks. We give here only a brief sketch of what is in this table, because we are concerned in this study with only one limited aspect of it, which is the period of time when the table would have been used.

During the years since these pages were first identified by Ernst Förstemann in 1886 (1886: 66) and subsequently elucidated by him in his commentary on the Dresden Codex (1901, 1906), the Venus table has been studied by many scholars. A list of major figures in the post-Förstemann history of scholarship on the Venus table would certainly include, from earliest to latest, Eduard Seler (1898, 1904), Robert Willson (1924), John Teeple (1926, 1931), Maud Makemson (1943), Linton Satterthwaite (1947), J. Eric S. Thompson (1950, 1972, 1974), Karl Nowotny (1961), Michael Closs (1977), Floyd Lounsbury (1978, 1983), Anthony Aveni (1980, 1992, 2001), John Justeson (1989), and Susan Milbrath (1995, 1999). Our attempt in this present study is to extend the work of previous scholars on the possible entry dates of the table, which was largely mathematical instead of empirical in focus, and to look at the degree to which actual dates of the heliacal rise of Venus agree with the canonical dates for that station in the table.

THE ENTRY DATE OF THE VENUS TABLE

Answering the question of when the Venus table was meant to be used starts with a consideration of the base date that is given in the introduction to the table, on page D.24. The relevant information is given in the lower left corner of the page (Figures 3.1 and 3.3). The base date is given in a format using a "ring number" and a "long round" to permit the calculation of an initial series date, which records the number of days completed since the "eral base" (the beginning of the current era of Maya time), a day designated as 13.0.0.0.0 4 Ahau 8 Cumku—11 August 3114 BC in a back-reckoned Gregorian calendar.

The ring number is shown in the leftmost column of the codex page (Figure 3.3a). It consists of three numbers, 6.2.0, and the zero has a red ring around it. (In the graphic convention used here, black numbers are shown as solid bars and dots and red numbers are shown in open outline.) Rings like this usually look like a ribbon tied with a bow on top, but this one looks more like a ring of flame. Beneath the ring number is a calendar-round permutation, a date unique within a period of 52 years. The date here is 4 Ahau 8 Cumku, which we recognize as the calendar round of the eral base. Immediately to the right of the column containing the ring number is another bar, dot, and shell-

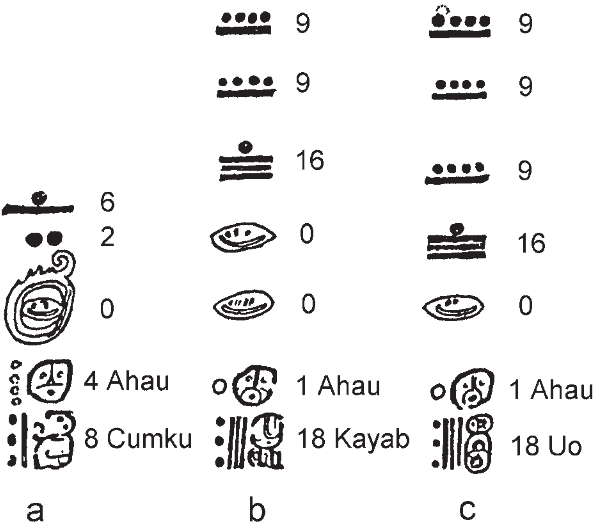


Figure 3.3. Information on page D.24 of the Dresden Codex permitting the calculation of the base date of the Venus table (modified after Villacorta C. and Villacorta 1976: 58).

sign number: 9.9.16.0.0 (Figure 3.3b). This is the long round, beneath which is another calendar-round permutation, 1 Ahau 18 Kayab. In the column immediately to the right of this one is a third number, 9.9.9.16.0, which is the initial series date (Figure 3.3c). The interrelationship of ring number, long round, and initial series is explained in the following paragraph. Finally, however, there is yet a third calendar-round date, 1 Ahau 18 Uo, written beneath the initial series date; the significance of this date becomes apparent only later in this study.

The calculation of the base date of the Venus table may be summarized as follows:

	13. 0. 0. 0. 0	4 Ahau 8 Cumku	11 August 3114 BC (Gregorian)
–	6. 2. 0		
	12.19.13.16. 0	1 Ahau 18 Kayab	2 August 3120 BC (Gregorian)
+	9. 9. 16. 0. 0		
	9. 9. 9. 16. 0	1 Ahau 18 Kayab	7 February AD 623 (Gregorian)

It begins with the ring number, which, in this context, is an arithmetic operator equivalent to a minus sign. It means that the number 6.2.0—which is (6 × 360) + (2 × 20) + 0, or 2200 days—is to be subtracted from the first day of the era, 13.0.0.0.0. This subtraction produces a date in the previous era, a day 12.19.13.16.0 1 Ahau 18 Kayab. This is one way in which the calendar-round permutation in the middle column is relevant. It is to this date before the eral base that the long round, 9.9.16.0.0, must be added. Here there is no arithmetical operator sign; the operation is understood. The addition produces an initial series date (i.e., the number of days completed since the eral base) of 9.9.9.16.0 1 Ahau 18 Kayab, and this is the base date of the Venus table, equivalent to 7 February AD 623 in the Gregorian calendar. This is the second way in which the calendar-round date of 1 Ahau 18 Kayab is relevant to the calendrics of the Venus table.

The fact that the base date of the table, as given explicitly, is in AD 623 does not mean, however, that the table was intended to be used with that as the starting date. Even though 7 February AD 623 was a date 1 Ahau in the Maya calendar, it was not a date of heliacal rise of Venus nor was it close to any of the other three synodic stations with which the Venus table is concerned. The most probable day for the heliacal rise of Venus in AD 623 was 23 February, 16 days after the 1 Ahau base date. On the base date, 7 February, Venus was still a very visible evening star, located more than 20° above the horizon at sunset (Hinkley 1989). Thus, as with other tables in the Dresden Codex, the base date is not the entry date of the table. A valid entry date can be calculated by adding one of the stated multiples to the base date, which involves us in a consideration of the table of multiples, which occupies the rightmost four columns of the introduction on page D.24 (Figure 3.1).

As the name implies, the table of multiples lists multiples of the fundamental quantities that make up the Venus table. A transcription of the Maya text is given in Table 3.1. Each row of each page of the table proper deals with one synodic period of 584 days, and there are five pages (D.46–D.50). Therefore, each full row represents (5 × 584) or 2,920 days, the smallest quantity in the table of multiples (at D5 in Table 3.1). It is located, as is usually the case in such tables, in the lower right corner. Ignoring for the moment the second row from the top, the structure of the table of multiples can be easily perceived. The values of the multiples increase from right to left and from bottom to top. Thus, we have 1, 2, 3, 4, 5, etc. times 2,920 days, moving leftward and upward. The values listed represent the number of days in 1, 2, 3, 4, 5, etc. full rows of the Venus table. There are 13 rows in the table, and the multiples of 2,920 days stop in the upper right-hand corner (at D1) with 13 × 2,920 = 37,960 days, which is the full length of the entire Venus table. The last three multiples, proceeding leftward across the top row, represent 2, 3, and 4 full tables (at C1, B1, and A1, respectively).

The second row from the top, which interrupts the listing of exact multiples, contains four aberrant multiples, so called because the tabulated values are *not* exact multiples of 584 days. It is necessary to use some of these values to make corrections when recycling the Venus table over long periods of time (as

TABLE 3.1. Transcription of the contents of the table of multiples of the Venus table, on page D.24 of the Dresden Codex. Elements shown in italics are restored or corrected on the basis of consistency with the general structure of the table. Quantities shown in parentheses are the decimal equivalents of the vigesimal quantities on the top line of each cell.

	A	*B*	*C*	*D*
1	*1.1.*1.14.0 (151,840) (4 × 37,960) 1 Ahau	*15.16.*6.0 (113,880) (3 × 37,960) 1 Ahau	*10.10.*16.0 (75,920) (2 × 37,960) 1 Ahau	*5.5.*8.0 (37,960) (13 × 2,920) 1 Ahau
2	1.5.14.4.0 (185,120) (317 × 584 − 8) 1 Ahau	9.11.7.0 (68,900) (118 × 584 − 12) 1 Ahau	4.12.8.0 (33,280) (57 × 584 − 8) 1 Ahau	1.5.5.0 (9,100) (15 × 584 + 340) 1 Ahau
3	4.17.6.0 (35,040) (12 × 2,920) 6 Ahau	4.9.4.0 (32,120) (11 × 2,920) 11 Ahau	4.1.2.0 (29,200) (10 × 2,920) 3 Ahau	3.13.0.0 (26,280) (9 × 2,920) 8 Ahau
4	3.4.16.0 (23,360) (8 × 2,920) 13 Ahau	2.16.14.0 (20,440) (7 × 2,920) 5 Ahau	2.8.12.0 (17,520) (6 × 2,920) 10 Ahau	2.0.10.0 (14,600) (5 × 2,920) 2 Ahau
5	1.12.*8*.0 (11,680) (4 × 2,920) 7 Ahau	1.4.6.0 (8,760) (3 × 2,920) 12 Ahau	16.4.0 (5,840) (2 × 2,920) 4 Ahau	8.2.0 (2,920) (5 × 584) *9* Ahau

discussed in what follows). Why some correction is needed from time to time can be explained by the following relationships:

> Canonical length of Venus synodic period (1 row on 1 page) = 584 days.
> Actual mean length of Venus synodic period = 583.92 days.
> Therefore, difference every synodic period = 0.08 days.
> 1 row of table = 5 Venus synodic periods or ca. 8 years.
> Therefore, difference every 8 years = (5 × 0.08) = 0.40 days.
> Table has 13 rows, covering ca. 104 years.
> Therefore, difference every 104 years = (13 × 0.40) = 5.20 days.

The canonical value of the synodic period of Venus used by the Maya, 584 days, is very close to the actual mean value of that period, but it is slightly longer—a difference of 0.08 days, or nearly two hours, each synodic period. Because each row of the Venus table covers five synodic periods, or about eight Earth years, the difference will cumulate over an eight-year period to about half a day. The Venus table has 13 rows, covering 104 years. After 104 years, the error will have cumulated to just over five days. Thus, after 104 years a heliacal rise date as predicted by the table would fall about five days too late—that is, about five days after heliacal rise had already occurred. Some days would need to be subtracted from the table to keep it synchronized with astronomical reality.

CORRECTING THE TABLE FOR LONG-TERM USE

How the table could be corrected while retaining a ritually necessary characteristic was worked out in the 1920s and 1930s by John Teeple (1926, 1931). Not only did several days have to be subtracted after a full 104-year run of the table, but, for mythological or ideological reasons, the new starting date had to be a day 1 Ahau in the 260-day *tzolkin* cycle. Teeple showed that if instead of allowing the table to run its full length (65 Venus periods, or about 104 years), one stopped a bit short, after almost but not quite 61 Venus periods, there would be a 1 Ahau day that fell four days before a *canonical* heliacal rise date as given by the table. If that 1 Ahau day were, however, redefined as a heliacal rise date and used to start a new table, the commensurate error would be almost corrected and the 1 Ahau imperative would be respected. Teeple showed also that a similar correction made near the end of the fifty-seventh Venus period would effect an eight-day correction while starting a new table on 1 Ahau.

If one begins with a Venus table having a base date of 1 Ahau 18 Kayab (as does the one actually appearing in the Dresden Codex), and if one applies Teeple's four-day correction over a period of about four centuries, the starting calendar-round dates for five successive versions of the Venus table are these (Teeple 1926: 402):

1 Ahau 18 Kayab
1 Ahau 8 Yax
1 Ahau 18 Uo
1 Ahau 13 Mac
1 Ahau 3 Xul

Of these five dates, four are recorded explicitly in the Venus table. The first, fourth, and fifth dates occur in the last column of the last page of the table (shown in boldface in Table 3.2) and, as such, are presumptive starting dates for different versions of the table. The third date on the list, 1 Ahau 18 Uo, appears, as we have seen, in the table's introduction (Figure 3.3). Only the second of Teeple's hypothetical beginning dates is not found in the present table. Furthermore, Teeple (1931: 95) noted that when one makes an eight-day

TABLE 3.2. Transcription of the contents of the final page of the Venus table, on page D.50 of the Dresden Codex. Elements shown in italics are restored or corrected on the basis of consistency with the general structure of the table. The month, or *haab,* components of the three tabulated entry dates appear in boldface in the rightmost column.

12 Eb	*11 Ik*	*1 Eb*	*9 Ahau*
7 Eb	*6 Ik*	*9 Eb*	*4* Ahau
2 Eb	*1* Ik	*4* Eb	*12* Ahau
10 Eb	*9* Ik	12 Eb	7 Ahau
5 Eb	*4* Ik	7 Eb	2 Ahau
13 Eb	12 Ik	2 Eb	10 Ahau
8 Eb	7 Ik	10 Eb	5 Ahau
3 Eb	2 Ik	5 Eb	13 Ahau
11 Eb	10 Ik	13 Eb	8 Ahau
6 Eb	5 Ik	8 Eb	3 Ahau
1 Eb	13 Ik	3 Eb	11 Ahau
9 Eb	8 Ik	11 Eb	6 Ahau
4 Eb	3 Ik	6 Eb	1 Ahau
10 Kankin	0 Uayeb	5 Mac	**13 Mac**
(verb)	(verb)	(verb)	(verb)
North	West	South	East
(#17)	(#18)	(#19)	(#20)
Venus	Venus	Venus	Venus
7.2.12	7.7.2	8.1.2	8.2.0
(2572)	(2662)	(2912)	(2920)
15 Cumku	0 Tzec	10 Kayab	**18 Kayab**
(verb)	(verb)	(verb)	(verb)
(#16)	(#17)	(#18)	(#19)
Venus	Venus	Venus	Venus
East	North	West	South
0 Yaxkin	10 Zac	15 Tzec	**3 Xul**
11.16	4.10	12.10	0.8
(236)	(90)	(250)	(8)

correction by starting a new run of the table in the fifty-seventh Venus period, the Venus table thus abbreviated will have contained only 33,280 days rather than the full 37,960 days. The figure 33,280 is one of the aberrant multiples already mentioned (at C2 in Table 3.1). The corresponding figure for a four-day correction, 35,620 days, is the difference between that same aberrant multiple and the one immediately to its left, at B2 (Teeple 1931: 96). Thus, Teeple's suggestion about how the Venus table was corrected for long-term re-use was supported by several kinds of information actually appearing in the codex.

PREVIOUSLY SUGGESTED HISTORICAL PLACEMENTS

The question remains, however, of when in real, historical time the Venus table would have been accurate enough to have been used. Because the 1 Ahau base date in AD 623 preceded a heliacal rise of Venus by about two weeks, all scholars have concluded that one of the multiples must be added to the base date to produce an entry date for an astronomically workable version of the table. Thompson (1950: 226; 1972: 63) chose the highest multiple given on page D.24 (at A1 in Table 3.1)—four grand multiples, meaning four times the complete length of the table, equivalent to eight calendar rounds (Table 3.3)—and obtained an entry date of 10.10.11.12.0 1 Ahau 18 Kayab, 29 October AD 1038 (Gregorian). Thompson assumed that near the end of this 104-year run an eight-day correction was made to deal with accumulated recessional error and that a 1 Ahau 18 Uo version of the table began on 10.15.4.2.0, 11 December AD 1129 (Gregorian). After two subsequent four-day corrections, Thompson's 1 Ahau 13 Mac version began in June of AD 1227 and his 1 Ahau 3 Xul version in December of AD 1324. This hypothesis is essentially the same as the later of two dating schemes suggested by Teeple (1931: 98), and its principal elements were used in studies by Closs (1977) and Aveni in the original edition of *Skywatchers* (1980).

A different approach to understanding the historical position of the Venus table appeared in the early 1980s with the work of Floyd Lounsbury. Lounsbury began the process, which we continue here, of systematically evaluating competing models of the table against the data available to modern astronomy. The results of his tests (Lounsbury 1983: 8, table 4) showed that whereas the base date in AD 623 fell short of a true heliacal rise date by about two weeks, the Teeple/Thompson entry date in AD 1038 overshot a heliacal rise date by several days—that is, the astronomical event would have been observed several days before the canonical date that started the table. Lounsbury (1983: 8–9) concluded—and we have verified with calendrical and astronomical software—that the closest fit during the long span of Maya history between a day 1 Ahau 18 Kayab and a heliacal rise of Venus occurred in November of AD 934 (Table 3.3). By this demonstration, Lounsbury showed definitively that the historical versions of the Venus table began earlier than called for by the Thompson dating. The rest of Lounsbury's dating scheme is, however, identical to that of

TABLE 3.3. Historical positions of the entry dates of the Dresden Codex Venus table advocated by J. Eric S. Thompson (1950: 226; 1972: 63), Floyd G. Lounsbury (1983: 11), and Harvey M. and Victoria R. Bricker (the present study).

THOMPSON	LOUNSBURY	H. & V. BRICKER
1 Ahau 18 Kayab 9.9.9.16.0 **7 Feb AD 623**	1 Ahau 18 Kayab 9.9.9.16.0 **7 Feb AD 623**	1 Ahau 18 Kayab 9.9.9.16.0 **7 Feb AD 623**
(+ 1.1.1.14.0 = 4 tables)	(+ 15.16.6.0 = 3 tables)	(+ 15.16.6.0 = 3 tables)
	↓	↓
	1 Ahau 18 Kayab 10.5.6.4.0 **23 Nov AD 934**	1 Ahau 18 Kayab 10.5.6.4.0 **23 Nov AD 934**
↓	(+ 1 table ± 0 days)	(+ 1 table – 8 days)
1 Ahau 18 Kayab 10.10.11.12.0 **29 Oct AD 1038**	1 Ahau 18 Kayab 10.10.11.12.0 **29 Oct AD 1038**	1 Ahau 18 Uo 10.9.18.12.0 **5 Jan AD 1026**
(+ 1 table – 8 days)	(+ 1 table – 8 days)	(+ 1 table – 4 days)
1 Ahau 18 Uo 10.15.4.2.0 **11 Dec AD 1129**	1 Ahau 18 Uo 10.15.4.2.0 **11 Dec AD 1129**	1 Ahau 13 Mac 10.14.17.11.0 **16 Jul AD 1123**
(+ 1 table – 4 days)	(+ 1 table – 4 days)	(+ 1 table – 4 days)
1 Ahau 13 Mac 11.0.3.1.0 **20 Jun AD 1227**	1 Ahau 13 Mac 11.0.3.1.0 **20 Jun AD 1227**	1 Ahau 3 Xul 10.19.16.10.0 **22 Jan AD 1221**
(+ 1 table – 4 days)	(+ 1 table – 4 days)	—
1 Ahau 3 Xul 11.5.2.0.0 **28 Dec AD 1324**	1 Ahau 3 Xul 11.5.2.0.0 **28 Dec AD 1324**	—

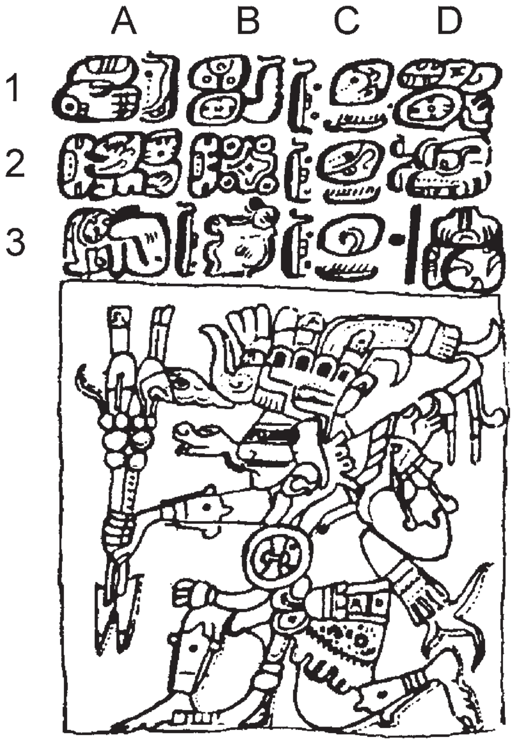
Thompson because he assumed that a second 1 Ahau 18 Kayab version of the table was begun *without correction* in AD 1038. From this point on, Lounsbury's and Thompson's dates are identical. The Lounsbury chronology has been accepted by most scholars publishing recently, including Justeson (1989), Aveni (2001: 191) in the revised edition of *Skywatchers*, and Milbrath (1995, 1999).

Lounsbury's choice of an AD 934 entry date was undoubtedly correct, but other elements of his argument were not. He considered that the most likely day for the heliacal rise of Venus was precisely the day 1 Ahau 18 Kayab—in other words, that there was a deviation score of 0 days between the canonical and actual dates of this event. Lounsbury got his perfect result only by using a slightly inaccurate formula for correlating the Maya and Western calendars, equating the 4 Ahau 8 Cumku eral base with Julian Day Number 584,285 rather than the correct 584,283 (Thompson 1974: 84–85; Bricker and Bricker 2001). The effect of this inaccurate correlation is that the 1 Ahau 18 Kayab date, on 23 November AD 934, fell two days earlier in the Western calendar than Lounsbury said it did, two days before the most probable date of the heliacal rise of Venus on November 25, giving a deviation score of –2 rather than 0. Furthermore, Lounsbury (1983: 12–13) attempted to bolster his argument about the 1 Ahau 18 Kayab day in AD 934 with additional astronomical considerations—a conjunction of Venus and Mars on that day, which was, he claimed, a day of heliacal rise for both planets. Because Lounsbury used the wrong correlation, however, the day for which he collected the astronomical data is 3 Ik 0 Cumku, two days after 1 Ahau 18 Kayab. On day 3 Ik, Venus and Mars *were* in conjunction, and it was most probably a heliacal rise day for Venus, but Mars was still lost in the glare of the sun, and the conjunction could not have been perceived from Earth. On the real 1 Ahau 18 Kayab, two days earlier, both Mars and Venus were still in their periods of invisibility. Thus, there was no spectacular astronomical event to commemorate. A similar astronomical argument was used by Lounsbury (1983: 17) about the motivation for making a recycling correction that started a new version of the table on 1 Ahau 18 Uo in AD 1129. He suggested that because of a conjunction of Venus and Jupiter, it was a sort of "reenactment" of the astronomical event of AD 934, but this argument too lacks foundation. On both days in question (the real 1 Ahau 18 Uo and the day two days later used by Lounsbury), Jupiter was invisible and there could have been no observation of a conjunction. On 1 Ahau 18 Uo, the day before the most probable heliacal rise date, Venus too was probably invisible. There is, therefore, nothing of astronomical note to talk about on 1 Ahau 18 Uo in AD 1129.[1]

THE FUNCTION OF THE VENUS TABLE

How can divergent opinions about the dating of the Venus table be resolved? Based on what criteria can the correct or, at least, best model be recognized? Answers to these questions depend on what is understood to be the function of the Venus table. Our view, which is the same as that of Lounsbury (e.g., 1978: 789) and Aveni (2001: 184), to cite just two, is that it functioned as a *warning table* because there was danger to be anticipated and, if possible, avoided.

Figure 3.4. The middle picture and caption on page D.49 of the Dresden Codex, showing Xiuhtecuhtli as Venus (modified after Villacorta C. and Villacorta 1976: 108).



There is abundant support for the warning-table interpretation on the relevant pages of the Dresden Codex. Two of the pictures and their accompanying text on the right side of each page of the Venus table suggest that the first appearance of Venus as a morning star was regarded by the ancient Maya as an event fraught with danger and violence. Three characteristics of these pages support the view that the middle and lower pictures on each page referred to the first visibility of Venus after inferior conjunction, the synodic station known as heliacal rise or MFIRST. The first characteristic is that these pictures are adjacent to the fourth column on each page (see, e.g., Figure 3.2), which contains dates of Venus MFIRST. The second is that the first two collocations in the captions above the middle pictures say that the action attributed to Venus occurred in the east (e.g., at A1–B1 in Figure 3.4), and Venus is associated with the east only when it is a morning star. The third characteristic is iconographic: the middle pictures show deities brandishing spearthrowers and darts; the scenes at the bottom of the pages depict victims with spears or darts run through their abdomens (Figures 3.2 and 3.4).

The five sets of pictures call to mind the central Mexican description of Quetzalcoatl as Venus, first descending into the underworld after last visibility as evening star and then emerging as a morning star after having spent eight days in the underworld:

> The old people said he [Quetzalcoatl] was changed into the star that appears at dawn. Therefore they say it came forth when Quetzalcoatl died, and they called him Lord of the Dawn.
>
> What they said is that when he died he disappeared for four days. They said he went to the dead land then. And he spent four more days making darts for himself. So it was after eight days that the morning star came out, which they said was Quetzalcoatl. It was then that he became lord, they said.
>
> And so, when he goes forth, they know on what day sign he casts light on certain people, venting his anger against them, shooting them with darts.
>
> If he goes on 1 Alligator, he shoots old men and old women, all alike.
>
> If on 1 Jaguar or 1 Deer or 1 Flower, he shoots little children.
>
> And if on 1 Reed, he shoots nobles. The same with everybody, if on 1 Death.
>
> And if on 1 Rain, he shoots the Rain. No rain will fall.
>
> And if on 1 Movement, he shoots youths and maidens.
>
> And if on 1 Water, there is drought, etc.
>
> So each of these [day signs] was venerated by the old men and the old women of former times. (Bierhorst 1992: 36–37)

The passage just quoted comes from the *Anales de Cuauhtitlan*, a central Mexican manuscript. It was used by Seler (1898; 1904: 384–385) more than a century ago in his comparison of the Venus pages of the Dresden Codex and the Codex Borgia, a central Mexican pictorial manuscript. The ties with central Mexico are both textually and iconographically explicit in the Dresden's Venus table (Whittaker 1986; Taube and Bade 1991). For example, the caption over the middle picture on page 48 (Figure 3.5a) contains a partial syllabic spelling of the name of the Aztec god Tlahuizcalpantecuhtli, which we know from the Codex Telleriano-Remensis (Quiñones Keber 1995) represented Venus as morning star, and it is so depicted in the Venus almanac in the Codex Borgia (Códice Borgia 1993). The text says that Tlahuizcalpantecuhtli *is* Venus. Furthermore, the caption over the middle picture on page 49 mentions the Aztec fire god Xiuhtecuhtli (Figure 3.5b), and the deity pictured below that caption (Figure 3.4) is iconographically very similar to representations of Xiuhtecuhtli in central Mexican art. In this case, Xiuhtecuhtli is the Aztec god equated with Venus (at A2–B2 in Figure 3.4). Added to this, the Venus god on page 50 (Figure 3.2) also

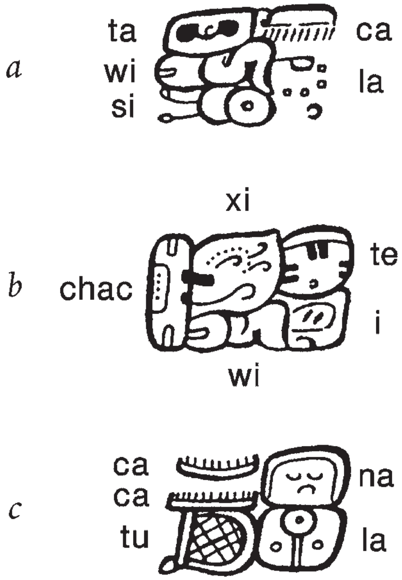


Figure 3.5. Syllabic spellings of the names of three central Mexican gods on pages D.48–D.50 of the Dresden Codex (after Whittaker 1986: 57–58, figures 2–4).

has a Nahuatl name, Cactonal (Figure 3.5c). He wears a blindfold and in this respect resembles Ixquimilli, a central Mexican god related to Tezcatlipoca and Itzlacoliuhqui. He, too, is said to be Venus in the caption over his picture. Thus, there is abundant evidence of central Mexican influence on these pages that supports the relevance of using the passage from the *Anales de Cuauhtitlan* for interpreting the iconography in the Dresden Venus table as related to the first appearance of Venus after inferior conjunction.

The violent theme shown in these pictures suggests that the heliacal rise of Venus as a morning star was an event dreaded by the Maya, for whom the Venus table was prepared, and not just the central Mexicans. This situation is quite different from what Barbara Tedlock (1999: 43) has described for the people of Momostenango, who regard the heliacal rise of Venus as morning star as a lucky event. In our view, then, the Dresden Venus instrument was primarily a warning table, providing advance warning of days that would be or might be dangerous for people; the middle and lower pictures show the dangerous characteristics or "actions" of Venus on that day.

IMPLICATIONS OF THE VENUS TABLE AS WARNING TABLE

If the Venus table was a warning table, the uncertainties about its historical dating might be resolved by measures of its efficacy. Here again we follow the lead of Floyd Lounsbury, who explained the matter as follows a quarter century ago: "The table was probably used as a warning table, geared to anticipate the phenomena, thus favoring negative errors over positive ones, or early predictions over late ones" (Lounsbury 1978: 789). This is, in fact, the needed criterion of efficacy. A warning table is not of much use if the warning follows the event (which would be like putting up a coastal hurricane warning three days after the storm has hit and moved inland). In the case we are considering, where to-the-day precision is not possible because of observational uncertainties, warning of the heliacal rise of Venus should come a few days *before* the most probable date for the event. (In this sense, the minus-two-day deviation for AD 934 resulting from the use of the correct correlation is in fact *not* worse than the zero deviation Lounsbury thought he had while using the wrong one.)

Another problem in measuring efficacy is one that was alluded to but not really dealt with by Teeple (1931: 97). The length of the table is about 104 years, and because of recessionary error, the fit between canonical and actual heliacal rise events at the start of the table will have changed by the time the table ends. Measuring efficacy as the size of the deviation between predicted and actual events cannot be done for the starting date alone; it must be done for dates throughout the whole century-long span of the table. Lounsbury did not do this, because the tools to do the required historical astronomical research that he had at his disposal several decades ago were both limited and cumbersome. Now, however, we can do the necessary comparisons easily and quickly, using older software like BRESIM (Hinkley 1989) and the newer "Planet's Visibility" program of Swerdlow and Lange (2002). As a result of having done this, we have a somewhat different view of the historical placement of the Venus table.

In a Venus table that *starts* with to-the-day accuracy, which was the goal of Lounsbury's research, the predictions of dangerous days will, by the time the end of the table is reached, be falling some days after the dangerous days have already occurred. It is then obvious that the best warning table would start with a nontrivial negative error, so that by the end of the table there are very small positive errors, or very few of them, or none at all. An operational definition of an efficacious canonical date of heliacal rise is one that falls no more than seven days before the actual date and no more than one day later—in other words, within a range "HR–7" to "HR+1." Undershooting the actual day by seven days is not very good, but it is at least a failsafe prediction. It is also the maximum acceptable negative error, because a deviation of –8 would cause a structural overlap between ELAST (last visibility of Venus as evening star before inferior conjunction) and MFIRST, the canonical dates for which are separated by only

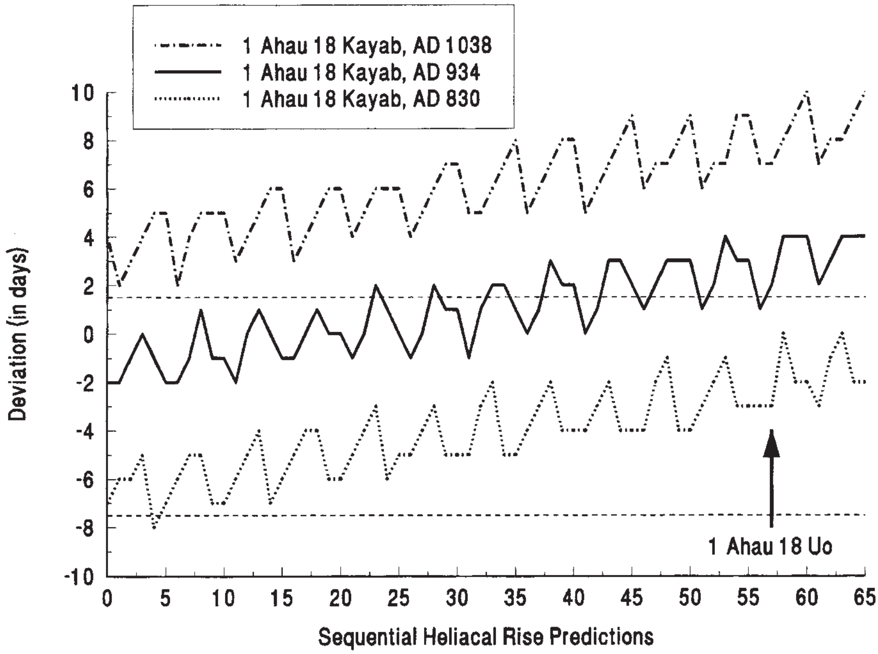


Figure 3.6. Deviation scores (date of canonical MFIRST *minus date of actual* MFIRST*) for Venus heliacal rise events tabulated in three versions of the Venus table of the Dresden Codex beginning on a day 1 Ahau 18 Kayab. Upper (dash-dot) line: entry date in AD 1038; middle (solid) line: entry date in AD 934; lower (dotted) line: entry date in AD 830. A negative deviation score means that the canonical or predicted date falls* before *the actual date. The area of the graph containing deviation scores ranging from –7 to +1, delimited by dashed lines parallel to the x-axis, is the* zone of efficacy *for a warning table.*

eight days in the Venus table. A deviation score of +1, a positive error or overshooting of one day, is acceptable because of the observational uncertainties associated with heliacal rise events. The +1 error may not have been an error at all. Larger positive errors—+2, +3, and so forth—are, however, very likely to have represented warning failures, in that heliacal rise would have occurred before the canonical day appearing in the table. To recapitulate, then, the efficacious range for deviation scores of canonical dates runs from –7 through 0 to +1; outside this range, the warning table is not a reliable instrument.

The first set of data to which our criterion of efficacy is applied is the historical version of the Venus table having an entry date of 1 Ahau 18 Kayab (Figure 3.6). Graphing the deviation in days between the canonical or predicted heliacal rise dates and the most likely actual dates makes it immediately clear

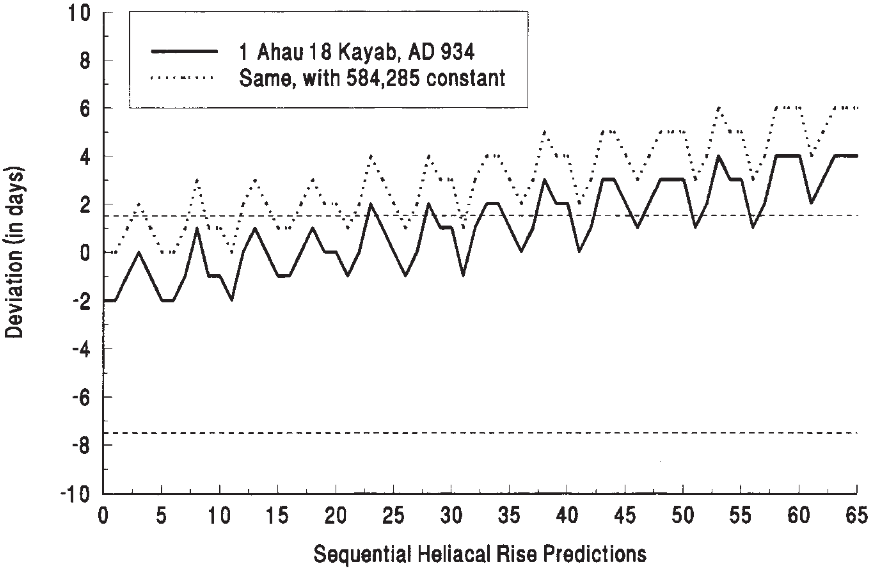


Figure 3.7. Deviation scores (date of canonical MFIRST *minus date of actual* MFIRST*) for Venus heliacal rise events tabulated in the 1 Ahau 18 Kayab version of the Venus table beginning in AD 934. The scores are calculated using two different correlation constants to relate the Maya and Western calendars. Upper (dotted) line: constant = 584,285; lower (solid) line: constant = 584,283. Graphic conventions as for Figure 3.6.*

that Thompson's proposed entry date in AD 1038 (the top line) cannot be accepted. Not a single one of the 65 dates falls within the acceptable range. The Lounsbury dating, starting in AD 934 (the middle line), is much better, but recessional error becomes severe by the last decades of the table. In fact, however, at the point where the table would become totally useless, an eight-day correction is made (at the place indicated by the arrow), beginning a new table on 1 Ahau 18 Uo.

Two other observations can be made about the 18 Kayab table. The need for an eight-day correction near the end of the version starting in AD 934 probably implies that no correction had been made in a previous run. The bottom line in Figure 3.6 shows what a 1 Ahau 18 Kayab table starting in AD 830 would look like. Although all the deviation scores are negative, it is almost entirely acceptable as a fail-safe warning table. Such a version of the Venus table is, however, just hypothetical.

The second observation results from a comparison of two different correlation constants for equating the Maya and Western calendars (Figure 3.7). The

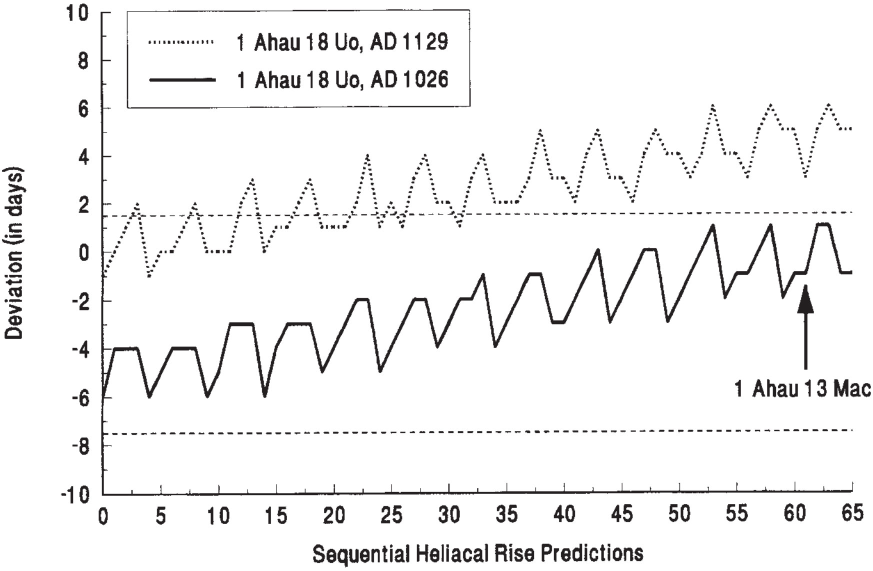


Figure 3.8. Deviation scores (date of canonical MFIRST *minus date of actual* MFIRST*) for Venus heliacal rise events tabulated in two versions of the Venus table beginning on a day 1 Ahau 18 Uo. Upper (dotted) line: entry date in AD 1129; lower (solid) line: entry date in AD 1026. Graphic conventions as for Figure 3.6.*

lower, solid line is the same as the middle line in Figure 3.6; it is the AD 934 Lounsbury version but calculated using the correct correlation constant. The upper, dotted line uses the erroneous constant preferred by Lounsbury: the two-day difference is not large, but it almost completely destroys the efficacy of the table.

The 1 Ahau 18 Uo table (Figure 3.8) that results from an eight-day correction falls entirely within the zone of efficacy if it begins in AD 1026 (the lower line). A four-day correction (at the arrow) starts a 1 Ahau 13 Mac version just before the point where problems would start to occur. The Thompson-Lounsbury version, beginning in AD 1129 (the upper line), becomes problematic almost at once and completely loses efficacy after about 50 years.

The 1 Ahau 13 Mac version of the Venus table (Figure 3.9) starts—in our opinion—in AD 1123 (the lower line). The canonical dates in such a version would depart from the zone of efficacy only once before a four-day correction would start a recalibrated 1 Ahau 3 Xul version. Once again, however, the Thompson-Lounsbury starting date in AD 1227 would produce predictions (the upper line) that would be almost useless as a warning table.

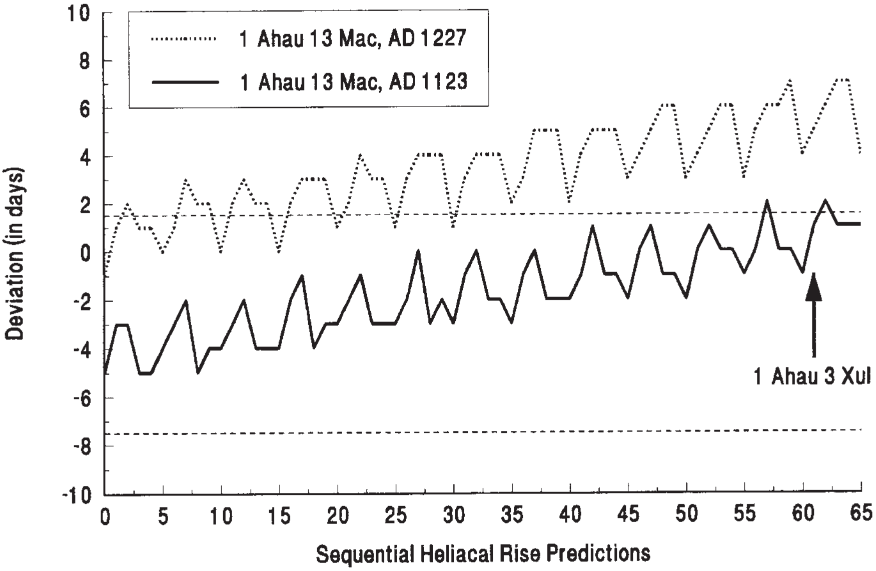


Figure 3.9. Deviation scores (date of canonical MFIRST *minus date of actual* MFIRST*) for Venus heliacal rise events tabulated in two versions of the Venus table beginning on a day 1 Ahau 13 Mac. Upper (dotted) line: entry date in AD 1227; lower (solid) line: entry date in AD 1123. Graphic conventions as for Figure 3.6.*

The final version of the Venus table that is actually documented in the Dresden Codex starts on 1 Ahau 3 Xul (Figure 3.10), which we think dates to AD 1221. This would be totally efficacious (lower line) until near the end of the table, at which time a correction—probably of eight days—would be required. There is, however, no record of such a correction. The Thompson-Lounsbury entry date (upper line) would again produce an essentially useless warning table.

CONCLUSION

The result of these comparisons is clear. If the Venus table was intended to serve as a warning table, the starting dates of the four explicitly mentioned historical versions are AD 934, 1026, 1123, and 1221 (Table 3.3). These entry dates can easily be derived from the base date and the table of multiples on page D.24 (Table 3.4) using the third grand multiple and/or three of the four aberrant multiples in the second row. The 1 Ahau 18 Kayab entry date results from adding the third grand multiple to the base date, as already explained. The 18 Uo version requires adding both the third grand multiple and the 4.12.8.0

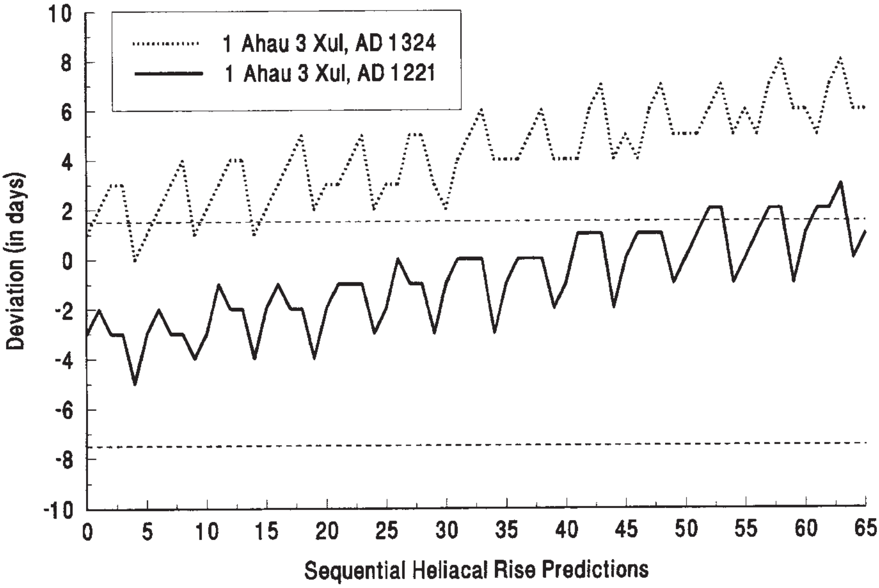


Figure 3.10. Deviation scores (date of canonical MFIRST *minus date of actual* MFIRST*) for Venus heliacal rise events tabulated in two versions of the Venus table beginning on a day 1 Ahau 3 Xul. Upper (dotted) line: entry date in AD 1324; lower (solid) line: entry date in AD 1221. Graphic conventions as for Figure 3.6.*

TABLE 3.4. Derivation of entry dates of the Dresden Codex Venus table by using its base date and its table of multiples.

	9. 9. 9.16.0	1 Ahau 18 Kayab	7 Feb AD 623	Base date
+	15.16. 6.0	*third grand multiple,* at B1 in Table 3.1		
	10. 5. 6. 4.0	1 Ahau 18 Kayab	23 Nov AD 934	Entry date
	9. 9. 9.16.0	1 Ahau 18 Kayab	7 Feb AD 623	Base date
+	15.16. 6.0	*third grand multiple,* at B1 in Table 3.1		
+	4.12. 8.0	*aberrant multiple,* at C2 in Table 3.1		
	10. 9.18.12.0	1 Ahau 18 Uo	5 Jan AD 1026	Entry date
	9. 9. 9.16.0	1 Ahau 18 Kayab	7 Feb AD 623	Base date
+	15.16. 6.0	*third grand multiple,* at B1 in Table 3.1		
+	9.11. 7.0	*aberrant multiple,* at B2 in Table 3.1		
	10. 14.17.11.0	1 Ahau 13 Mac	16 Jul AD 1123	Entry date
	9. 9. 9.16.0	1 Ahau 18 Kayab	7 Feb AD 623	Base date
+	1. 5.14. 4.0	*aberrant multiple,* at A2 in Table 3.1		
+	4.12. 8.0	*aberrant multiple,* at C2 in Table 3.1		
	10. 19.16.10.0	1 Ahau 3 Xul	22 Jan AD 1221	Entry date

aberrant multiple. Using the 9.11.7.0 aberrant multiple instead produces the 13 Mac version. Omitting the third grand multiple but adding together both the 1.5.14.4.0 and the 4.12.8.0 aberrant multiples produces the 3 Xul version, the last one explicitly mentioned in the codex.

Our conclusion, then, is that Lounsbury was correct about the historical placement of the 18 Kayab version of the Venus table, but both he and Thompson dated each of the other three versions about a century too late (Table 3.3). The origins of the Venus table are surely situated in the Classic period of Maya civilization. The earliest historically functional version dates to the Terminal Classic, and revised versions were used during the Early Postclassic. There is no record of actual or projected use beyond the early fourteenth century—that is, beyond the beginning of the Late Postclassic. This is our answer to the question of when the Dresden Codex Venus table worked.

ACKNOWLEDGMENTS

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NOTE

1. Our data in this paragraph that concern planetary visibility were determined using Hinkley 1989 and Swerdlow and Lange 2002.

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CHAPTER FOUR

DENNIS TEDLOCK AND BARBARA TEDLOCK

Moon Woman Meets the Stars: A New Reading of the Lunar Almanacs in the Dresden Codex

> *Archaeoastronomy is concerned less with how the astronomers of the past were like us and more with what they were about.*
>
> ANTHONY F. AVENI[1]

INTRODUCTION

The Maya hieroglyphic book known as the Dresden Codex was compiled a century or so before the Spanish invasion in Mesoamerica. The writers were speakers of a language of the Yukatekan branch of the Mayan language family, working somewhere in Yucatán or northern Guatemala. Their book opens with a series of almanacs (on pages 2–15) whose temporal rhythms appear to be limited to those of the 260-day Maya divinatory calendar, although many of the deities who appear in these pages later take roles in events that are clearly astronomical. Next come almanacs (on pages 16–23) whose overall temporal structure continues to be divinatory but whose smaller intervals sometimes display lunar characteristics. The protagonist of most of these almanacs, who has long been interpreted as a goddess of the moon, interacts with many of the characters who first appeared in earlier pages. The six pages (24, 46–50)[2] that follow her almanacs contain a table whose main focus is the synodic period of Venus but whose temporal intervals are modified so as to harmonize the rhythms of Venus with those of the moon (Aveni 1992). Many of the characters from earlier pages now reappear in new roles, taking shots at one another when the power of Venus comes into their hands. On the next eight pages (51–58) comes a table that plots potential eclipses of the moon (Justeson 1989: 83–85; Aveni 2001: 173–184) and sun (Lounsbury 1978: 789–804; Bricker and Bricker 1983). Some of the earlier gods appear once again, with the goddess of the moon taking the form of an old woman at the moment of death.

Behind the sequence of subject matter in these pages of the Dresden Codex lies an ancient narrative that must have been similar to the mythological portion of the Popol Vuh (D. Tedlock 1996: 32–43, 91–142), a sixteenth-century alphabetic work produced by K'iche' Maya authors in the Guatemalan highlands. This story, like that of the codex, opens in a dark world whose only temporal rhythm is that of the divinatory calendar. Changes that lead to the present state of the world begin when a young goddess named Xkik', or "Blood Moon," enters the stage and establishes the lunar rhythm of human pregnancy. She gives birth to twin sons whose heroic actions follow the patterns of the Venus period. Solar rhythms are foreshadowed in the story of the twins, but the sun itself plays no direct role until the very end.

Our main concern here is with the twelve Dresden almanacs (listed in Table 4.1) in which the protagonist is clearly and consistently named as the goddess of the moon and in which she interacts with a series of other characters who are also named.[3] J. Eric S. Thompson suggested long ago that almanacs in which the goddess engages in a series of face-to-face encounters with other characters might be tracking conjunctions between the moon and a series of constellations (Thompson 1972: 48–49). We will test his suggestion and extend it, investigating the possibility that a sidereal interpretation might also be applied to almanacs in which the counterparts of the goddess are located above her head or behind her back rather than in front of her. We will take the calendrical structure of the almanacs into consideration, but our main objective will be to give that structure meaning by locating the characters who interact with the goddess in real sidereal space. Part of our evidence will come from the zodiacal almanac in the Paris Codex, which pictures some of the same characters, and the Dresden Venus table, which includes some of their names in its descriptions of the stations of Venus. Other evidence will be drawn from such sources as Maya art of the Classic period, a lunar almanac in the Madrid Codex, the vocabulary of colonial Yukatek Maya, the story of Seven Macaw and his wife,

TABLE 4.1. Each almanac is identified by the number given to it by Thompson (first column), followed by its Dresden page numbers, the sequence of intervals separating its stations, the total length of the intervals, and the positions taken by the characters who interact with the moon goddess.

Almanac	*Pages*	*Intervals in days*	*Total*	*Interaction*
33	16a	21 + 31	52	burden
36	19a–21a	13 + 13 + 13 + 13 + 13	65	spouse
39	16b–17b	13 + 4 + 20 + 15	52	burden
40	17b–18b	11 + 7 + 6 + 16 + 8 + 4	52	herald
41	19b	29 + 23	52	spouse
42	19b–20b	28 + 24	52	spouse
44	21b	7 + 7 + 7 + 5	26	spouse
47	16c–17c	8 + 13 + 13 + 13 + 8 + 10	65	herald
48	17c–18c	15 + 33 + 4	52	burden
49	18c–19c	32 + 20	52	burden
50	19c–20c	11 + 11 + 11 + 10 + 9	52	burden
51	21c–22c	5 + 21 + 16 + 10	52	spouse

Chimalmat, in the Popol Vuh, and the contemporary astronomical practices of the K'iche' and Tzotzil Maya.

In a previous article we demonstrated that the sidereal frameworks of the Paris zodiacal almanac and the Dresden Venus table can be systematically correlated, permitting the accurate mapping of constellations whose locations had previously been disputed (Tedlock and Tedlock 2004). At the same time, we undertook a preliminary exploration of the lunar almanacs, looking for cases in which the characters encountered by the moon goddess could be matched to constellations. In two almanacs we found pairs of characters separated by intervals that are equal to the time it takes the moon to move from one of the corresponding constellations to the other. Here we will put this line of interpretation to a more severe test, focusing on almanacs in which at least three of the goddess's counterparts can be located in sidereal space, and in which the time intervals separating her interactions with each of them are consistent with their locations.

THE STRUCTURE OF THE LUNAR ALMANACS

The protagonist of the Dresden lunar almanacs is named in each of the texts that describe her encounters with other characters. The glyphs in question variously combine signs for *uh,* "moon"; *sak,* "white"; and *ix* or *ixik,* "woman" (Figure 4.1).[4] In the available dictionaries for Mayan languages of the Yukatekan branch, Itzaj lunar terminology comes closest to matching the glyphs, with *ix'uh,* "moon," and *saak ix'uh,* "moonlight" (Hofling and Tesucún 1997). As a

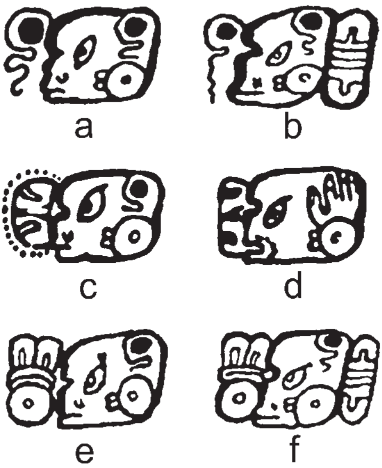


Figure 4.1. Names of the goddess of the moon in her almanacs. In (a) and (b) a sign consisting of a black dot and a wavy strand of hair, meaning uh, *or "moon," is prefixed to the profiled head, and the same sign is infixed in the profiled head in all examples except (d), where an alternative sign for* uh *in the form of a hand is substituted. Yet another sign for* uh *is prefixed in (c) and (d). In all six examples the main sign itself is a logograph for* ixik, *"woman," suffixed in (b) and (f) by a sign for* ik, *which serves as a phonetic supplement. The logograph for* sak, *"white," replaces the* uh *prefix in (e) and (f).*

term for "woman," *ixik* does not occur in Yukatekan languages but is attested in Ch'orti' (Pérez Martínez et al. 1996), indicating that it is a holdover from the Classic period, when a Ch'olan language ancestral to Ch'orti' was the canonical choice for writers of Maya hieroglyphic texts. As translations of the names of the goddess we suggest "Moon Woman" for the glyphs that lack the *sak* element and "Moonlight Woman" for the ones that have it.

Moon Woman interacts with the other characters in her almanacs in three different ways (Hofling 1989: 54–56). In five almanacs, each of her counterparts is described as *ukuch,* "her burden" (Figure 4.2a), and the corresponding pictures show them riding on her back. We take this to mean that the stars corresponding to a given burden appear above the horizon immediately following a moonrise. Our basis for this interpretation lies in the astronomical terminology used by the writers of the Popol Vuh, who refer to Venus, on the occasion of its heliacal eastern rise, as *iqoq'ij,* thus combining *iqo-,* "to carry a burden on the back,"

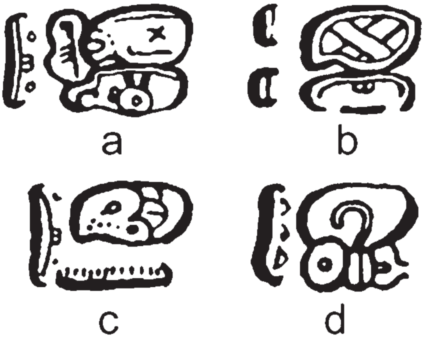


Figure 4.2. Glyphs that describe the relationship between Moon Woman and other characters. In some almanacs her counterpart is always ukuch, *"her burden" (a); in others she is* yatan, *"face-to-face" with or "married" to her counterpart (b); and in still others her counterpart is either* umuuk, *"her herald" (c), or* umut, *"her bird of omen" (d).*

with *q'ij,* "sun" (D. Tedlock 1996: 295). Just as Venus carries the sun on its back when it appears just before sunrise, so, we argue, the moon carries particular stars on its back on the occasions described in these almanacs.

In five other almanacs, Moon Woman is described as *yatan,* "the wife of" her counterparts (Figure 4.2b), and the pictures show them directly in front of her and on her own level, usually facing her but sometimes held in her arms.[5] We follow Thompson in taking this to mean that the moon is in conjunction with the corresponding stars.

The remaining two almanacs describe Moon Woman's counterparts as either *umuuk,* "her herald" (Figure 4.2c), or *umut,* "her sign (or omen)"—literally, "her partridge," referring to a bird whose sudden flight from ground level is read as a sign (Figure 4.2d). Whether her counterparts are labeled as heralds or signs, they are shown riding on her shoulders with their heads higher than hers, and when they take the form of birds they have their wings spread, as if taking flight. We take this to mean that the corresponding stars rise ahead of the moon, heralding its appearance. In the Popol Vuh, when Blood Moon leaves the underworld for the first time, owls guide her to the surface of the earth (D. Tedlock 1996: 101–102), and in both of these Dresden almanacs an owl is among the heralds of Moon Woman.

In each text, the glyphs that name the moon goddess and describe her relationship with her counterpart are accompanied by two additional glyphs, one of which names her counterpart and the other of which gives an augury. The group of four glyphs is arranged in a vertical column when there is no illustration, as in the case of the first event in Almanac 42 (Figure 4.3), and when there is an illustration, they are arranged in two rows of two glyphs each, as in the case of the second event in the same almanac. The latter text reads, *Yatan Uh'ix Sak Ahaw, nika'an,* "When Moon Woman is the wife of White Lord, flowers bloom."[6]

Each almanac is prefaced with a vertical list of alternative starting dates (as in Figure 4.3), drawn from the 13 day numbers and 20 day names of the 260-day divinatory calendar. In all the almanacs the list includes day names written in black, and in most cases it is topped with a single day number written in red (depicted in gray in the figure), meant to be combined with any of the names. Below each of the texts describing an event is a number written in black, and in most almanacs it is followed by a second number written in red (again as in Figure 4.3). The black number refers to a time interval measured in days, and the red one is a day number. The five almanacs that lack red numbers have blank spaces where they could have been inserted, so we assume that the

Figure 4.3. Almanac 42, with a narrative spanning 52 days. Heading the column at left, written in red (represented here by gray), are the dot and bar representing the starting day number, which is 6 (a dot carries a value of 1 and a bar is 5). This number can be combined with any of the starting day names listed below it, which are Kib, Lamat, Ahaw, Eb, and K'an. Further numbers are written below the texts of four glyphs each that describe the two events of this almanac, the first text written in a column and the second in two rows of two glyphs each. The first event is separated from any one of the possible starting dates by 28 days (a black number formed by 3 dots, 1 bar, and the ovoid sign for 20), and it occurs on a day bearing the number 8 (in red). The second event takes place 24 days later (numbered in black), on a day whose number is 6 (in red).

numbers were inadvertently omitted by a scribe who was in the habit of getting far ahead while writing in black, and who sometimes forgot to go back and make additions in red.

Thompson (1972: 52–60) read the black number beneath a given text as giving the number of days separating the current event from the previous one or (in the case of the first text) from the dates in the preface, and he read the red number as corresponding to the date of the current event. In effect, he was following the model of the Venus and eclipse tables, where the number of days required to reach a given event and the date of that event are always written in the same column with the glyphs describing the event itself. A different reading method has been proposed by Victoria R. Bricker (1986: 167–168) and followed by Charles A. Hofling (1989: 67–70). Where Thompson's reading is guided by the tabular structure of the almanacs, theirs is guided by syntactic structure. They treat the numbers beneath the descriptive texts as if they were integral parts of the texts themselves, with the numbers beneath one text beginning a new sentence that continues with the next text. Read in this way, the black number beneath a given description of an event refers to the interval required to reach the next event rather than the current one, and the red number refers to the date of the next event. In the case of the first event, the sentence begins with a date chosen from the list in the preface.

In the absence of an interpretation that consistently links the almanacs to astronomical events, there has been no compelling reason to choose between the two reading methods, but a sidereal interpretation makes the choice clear. As we will demonstrate in the following section, the tabular method is the one that produces matches between successive intervals in the almanacs and successive sidereal positions of the moon.

The overall lengths of the narratives in the lunar almanacs are determined by the structure of the 260-day divinatory calendar, whose only obvious relationship to astronomical intervals lies in the fact that its unit of measurement is the day. In Almanac 44, a single pass through all the intervals spans a total of 26 days, and there are ten alternative starting dates spaced 26 days apart. If the reader were to construct an unbroken narrative that ran through all ten starting dates in sequence, the cumulative interval would simply be that of the divinatory calendar (10 × 26 = 260 days). The situation is similar in the remaining almanacs. Nine of them have a narrative span of 52 days and carry five starting dates spaced 52 days apart, yielding the same cumulative result (5 × 52 = 260 days). The remaining two almanacs span 65 days and carry four starting dates spaced 65 days apart, yielding the same result once again (4 × 65 = 260 days). The Venus and eclipse tables also make use of divinatory dates, but their overall lengths are multiples of the respective synodic periods of Venus and the moon. Each pass across the Venus table lasts 2,920 days, spanning the nearest whole-day equivalent of five Venus periods (5 × 583.92 = 2,919.6), while a complete reading of the eclipse table lasts 11,959 days, falling less than a day short of 405 synodic months (405 × 29.53059 = 11,959.88895).

Periods of 26, 52, and 65 days are not in direct correspondence with lunar rhythms, but the shorter intervals into which the almanacs divide these periods sometimes display a lunar character. Taken together, the twelve almanacs divide their narrative lines into a total of 45 segments, ranging in length from 4 to 33 days (Table 4.1). By far the most common interval is 13 days, which happens to be the age the Yukatek Maya assign to the full moon, counting from the day of the first appearance of the crescent of the new moon.[7] But this interval never combines with adjoining intervals to produce a synodic month, whose canonical Maya values are 29 and 30 days. The number 15, which appears in Almanacs 39 and 48, is the canonical Maya value for half a synodic month, but like 13, it never enters into combinations that add up to a complete synodic month. As the length of an interval between two successive stations, 29 days occurs in Almanac 41, and adjacent intervals can be combined to make 29 days in Almanac 40 (7 + 6 + 16). No almanac has two successive stations separated by a 30-day interval, but combined intervals reach this total in Almanac 40 (6 + 16 + 8) and Almanac 50 (11 + 10 + 9). Since all the almanacs that include an interval of 29 or 30 days are limited to a 52-day narrative line, they cannot incorporate a second synodic month. Almanacs 36 and 47 both span 65 days, but their intervals cannot be combined to produce even a single synodic month.

If the synodic month had an important role in any of these almanacs, one would expect that the particular texts and pictures that stand 29 or 30 days apart might share names and iconographic details that set them apart from the other texts and pictures. But there are no almanacs in which the goddess is given one of her two names at a pair of stations separated by a synodic month and the other name at all the other stations. In Almanac 40, where the first and fourth stations are separated by 29 days, the goddess not only changes names from one station to the other, but she also changes her dress and ornaments in the pictures.[8] In Almanac 50, where the second and fourth stations are separated by 30 days, the goddess is named Moonlight Woman in both texts but again changes her clothing and ornaments.[9] As for the characters she encounters, they never appear twice in the same almanac, regardless of the intervals involved. Whatever might be the same about Moon Woman after the passage of a synodic month, the almanacs ignore this in favor of the contrast between her encounters with her counterparts.

In a few cases, lunar numbers can be reached by combining full runs of the narrative line of an almanac with partial runs. This method yields a number of intervals that are equal to the groups of five and six synodic months featured in the eclipse table (Hofling and O'Neil 1992). In Almanac 50, for example, a total of six synodic months can be reached by starting the narrative with the second of the eleven-day intervals (see Table 4.1), then following the narrative back to this same point three times to run up a total of 3 × 52 = 156 days, and finally moving ahead by two intervals to add 11 + 10 = 21 more days, thus running up a grand total of 156 + 21 = 177 days. The problem is that although combinations of full and partial narrative runs may have the effect of returning the moon to the same point in the synodic month from which it started, they necessarily end the narrative at an almanac station that is different from the one at which it started. This is true not only in the sense that the two stations in question have different positions within the narrative sequence but also in the sense that no two stations in the same almanac carry the same text or the same picture. In other words, the two events this kind of reading treats as the same are treated by the authors of the almanacs as different.

Out of the 45 intervals that separate one almanac station from the next, 41 are shorter than 29 days and 21 are shorter than 13 days. With the notable exception of the eight days separating the western disappearance of Venus from its eastern reappearance, intervals as short as the ones in this last group are rare in the corpus of Maya astronomical texts. They suggest the rapidity of the moon's movement against the background of the fixed stars. During the sidereal month, the moon does what it takes the sun a year to do, making a complete circuit of the constellations along its path in 27.32166 days. If the almanacs were tracking the moon by means of a zodiacal scheme like the one laid out for the sun in the Paris Codex (pages 23–24), it would have been divided into thirteen equal segments. It takes the sun 28 days to travel from one sign to the next, yielding an idealized zodiacal year of $13 \times 28 = 364$ days, whereas the moon's passage from one sign to the next would take slightly longer than 2 days ($27.32 \div 13 = 2.10$). The smallest interval in the almanacs is four days, which would guarantee a change in the zodiacal location of the moon.

The nearest whole-day equivalent of a sidereal month, 27 days, does not occur in any of the twelve almanacs, nor does any combination of successive intervals add up to 27 days. This fact, in combination with the fact that Moon Woman never interacts with the same counterpart more than once in the same almanac, is consistent with the notion that the almanacs are tracking her progress through sidereal space, with her successive counterparts occupying different locations along her path. In Almanac 47 it is possible to reach the 55-day length of two sidereal months ($2 \times 27.32 = 54.64$) by combining intervals ($8 + 13 + 13 + 13 + 8$), but the first number in this series measures the distance from the almanac's list of starting dates to its first station rather than the distance between two stations, so that the series as a whole does not create a need for the repetition of a text or picture.[10]

Maya reckoning of sidereal months, so far as it is known from sources other than hieroglyphic books, goes by intervals lasting 82 days, the nearest whole-day equivalent of three such months ($3 \times 27.32 = 81.96$ days).[11] This number and multiples thereof show up in the timing of rituals in the lives of Classic Lowland Maya kings, as recorded on monuments (Dütting and Schramm 1988: 139–146). In the contemporary K'iche' Maya community of Momostenango, an 82-day interval separates the opening and closing of each of four directional shrines (B. Tedlock 1992: 192–196). No moon almanac has a narrative line that reaches beyond 65 days, but in Almanac 50, combining a partial run that covers the last three station intervals ($11 + 10 + 9 = 30$ days) with a full 52-day run makes a total of 82 days. We reject such a reading for the same reason we rejected it in the case of combinations that add up to multiples of synodic months: it posits a sameness in events that are described by the almanac in question as different.

There remains the problem of finding a way to recycle the almanacs, so that their narrative lines match lunar events on repeated occasions. Proceeding directly from one reading of a narrative lasting 26 or 52 days to the next could return the moon to an approximation of its previous sidereal positions, but serious problems would arise at the time of the third such reading, with 3 × 26 = 78 days falling four days short of three sidereal months (3 × 27.32 = 81.96), and 2 × 52 = 104 days falling five days short of four sidereal months (4 × 27.32 = 109.28). In the case of a 65-day narrative, a single reading immediately produces an enormous discrepancy, pushing the moon ten days beyond two sidereal months (2 × 27.32 = 54.64).

The only way to break free from the limitations of a period lasting 26, 52, or 65 days is to interpose an interval of some length between one reading of the narrative and the next. One possibility is that the divinatory dates in a sequence of almanacs might match up end-to-end, producing a single, continuous narrative line that could be read across all of them before returning to the starting point. The 26-day almanac is out of the running, since none of the other eleven almanacs shares its structure. As for the two 65-day almanacs (36 and 47), they occupy widely separated places, and furthermore the calendar dates of one do not match up with the dates of the other. Among the 52-day almanacs there are four (numbers 39 through 42) that directly follow one another across the middle register of pages 16–20, but in each case the dates fail to make a continuous reading possible. Also lacking matching dates are two 52-day almanacs (numbers 48 and 49) that adjoin one another on the bottom of pages 17–19, together with two more adjoining almanacs (50 and 51) on the bottom of pages 19–23. The only dates that permit a continuous reading are those of two adjoining 52-day almanacs (49 and 50) on the bottom register of pages 18–19. The dates that preface both of these almanacs are listed in the order 13 Ahaw, 13 Eb, 13 K'an, 13 Kib, and 13 Lamat. The first run through Almanac 49 begins on 13 Ahaw and ends on 13 Eb, which matches the second date in the preface of Almanac 50. A run of Almanac 50 beginning on 13 Eb ends on 13 K'an, which permits a return to the 13 K'an starting date for Almanac 49, and so on.[12] The problem is that reading across the two almanacs makes for a cumulative total of 104 days before their events are repeated, an interval that comes nowhere close to being an even multiple of sidereal months. If these two almanacs have anything to do with lunar events, they must be recycled in some other way.

TABLE 4.2. The first eight points of commensuration between multiples of 26-day intervals and multiples of 27.32166-day sidereal months.

26-day intervals		*Sidereal months*	
Multiples	*Total days*	*Multiples*	*Total days*
20	520	19	519.11
21	546	20	546.43
41	1,066	39	1,065.54
42	1,092	40	1,092.87
62	1,612	59	1,611.98
82	2,132	78	2,131.09
83	2,158	79	2,158.41
103	2,678	98	2,677.52

Returning to the question of how to recycle the narrative line within a particular almanac, the only remaining possibility is that successive beginning dates were meant to be separated by even multiples of 26, 52, or 65 days (depending on the type of almanac) that were close to being even multiples of sidereal months. Only in this way could the stations of an almanac repeatedly match actual lunar events while conforming to a particular set of divinatory dates. In the case of Almanac 33, with ten starting dates and station intervals totaling 26 days, the first eight intervals permitting the repetition of a sidereal narrative are shown in Table 4.2. After an optimum first-time match between a particular starting date and the moon's position among the stars, a reader of the table could use a rule of thumb that went something like this: most of the time, repeat the use of a given starting date, but let it go by once, thus separating one start from the next by 2 × 260 = 520 days. Occasionally, as needed, do two consecutive readings instead, moving down the list of starting dates by one place for the second reading. Then revert to the 520-day rule until the next starting date is needed.

It should be noted that an interval of 1,092 days (on the fourth line of Table 4.2) not only serves to commensurate 42 periods of 26 days each with 40 sidereal months but also approximates an exact multiple of synodic months (37 × 29.53059 = 1,092.63183). Further, this same interval is the earliest point of commensuration between lunar periodicity and the Maya computing year of 364 days (3 × 364 = 1,092 days), which figures in the multiplication tables of the Dresden Codex (Lounsbury 1978: 773). The computing year is also the zodiacal year of the Paris Codex, during which the sun passes through thirteen star signs (13 × 28 = 364 days), and in fact there is no earlier point of commensuration between sidereal or synodic months and multiples of the 28 days assigned to

TABLE 4.3. The first eight points of commensuration between multiples of 52-day intervals and multiples of 27.32166-day sidereal months.

52-day intervals		*Sidereal months*	
Multiples	*Total days*	*Multiples*	*Total days*
10	520	19	519.11
20	1,040	38	1,038.22
21	1,092	40	1,092.87
31	1,612	59	1,611.98
41	2,132	78	2,131.09
42	2,184	80	2,185.73
52	2,704	99	2,704.84
62	3,224	118	3,223.96

TABLE 4.4. The first eight points of commensuration between multiples of 65-day intervals and multiples of 27.32166-day sidereal months.

65-day intervals		*Sidereal months*	
Multiples	*Total days*	*Multiples*	*Total days*
8	520	19	519.11
16	1,040	38	1,038.22
21	1,365	50	1,366.03
29	1,885	69	1,885.19
37	2,405	88	2,404.31
45	2,925	107	2,923.42
50	3,250	119	3,251.28
58	3,770	138	3,770.39

the sun's passage through each sign. We suggest that lunar periodicity, both sidereal and synodic, was a major factor behind the selection of the number 364 as an instrument for astronomical calculations.

Turning now to the 52-day almanacs, the first eight intervals permitting the repetition of their sidereal narratives are shown in Table 4.3. The first of these intervals, 520 days, is the same as in the case of the 26-day almanac. The rule of thumb is the same as well: stay with a given starting date, using it at 520-day intervals, but when the need arises do two consecutive readings instead, moving one place down the list of starting dates in the process. After that, revert to the 520-day rule until the next starting date is needed.

The first eight intervals permitting the repetition of the sidereal narratives in 65-day almanacs are shown in Table 4.4. Once again the first repetition comes at 520 days. The next interval has the same length, but after that a new starting date is reached by letting the old date go by once, thus running up a total of 260 days since its last use, and then moving one place down the list, which adds 65 more days to make a total of 325 between starts. Thereafter, the intervals between starts alternate between 520 days and 325 days.

Among the intervals that figure in the repetition of any of these narratives, 520 days is by far the most prominent. As John E. Teeple (1931: 90) pointed out long ago, 2 × 260 = 520 days is the nearest whole-day equivalent of three eclipse half-years (3 × 173.31 = 519.93). What this means, over the short run, is that if a lunar eclipse took place at one of the stations in a lunar almanac, and if the next reading of that almanac commenced 520 days later than the previous reading, the chances would be good that a lunar eclipse would occur at or very near the same station as before. But whenever two successive readings of an almanac were begun 26, 52, or 325 days apart, a further repetition of this event would be impossible. Thus the relationship between the almanacs and lunar eclipses is tenuous at best, as is further demonstrated by the fact that none of the intervals in Tables 4.2, 4.3, and 4.4 matches the intervals tabulated in the Dresden eclipse table (see Aveni 2001: table 17).

As can be seen from an inspection of the fractions of days in the fourth column of each table, none of the intervals that permit the rereading of an almanac brings the moon any closer than about three hours to repeating its starting sidereal position at the same time of day as in the previous reading, and the gap can run as long as most of a day. Such variability would present a problem if the almanacs gave evidence of systematic attention to particular moments in the synodic month (such as the sunset rise of the full moon), but as we have seen, they do not. If the almanacs are tracking the moon's sidereal position by the measure of whole days, then the time of day is not an issue except in the sense that a given event in a particular reading of a particular almanac might involve a moonrise taking place during the day, when the stars preceding or following the moon could not be seen until later, or it might take place when the moon was too close to the sun for the stars in question to be seen at any time of day, or even when the moon itself was undergoing its two or three days of complete invisibility. On such occasions the reader could know where the moon had arrived among the stars by consulting an almanac currently in use rather than by making a direct observation. In the cases of the Paris zodiacal almanac and the Dresden Venus table, the main focus of the sidereal information is to enable the reader to discover the location of the sun or Venus when the stars at that location cannot be observed. What makes the lunar almanacs different is not the invisibility of some of the sidereal events they narrate but rather the fact that many of these events could have been observed directly.

MOON WOMAN'S PATH AMONG THE STARS

In mapping the moon's position with respect to star groups, we have chosen various sequences of real events from the third decade of the thirteenth century, but for present purposes, sequences drawn from recent years would not produce results that were substantially different.[13] Our chosen latitude is that of Chichén Itzá, which is 20° 40′ north. In considering which stars in a given location might be the relevant ones, we will be guided, in part, by the astronomical practices of the contemporary highland Maya. When K'iche' observers use the evening rises of stars to reckon the progress of the dry season (B. Tedlock 1999: 52), and when Tzotzil observers use the dawn sets of some of the same stars to track the progress of the night during the wet season (Vogt 1997), they focus largely on bright stars or star groups that are easy to spot in the late dusk or early dawn. Further, they sometimes use stars that lie well outside the zodiac as defined by Western astronomy, especially when there are no bright stars available near the ecliptic. In the same way, we will pay special attention to bright stars, and in some cases we will look for them outside the familiar zodiac.

Figure 4.4. Almanac 39 (Dresden pages 16b–17b) describes four sidereal positions of the rising moon in texts composed of four glyphs each, with the first two texts accompanied by pictures. At extreme left is a column of optional starting dates; the bar-and-dot numerals below each text give the number of days separating the event it describes from the starting date (in the case of the first text) or from the previous event. Moon Woman's burdens are named by the first glyph of each text. She carries Chaak 13 days after the starting date, followed by Kimil, or "Death," after 4 more days, Itzamna after another 20 days, and God Q after another 15 days, for a total of 52 days.

Let us begin with Almanac 39, in which Moon Woman carries four different burdens over the course of 52 days (Figure 4.4). The first burden is named and pictured as Chaak, a well-known god of thunderstorms, but we can find no independent evidence as to his place among the stars. Next, after four days, comes a god who is named and pictured as Kimil, or "Death," often referred to by Mayanists as God A. He is also pictured in the Paris zodiacal almanac (Figure 4.5a), pictured and named in Dresden almanacs other than lunar ones (Figure 4.5b, c), and twice named in the row of the Dresden Venus table that tracks the sidereal location of Venus (Figure 4.5e, f). His position in the sequence of the Paris almanac makes it clear that his celestial home is in Leo,[14] and his historical encounters with Venus as the morning star (Figure 4.6) and evening star (Figure 4.7) on dates from the Venus table confirm this association, placing the focus on the Sickle of Leo and on Regulus, a first-degree star and the brightest in Leo. In K'iche' astronomy, the early evening rise of Regulus marks the beginning of a division of the dry season.

On the basis of the evidence for the Death stars' location, we can start the mapping of Almanac 39 with an occasion on which the moon rises just ahead of the Sickle of Leo (Figure 4.8). Following the tabular reading method, an interval of twenty days separates this event from the next one, which finds the moon rising ahead of the Pleiades (Figure 4.9), a star group that is like Regulus in playing a role in K'iche' reckoning of the dry season. On this occasion Moon Woman's burden is named (but not pictured) as Itzamna, also known to Mayanists as God D. In Classic Maya art, Itzamna is sometimes shown confronting or wrangling a peccary in vase paintings (Figure 4.10a), and a peccary constellation is included among the cartouches of the sky bands that are carved in stone on the façade of Las Monjas (Figure 4.10b) and painted along the top of one of the palace murals at Bonampak (Figure 4.10c). Inside the Bonampak cartouche and bursting through its borders are six or seven tightly packed peccaries and at least five star signs, constituting a probable representation of the Pleiades.[15] In later times the Maya of Yucatán saw the Pleiades differently, calling them Tzab, which is the Yukatek term for the rattles of a rattlesnake (Barrera Vásquez 1980). In Postclassic art, Itzamna is no longer associated with peccaries, but he is sometimes shown wielding a serpentine hyssop whose most prominent feature is a cluster of rattlesnake rattles (Figure 4.10d). From all of this information we conclude that our sidereal mapping of Almanac 39 puts the moon in the right location for Itzamna to take the role of Moon Woman's burden. It remains an open question as to which stars in this vicinity might correspond to his person rather than to his peccaries or rattles.[16]

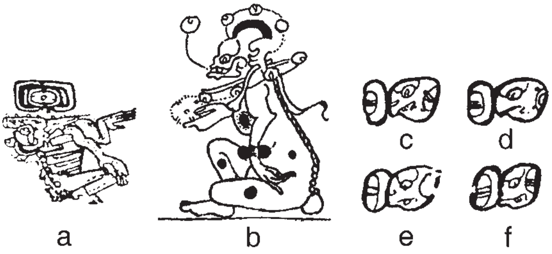


Figure 4.5. Kimil, or "Death" (God A), eating the setting sun in the Paris zodiac (a), exhaling a meteor (b) and named (c) on Dresden page 15c, and named in Almanac 39 (d) and on pages 46 (e) and 49 (f) of the Dresden Venus table.

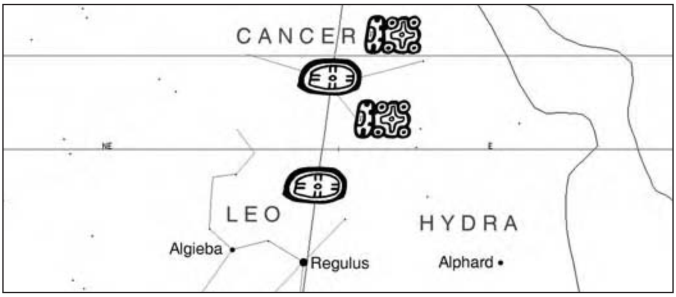


Figure 4.6. Positions of Venus and the sun when Venus appeared as the morning star on July 11, 1131 (above the upper horizon line), and July 27, 1326 (above the lower line). On these occasions the Dresden table (page 46) names the sidereal location of Venus as that of Death (God A). The two positions, combined with the two in Figure 4.7, center on Regulus and the Sickle in Leo.

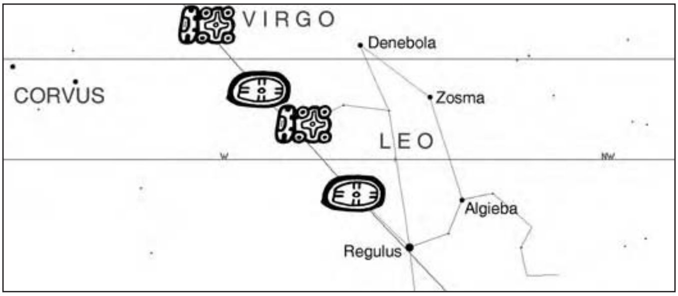


Figure 4.7. Positions of Venus and the sun when Venus appeared as the evening star on August 13, 1135 (above the lower horizon line), and August 29, 1330 (above the upper line). On these occasions the Dresden table (page 49) names the sidereal position of Venus as that of Death (God A).

The moon's rise ahead of the Pleiades is followed, fifteen days later, by a rise ahead of features of the night sky that include the tail of Scorpius and the entrance to Great Rift of the Milky Way (Figure 4.11), a long, dark streak that

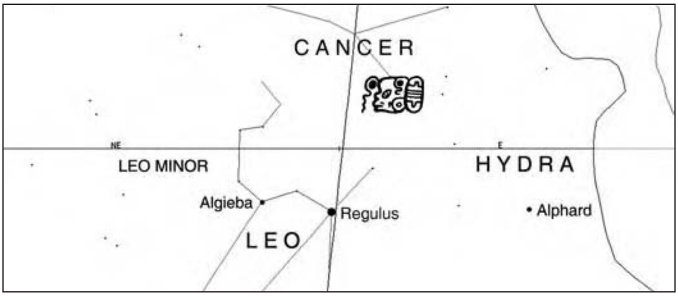


Figure 4.8. As the moon rises ahead of Leo, Moon Woman carries Death as her burden, as described in Almanac 39.

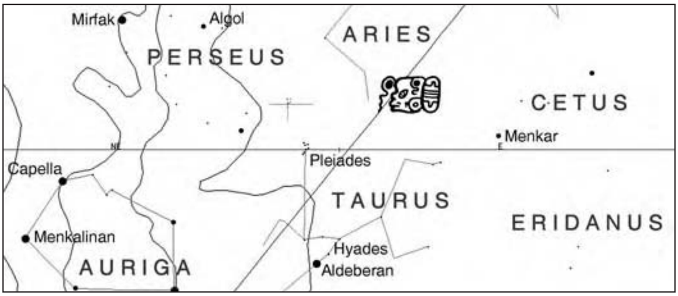


Figure 4.9. As the moon rises ahead of Taurus twenty days after rising ahead of Leo (in Figure 4.7), Moon Woman carries Itzamna as her burden, as described in Almanac 39.

splits part of the Milky Way into two strands. Now Moon Woman's burden is named as a personage who is known in the Mayanist literature as God Q, pictured elsewhere in the Dresden Codex (Figure 4.12a) but not in any of the lunar almanacs. The glyph that commonly names him may contain a reference to the Great Rift in its main sign, which reads *p'e,* "open, split, divide" (Figure 4.12b, c, d). An unusual version of his name in the Venus table (in the middle caption of page 50) may read Tz'up'e, "Split Down the Middle." In K'iche' the Great Rift is called Q'eqa B'e, "Black Road" (B. Tedlock 1992: 181), and the Popol Vuh describes it as leading to a subterranean kingdom whose lords await visitors with the thought of sacrificing them (D. Tedlock 1996: 95). Given that God Q seems to be located in the vicinity of the Great Rift, it should be no surprise that he has strong associations with sacrifice and death in Maya iconography (Taube 1992: 107). But whether or not his name and attributes are in fact connected to the Great Rift, his sidereal location will be confirmed by the next of the almanacs to be considered here.

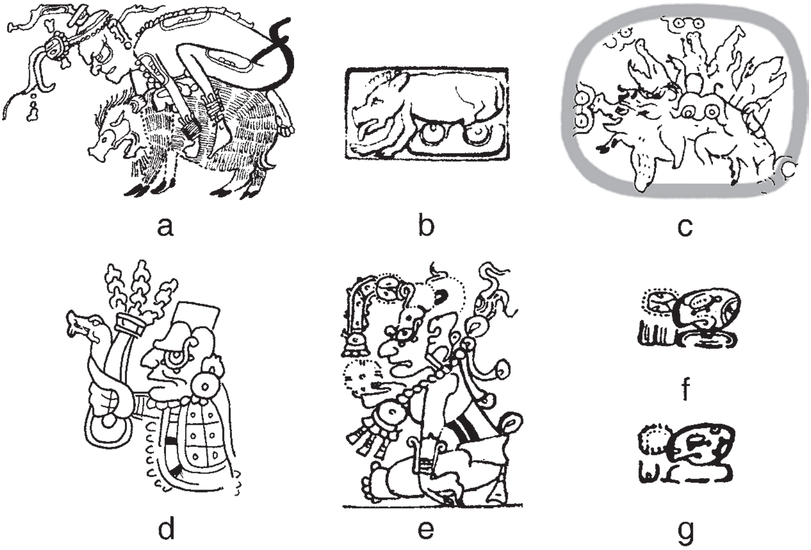


Figure 4.10. In art of the Classic period, Itzamna wrangles a peccary in a vase painting (a), and peccary constellations are included in the cartouches of the sky bands that run above the main door of Las Monjas at Chichén Itzá (b) and along the top of one of palace murals at Bonampak (c). In Postclassic codices, Itzamna wields a hyssop in the form of a serpent with three rattlesnake tails on Madrid page 63c (d) and wears the initial sign of his name glyph on his forehead on Dresden page 15c (e). In both cases his eye is a star sign, which is also present in his name glyph on Dresden page 15c (f) and in Almanac 39 (g).

In Almanac 51, Moon Woman comes face-to-face with four different counterparts over the course of 52 days (Figure 4.13). The first of these is named and pictured as Pawahtun, a god of the four directions (also known as God N). In a Classic stone carving at Quiriguá, a profiled Pawahtun occupies a turtle shell marked with a quincunx sign (Figure 4.14a), which in full view would consist of four dots arranged in a square with a fifth dot at the center. In the Dresden Venus table, his name is prefaced with the four dots of the number four (Figure 4.14c, d). Since the Yukatek term for "four," *kan,* also means "square," this part of his name could refer not only to the four directions but also to the rectangular shape of the Maya world. In Almanac 51, Pawahtun's name is prefaced with the single bar that signifies the number five (Figure 4.14e), probably referring to the sum of the four directions plus the center. His general celestial location can be inferred from his historical encounters with Venus as the morning star on dates from the Venus table (Figure 4.15), which place him in the vicinity of western Pisces and eastern Aquarius. The only bright stars in this area are Fomalhaut,

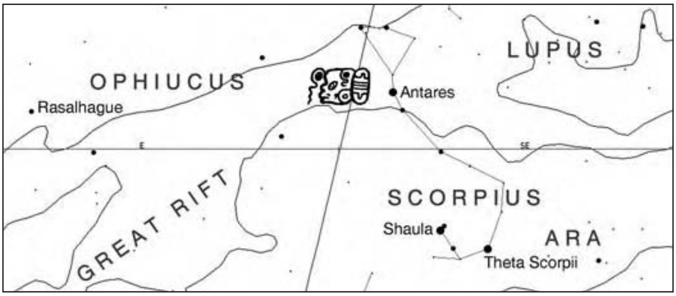


Figure 4.11. As the moon rises ahead of the opening of the Great Rift in the Milky Way fifteen days after rising ahead of Taurus (in Figure 4.9), Moon Woman carries God Q as her burden, as described in Almanac 39.

to the south of the ecliptic, and the four that form the Square of Pegasus, to the north. Pawahtun's association with the quincunx, the four directions, and the shape of a square argues strongly for the Square of Pegasus as his sidereal home. Moreover, when the Square of Pegasus crosses the meridian in Maya latitudes, it becomes a microcosmic diagram, with its four sides facing in the four cardinal directions and enclosing the zenith (Tedlock and Tedlock 2004).

On the basis of the evidence for the location of Pawahtun, we can begin our mapping of Almanac 51 with an occasion on which the moon rises together with the Square of Pegasus (Figure 4.16). After the 21-day interval that separates this event from the next one, the moon rises together with Aquila and Sagittarius, and it may be that Delphinus should also be considered, even though its stars are not bright (Figure 4.17). Here Moon Woman comes face-to-face with a character who is named but not pictured as Yax B'alam, or "First Jaguar." He takes the form of a jaguar in the Paris zodiac (Figure 4.18a), but in a Dresden almanac outside the lunar series he is depicted as human except for patches of jaguar fur on his face and body (Figure 4.18b). The jaguar of the Paris zodiac is located somewhere in the vicinity of Capricornus, the next constellation east

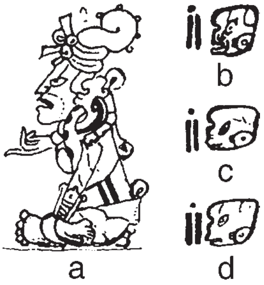
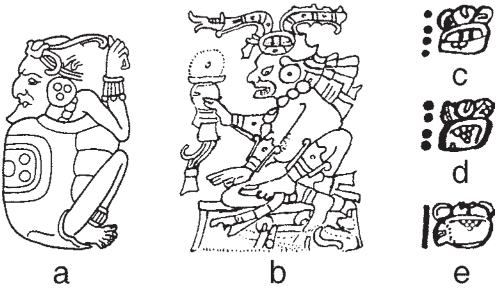


Figure 4.12. God Q, pictured (a) and named (b) on Dresden page 10c, and named in Almanac 39 (c) and Almanac 51 (d). The main sign of his name glyph reads p'e, *"open, split, divide," and the prefix, whose parallel stripes are also shown on his body, suggests a similar concept.*

Figure 4.13. Almanac 51 (Dresden pages 21c–22c) describes four sidereal positions of the moon in texts composed of four glyphs each, with illustrations for all but the last text. At extreme left is a column of starting dates. The characters who come face-to-face with Moon Woman are named by the second glyph of each text. She is met by 5 Pawahtun 5 days after the starting date, followed by Yax Balam, or "First Jaguar," after 21 more days, an unknown god after another 16 days, and God Q after another 10 days, for a total of 52 days.

of Sagittarius (just below the moon in Figure 4.17). The reason for considering Delphinus is that it figures in the astronomy of the Tzotzil Maya, who find it similar to the Pleiades except for its relative faintness (Vogt 1997). Both star groups are seen as footprints made by sandals, with the footprints of Delphinus having been made in stealth by robbers. If an analogous comparison between the Pleiades and Delphinus was made by the Maya who envisioned peccaries (or perhaps their tracks) in the Pleiades, they might have ascribed the stealth of a jaguar to Delphinus. However that might be, our mapping has moved the moon to an area close to the location of the Paris jaguar.[17]

Figure 4.14. Pawahtun (God N) with a quincunx on his back at Quiriguá (a), seated on top of the sky on page 48 of the Dresden Venus table (b), named as 4 Pawahtun on pages 47 (c) and 48 (d) of the Venus table, and named as 5 Pawahtun in Almanac 51 (e).



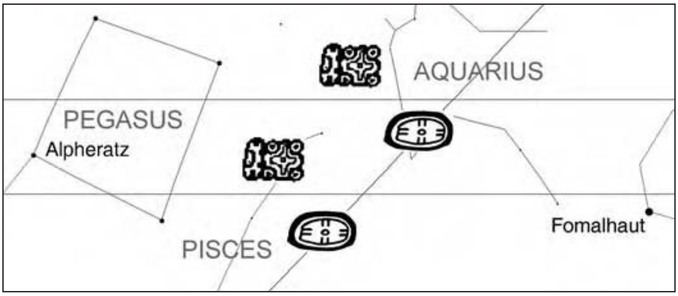


Figure 4.15. Positions of Venus and the sun when Venus appeared as the morning star on February 14, 1133 (above the upper horizon line), and on March 2, 1328 (above the lower line). On these occasions the Dresden table (page 47) names the sidereal location of Venus as that of 4 Pawahtun.

Moon Woman's third encounter in Almanac 51, coming fifteen days after her meeting with First Jaguar, brings her face-to-face with a personage whose name and picture make him difficult to identify (Figure 4.13). The main sign of his name glyph is a profiled head that looks vaguely like the glyph for *max,* "monkey," but it is missing the solid black areas that normally fill much of the space in that glyph. The picture, which is not that of a monkey, poses a problem of its own: it represents an elderly male deity in a manner that is generic, lacking enough detail to permit a specific identification. Making the situation still more anomalous is the fact that the moon goddess, though pictured, is not named in the caption. But ten more days bring her encounter with a character we have met before: God Q, or "Split Down the Middle." Now the moon rises together with the tail of Scorpius and the nearest part of the Great Rift (Figure 4.19), which is where we found God Q when Moon Woman carried him as her burden in Almanac 39 (Figure 4.11). Again, as in Almanac 39, he appears in the final episode of the narrative.[18]

Having explored two types of almanacs, the kind in which Moon Woman carries her counterparts on her back and the kind in which she meets them face-to-face, we will turn to the remaining type, in which they serve as her signs or heralds. In Almanac 47, which spans 65 days, six different birds (or five birds and a bat) take flight above her head (Figure 4.20). The first bird, an owl, presents a special problem whose solution we will postpone till later. The next bird, named as *k'uk'* (or "quetzal") and pictured as a male quetzal, is also a problem, since we can find no independent evidence as to his sidereal location, and the same is true of the sixth bird, named as *kutz,* or "turkey." Our best starting point is with the third bird, who is named and pictured as *mo'o,* "macaw." His

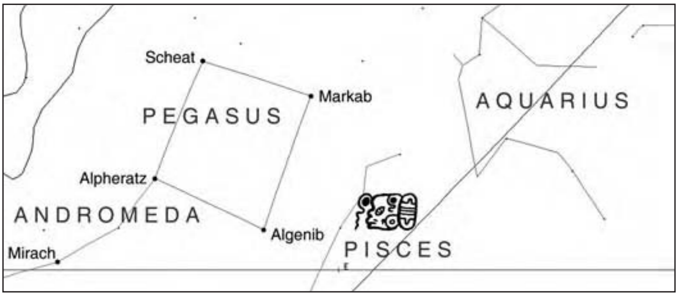


Figure 4.16. As the moon rises with the Square of Pegasus, Moon Woman is face-to-face with 5 Pawahtun, as described in Almanac 51.

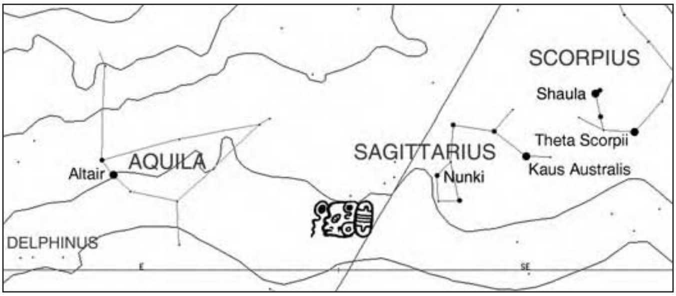


Figure 4.17. As the moon rises with Delphinus, Aquila, and Sagittarius 21 days after rising with the Pegasus Square (in Figure 4.16), Moon Woman is face-to-face with Yax Balam, "First Jaguar," as described in Almanac 51.

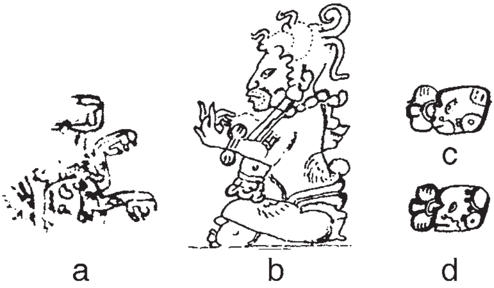


Figure 4.18. A jaguar eats the sun in the Paris zodiac (a); Yax Balam, or "First Jaguar," is pictured (b) and named (c) on Dresden page 7b and named in Almanac 51 (d). Note the patches of jaguar fur on First Jaguar's face and body.

location can be found by combining bits of evidence from Yukatek and K'iche' sources that date from the early colonial period. Yukatek sources mention a male deity named K'inich K'ak'mo', or "Sun-eyed Fire Macaw," and although they fail to reveal his celestial location, the Popol Vuh makes it very clear that his K'iche' counterpart, known as Wuqub' Kaqix (or "Seven Macaw"), corresponds to the seven stars of the Big Dipper (D. Tedlock 1996: 34, 237–238). Moreover, Seven Macaw's wife, Chimalmat, seems to have a Yukatek counterpart in Chimal K'inich K'ak'mo', "Shield of Sun-eyed Fire Macaw." It is not clear whether this is the name of Sun-eyed Fire Macaw's wife or simply a reference to his shield, but what is important here is that Chimal Ek', or "Shield Stars," is the Yukatek term for Ursa Minor (ibid.: 241). Considering all the evidence together, it seems reasonable to place the stars of Sun-eyed Fire Macaw in the Big Dipper, near the Shield Stars.

All except one of the seven stars of the Big Dipper is in the first- or second-degree range, and contemporary K'iche' observers mark the beginning of a division of the dry season by watching for evenings when the stars of its handle, the last to rise, replace Regulus as the first visible bringers of night. The Big Dipper is rather far from the ecliptic, but when it has risen just high enough for all seven stars to be seen, the two first-degree stars in the handle, Alioth and Alkaid, are without rivals in brightness along the entire eastern horizon. We will begin the mapping of Almanac 47 with a moonrise that comes moments behind the rise of Alkaid (Figure 4.21), counting this as an occasion on which the macaw serves as the herald of Moon Woman—or rather Moonlight Woman, as she happens to be named in this particular case.

With the macaw in place we are ready to return to the problem of the owl, the herald who begins the narrative of Almanac 47. He is pictured as a horned owl, and his name combines the number 13 with a logogram in the form of the profiled head of a horned owl. Deities with the features of a horned owl are named and pictured twice in Dresden almanacs other than lunar ones (Figure 4.22a, b), and although there are differences between the images, it has always

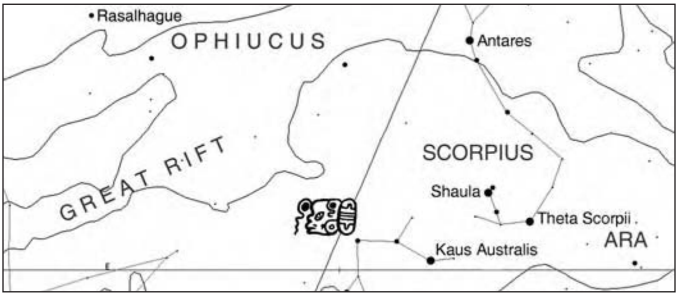


Figure 4.19. As the moon rises with the Great Rift a total of 26 days after rising with Delphinus, Aquila, and Sagittarius (in Figure 4.17), Moon Woman is face-to-face with God Q, as described in Almanac 51. Compare the moon's position here with that of Figure 4.11, where the moon rises ahead of the Great Rift and Moon Woman has God Q as her burden.

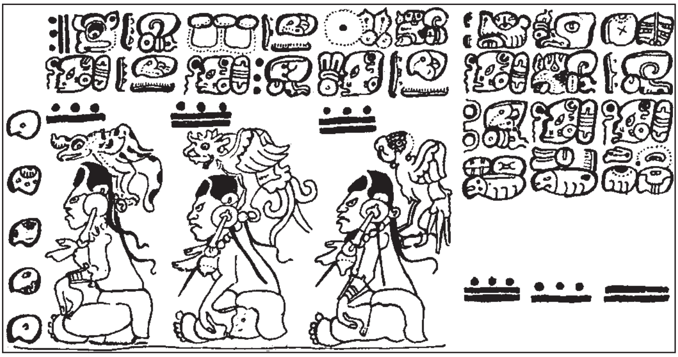


Figure 4.20. Almanac 47 (Dresden pages 16c–17c) describes six sidereal positions of the moon in texts composed of four glyphs each, with the first three texts accompanied by pictures. The characters who serve as Moon Woman's bird of omen or herald are named by the first glyph of each text. She is heralded by 13 Kan Kuy, or "13 Sky Owl," 8 days after the starting date, followed by k'uk', *"quetzal," after 13 more days;* mo'o, *"macaw," after 13 more; Ya Sotz'il, "Terrible Bat," after 13 more; a vulture after 8 more; and* kutz, *"turkey," after 10 more, for a total of 65 days.*

been assumed that they are representations of a single deity. One of the figures is named 13 Kan Mut Kuy, "13 Sky Omen Owl," whereas the other is 13 Kanal Kuy, "13 Sky Owl," but these appear to be variations on the same name. A similar name, 13 Kanal Mut, or "13 Sky Omen," appears among the designations of sidereal locations in the Venus table (Figure 4.22c, d).[19] This owl's historical encounters with Venus as the evening star take place in extreme western Pisces and in Aquarius (Figure 4.23), and given the spatial relationship between the evening-star Venus and Regulus (Figure 4.7), it could be that Fomalhaut, a first-degree star in Piscis Austrinus, should be taken into consideration.

The problem with the owl in Almanac 47, who takes the role of herald a total of 26 days before the macaw, is that he ends up nowhere near the owl of the Venus table. The stars that mark his appearance are those of Virgo and Corvus (Figure 4.24). Unless the Venus table or the almanac is in error, or we have put the macaw in the wrong place, there must be more than one celestial owl. The Popol Vuh mentions four (D. Tedlock 1996: 94), each with a name that includes *tukur,* the K'iche' term for large horned owls, but there are no obvious clues as to their locations in the sky. A moon almanac in the Madrid Codex brings us closer to a solution, picturing horned owls as heralds of Moon Woman on two different occasions, one of them coming twelve days after the other (Figure 4.25). If we suppose that the first of these Madrid owls is equivalent to the one in Dresden Almanac 47 and is thus located in the region of Virgo

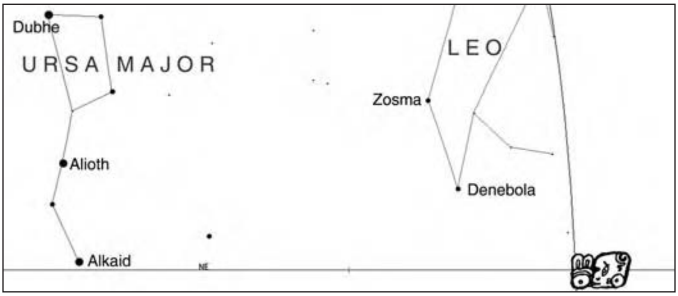


Figure 4.21. As the Big Dipper rises ahead of the moon, mo'o, *or "macaw," is the herald of Moon Woman, as described in Almanac 47.*

and Corvus, then the passage of twelve days brings an occasion on which the stars rising ahead of the moon (Figure 4.26) include the same ones that are near Venus when its sidereal location is recorded as that of an owl (Figure 4.23).[20] So the Venus table and Almanac 47 are referring to two different owls, both of which figure in the Madrid almanac, and the location of the macaw is confirmed.

After Moon Woman has been heralded by the macaw, with a moonrise preceded by the appearance of the Big Dipper, the passage of thirteen days brings a moonrise preceded by stars that belong to Aquarius, westernmost Pisces, and part of Pegasus (Figure 4.27), placing the new herald not far from the second owl of the Madrid almanac.[21] The glyph that names this herald has the profiled head of a leaf-nosed bat as its main sign, and one possible reading of the glyph as a whole is Ya Sotz'il, "Terrible (or Painful) Bat." The image in the Paris zodiac that corresponds to an area of the

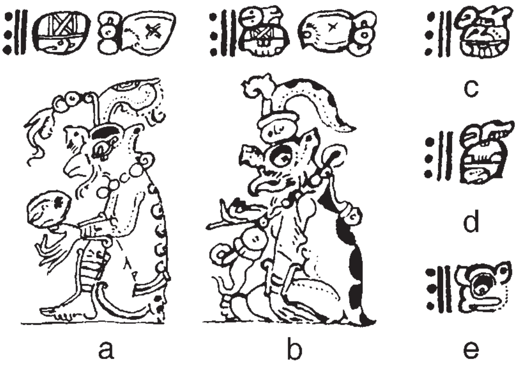


Figure 4.22. Horned owls are named and pictured on Dresden pages 7c (a) and 10a (b); the first name reads 13 Kan Mut Kuy, "13 Sky Omen Owl," and the second reads 13 Kanal Kuy, "13 Sky Owl." On page 47 of the Dresden Venus table (c and d), one of the planet's sidereal locations is named as 13 Kanal Mut, "13 Sky Omen." In Almanac 47 (e), a logogram representing the head of the owl is substituted after the number; the possible readings could have included 13 Sky Owl and perhaps any of the other variants on the name.

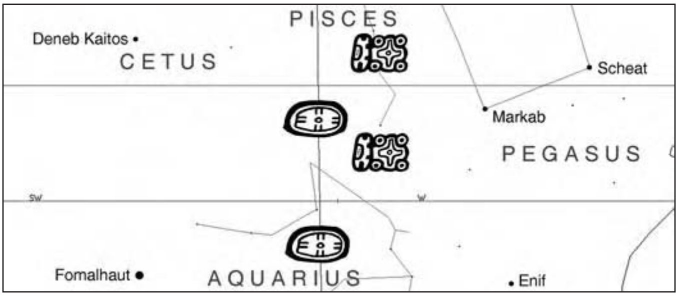


Figure 4.23. Positions of Venus and the sun when Venus appeared as the evening star on February 6, 1133 (above the lower horizon line), and February 23, 1328 (above the upper line). On these occasions the Dresden table (page 47) names the sidereal position of Venus as that of 13 Sky Omen.

sky overlapping with this one is that of a bat (Figure 4.28a). There is no picture of Moon Woman's herald in the present almanac, but in Almanac 40 a herald of the same name is pictured as a bird rather than a bat (Figure 4.28b).[22] The likeliest explanation is that the species of bird in question is named for some sort of resemblance to a bat. A bird name of this kind exists today in Ch'orti', whose term for an unidentified small hawk is *sutz' mwan,* composed of *sutz',* "bat," and *mwan,* a term that refers to a larger hawk when it is used by itself (Pérez Martínez et al. 1996). It could be that the scribe who put the bat in the Paris zodiac was reinterpreting what was originally a bird, or that the scribe who put the bird in Almanac 40 was reinterpreting what was originally a bat. Given the importance of bats in Maya art and mythology, we lean toward the latter possibility.

After eight days the moon rises with the stars of Auriga and Taurus ahead of it (Figure 4.29), and Moon Woman's herald is named by a glyph whose exact reading in Yukatek is not yet known, but whose main sign consists of the profiled head of a vulture. There is no picture here, but a vulture-headed deity with the same name is illustrated in one of the non-lunar almanacs of the Dresden Codex (Figure 4.30a, b). Vultures have a long association with Maya lordship, as is evidenced in Classic texts. When a glyph is composed of a profiled vulture head that wears a head scarf and is sometimes prefixed with the glyph for the day name Ahaw (as in Figure 4.30d), it has the reading Ahaw, meaning "Lord" (Macri and Looper 2003: 99). Another glyph with the same reading replaces the vulture's profile with that of a young man who has black spots on his cheek. A version of this glyph appears in the row of sidereal signs in the Venus table (Figure 4.30e), with the scarf reduced to its crosshatched element.

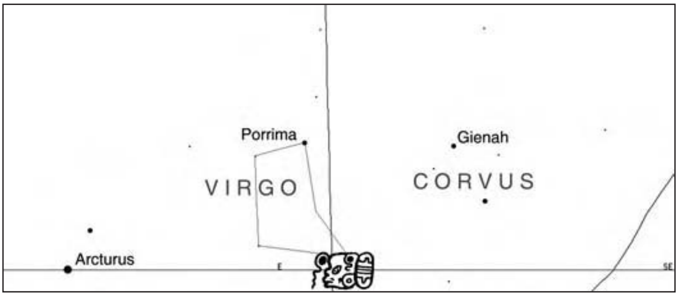


Figure 4.24. As Virgo and Corvus rise ahead of the moon, 26 days before the Big Dipper does so (in Figure 4.21), 13 Sky Owl is the herald of the moon, as described in Almanac 47.

Figure 4.25. Excerpt from a moon almanac on Madrid page 95c, picturing two horned owls (at left and right) as heralds of Moon Woman. One of them takes this role a total of twelve days after the other.

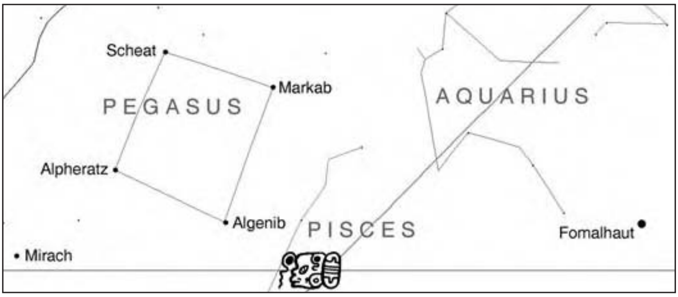


Figure 4.26. As Pegasus and Aquarius rise ahead of the moon, twelve days after Virgo and Corvus did so (in Figure 4.24), the second owl of the Madrid almanac, which would be the same owl as the one in the Dresden Venus table, is the herald of Moon Woman. Compare the area above the moon with the area containing Venus and the sun in Figure 4.23.

The main sign is prefaced by the single dot of the number one, yielding Hun Ahaw, or "One Lord," the name of a young hero who is the twin brother of First Jaguar.[23] In the Venus table, One Lord's historical encounters with Venus as the morning star place him in the area of Auriga and Taurus (Figure 4.31), which is where we found the vulture-headed deity who heralds the appearance of Moon Woman (Figure 4.29). The Pleiades (in Taurus) are already accounted

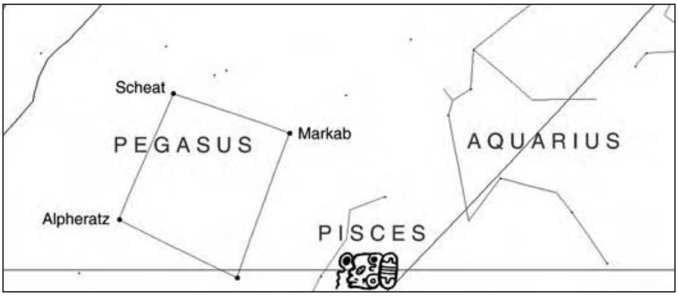


Figure 4.27. As Pegasus and Aquarius rise ahead of the moon, thirteen days after the Big Dipper did so (in Figure 4.21), Ya Sotz'il, or "Terrible Bat," is the herald of Moon Woman, as described in Almanac 47.

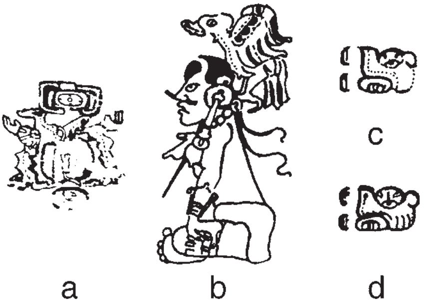


Figure 4.28. A bat eats the sun in the Paris zodiac (a); a bird is pictured as Moon Woman's herald in Almanac 40 (b) but is given a name (c) that can be read as Ya Sotz'il, "Terrible Bat," which is also the name of her herald in Almanac 47 (d).

for by Itzamna, but plenty of other highly visible stars are available in this part of the sky. Aldebaran, at magnitude 0.9, is the brightest, and it is also closest to the ecliptic. Its position relative to Venus on the occasions in question is similar to that of Regulus when the name of Death marks the position of the morning star (Figure 4.6).[24]

In Classic paintings, One Lord and First Jaguar are sometimes represented as standing on opposite sides of a turtle shell that represents the earth (Miller 1999: 208–209). This depiction provides a way of cross-checking their sidereal positions, and it sheds further light on the meaning of the Square of Pegasus. It turns out that when Taurus is in the eastern sky, Delphinus and Aquila are in the west, which puts One Lord and First Jaguar on opposite sides of the world (Figure 4.32). Not only that, but the Square of Pegasus is halfway between them, straddling the meridian. The Square is the home of Pawahtun, and as we have already seen, he is sometimes represented as the occupant of a turtle shell (Figure 4.14). This combination of evidence, which brings together three different locations in a single, coherent vision of the night sky, greatly

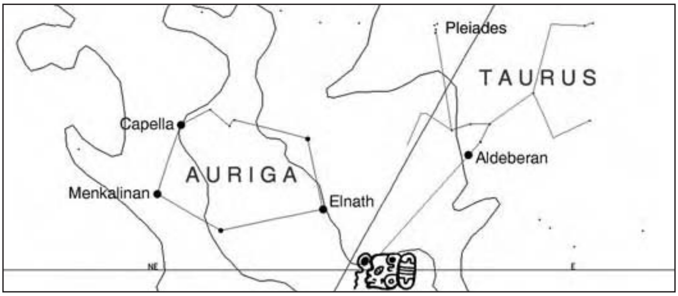


Figure 4.29. As Auriga and Taurus rise ahead of the moon, eight days after Pegasus and Aquarius did so (in Figure 4.27), the vulture is the herald of the moon, as described in Almanac 47.

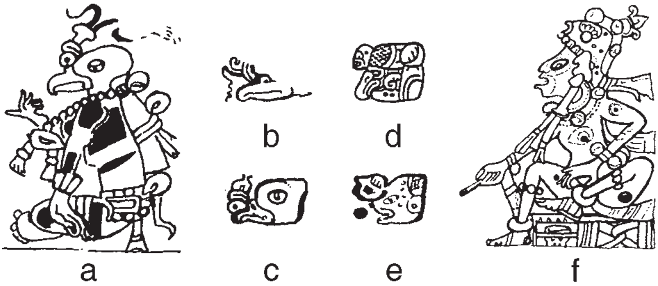


Figure 4.30. A vulture deity is pictured (a) and named (b) on Dresden page 8a and named in Almanac 47 (c). In Classic inscriptions a vulture profile (d), prefixed with an ahaw *sign and wearing a head scarf, reads* ahaw, *"lord." The god who bears the day name Hun Ahaw, or "One Lord," is named on page 49 (e) and pictured on page 50 (f) of the Dresden Venus table.*

strengthens the case that the four stars of the Square form a microcosm, a celestial model of the four-sided earth.

CONCLUSIONS

Wherever Maya gods may have resided during the era that opens the Dresden Codex—when the world was dark and the divinatory calendar was the only measure of time—it is now apparent that they did not wait until the era of the planet Venus and the sun to take up positions in the sky. Instead, they were already in place when Moon Woman began traveling her path among the stars. As we have shown, various episodes from her repeated passages through sidereal space are accurately chronicled in the Dresden lunar almanacs, whose

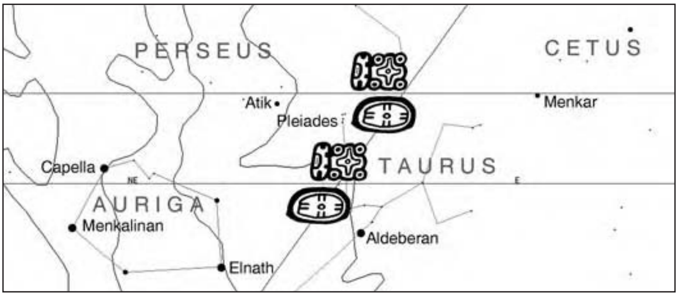


Figure 4.31. Positions of Venus and the sun when Venus appeared as the morning star on April 27, 1136 (above the upper horizon line), and on May 14, 1331 (above the lower line). On these occasions the Dresden table (page 49) names the sidereal location of Venus as that of One Lord.

interval numbers match the time it takes the moon to move from the home of one celestial deity to that of another. The discovery of these matches would not have been possible without the use of the tabular reading method, whereby the numbers beneath the description of an event apply to that same event. The syntactic method, whereby the numbers are applied to the following event instead, should now be set aside.

When the narrative line of a lunar almanac spans 26 or 52 days, the relationship between dates on the divinatory calendar and sidereal locations of the moon can be repeated by interposing intervals of 2 × 260 = 520 days between the starting dates of successive readings, and the accumulating discrepancies that arise from this procedure can be corrected by occasionally moving from one reading to the next without interruption, thus reducing the interval between starting dates to 26 or 52 days, depending on the type of almanac. In the case of a 65-day narrative, alternating the interval separating starting dates between 520 and 325 days keeps an almanac in line with the moon's sidereal positions.

Some of the intervals that occur within the almanacs suggest the synodic periodicity of the moon, but the texts and pictures ignore this aspect, focusing instead on the differences among Moon Woman's encounters with sidereal deities. In some cases eclipse intervals can be derived from the numbers in an almanac by combining full and partial runs of its narrative line, but this calculation produces an illusory connection between two events the almanac treats as different. Intervals of 520 days, which become prominent when the almanacs are recycled, closely approximate three eclipse half-years, but an almanac with an event that happened to coincide with an eclipse would fall out of phase with future eclipses as soon as the recycling process required a shorter interval

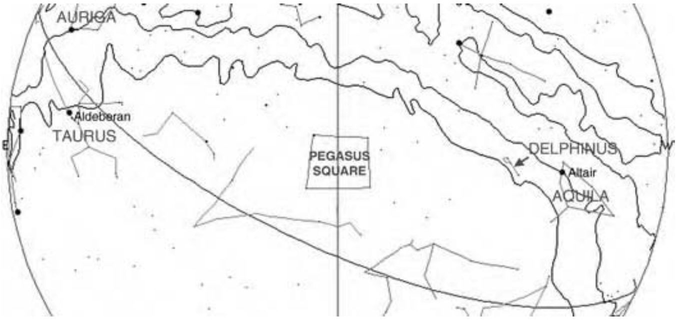


Figure 4.32. When the Pegasus Square reaches the meridian, marked by the vertical line, Taurus is in the east and Delphinus and Aquila are in the west.

between starting dates. A period of 1,092 days, which figures in the recycling of 26- and 52-day almanacs, commensurates 40 sidereal months, 39 zodiacal periods of the sun, 37 synodic months, and 3 Maya computing years of 364 days each, suggesting that lunar considerations played a role in the formulation of the computing year.

Without recourse to ethnohistoric and ethnographic sources, we might never have thought to give an astronomical interpretation to the relationship between Moon Woman and her burden, or to focus on bright stars such as Regulus and Aldebaran when comparing one of the moon's sidereal positions to another, or to stray far enough outside the dim areas of the Western zodiac to find the macaw in the Big Dipper and Pawahtun in the Square of Pegasus. The most important question to ask when choosing such sources is not whether they come from the same Maya era, place, or language as the text under interpretation, but whether they give evidence of astronomical concepts and practices that contrast with those of the West or run contrary to the commonsense notions of Western readers. If they meet this criterion, they are far more likely to provide insight into the meaning of ancient texts than a reading guided by Western structures and sensibilities.

NOTES

1. Aveni 2001: 341.

2. These pages are actually continuous; their numeration results from an early error in rejoining pages that had been separated.

3. On Dresden pages 16–23, we follow Thompson (1972: 47) in excluding Almanacs 37 (21a–22a), 38 (22a–23a), and 46 (23b) from the moon goddess category. Neither

her name nor her picture is present in 37 and 38. Both are present at the first station in 46 but absent thereafter, and the glyphs for *ukuch, yatan,* and *umut* or *umuuk* (one or another of which is consistently present in all the almanacs considered here) are absent throughout. We have also excluded Almanac 35 (pages 18a–19a), whose text has been obliterated almost entirely, and Almanac 52, where the *yatan* glyph is replaced by contrasting terms in four out of six texts, the name of the goddess is missing in three texts, and the names of her counterparts are missing altogether.

4. Our readings of these glyphs follow Schele and Grube (1997: 122–131) except in the case of Dresden 21b, where we read all the prefixes as *uh* rather than *hu* and the hand infix in the first caption as *uh* as well.

5. In a lunar almanac in the Madrid Codex (94b), the glyph corresponding to *yatan* reads *ah-tan,* which simply refers to the personage in question as "the one who is in front of" or "in the presence of" the goddess.

6. No one knows how to read the prefix of this augural glyph, but the main sign reads *nik,* "flower." Schele and Grube (1997: 84) read the suffix as *-il,* and indeed it closely resembles a sign that normally reads *li* or *il.* But we read it as a sign for *na* or *an* on the basis of its use as a suffix in the glyph for *yatan,* as written in this same text. In Yukatek, *nika'an* is "to flower" (Barrera Vásquez 1980).

7. One of the Yukatek terms for the full moon is *oxlahun kaan u,* "thirteen sky moon" (Barrera Vásquez 1980), which is to say that it has appeared in the sky for the thirteenth time since the thin crescent of the new moon first became visible in the west. In Western astronomy the age of a full moon is fifteen (more precisely 14.77) days, but that is because it is reckoned from the moment when the moon is in conjunction with the sun, which happens in the midst of two or three days when the moon is invisible, rather than from the day when it becomes visible. There are Classic Maya sites at which moon ages seem to have been reckoned from the day of the new moon's visibility, but there are others where the zero day may have been the dark of the moon or even the last day of the old moon's visibility (Lounsbury 1978: 774).

8. If we switch from the tabular to the syntactic reading method so that the 29-day interval separates the second and fifth stations, the names applied to the goddess contrast just as they do with the tabular method. Pictures cannot be compared in this case, since the second station has no picture.

9. Switching to a syntactic reading, so that the 30-day interval separates the third and fifth pictures, also keeps the name the same, but it results in an even greater contrast in clothing and ornaments.

10. In a syntactic reading, the 55-day interval separates the first station from the sixth station, but two quite different birds serve as Moon Woman's herald at these stations: an owl and a turkey. If these two birds represent two different sidereal locations, they constitute evidence against the syntactic reading method.

11. On a larger scale, the Classic Lowland Maya observed a series of four directional rituals spaced 819 days apart (Lounsbury 1978: 811), an interval that has been treated as purely numerological but in fact comes within less than a day of 30 sidereal

months (30 × 27.32 = 819.65 days). Since 13 is a factor in 819 (13 × 63 = 819) but 20 is not, the beginning date for this period had a constant number and a variable name, which is also the case with the moon goddess almanacs.

12. This is true whether or not a tabular or syntactic reading method is applied.

13. The maps that illustrate this essay were generated by using SkyGlobe software created by Mark A. Haney (1997), except that we have used Mayan glyphs to indicate the locations of the moon, sun, and Venus. All the individual stars labeled with their names are of at least second magnitude. The moon's positions to the north or south of the ecliptic reflect our particular choices of times, but for present purposes other sequences of positions would do just as well.

14. For reasons we have set forth in detail elsewhere (Tedlock and Tedlock 2004), our method for reading the sequence of sidereal signs in the Paris almanac involves consistently spacing them 168 days apart, the same method followed previously by Kelley (1976: 45–50), Schele and Grube (1997: 213–215), and B. Tedlock (1999: 46–54). Our references to the locations of Paris signs are based on our own calculations and the zodiacal map in Freidel and his coauthors (1993: 102–103).

15. We agree with Mary Miller (personal communication) that this cartouche refers to the Pleiades. The astronomical cartouches of Bonampak run from left to right (the normal reading order for hieroglyphs) and west to east in actual orientation (the direction of the sidereal motion of the sun and moon), with a cartouche that contains a sea turtle with a row of three stars across its back located to the right and east of the peccaries. The three stars have long been known to be those of Orion's belt, located a short distance east of the Pleiades. As D. Tedlock (1995) has pointed out, Linda Schele (in Freidel et al. 1993: 83–84) placed the peccary constellation in the opposite direction from Orion's belt, in Gemini, because she inadvertently read the cartouches of the Bonampak sky band in reverse order.

16. A syntactical reading of this almanac would separate Death and Itzamna by four days rather than twenty, and the moonrise in question would take place ahead of Virgo, in a region of the sky that has no known connection to Itzamna.

17. A syntactical reading of the interval between Pawahtun and First Jaguar reduces it from twenty-one days to five, moving the moon to a position very near the Pleiades. There is no independent evidence for a jaguar in that region; instead, as we have already seen, the animals connected to the Pleiades are the peccary and the rattlesnake.

18. When Almanacs 39 and 51 are read by the syntactic method rather than the tabular one, they put God Q in two widely divergent sidereal locations, one between Capricornus and Aquarius and the other in Virgo.

19. We follow Schele and Grube (1997: 99, 106, 146) in reading these names, except that they take no notice of the *mut* sign that is incorporated in most of them.

20. As usual, the syntactic reading method fails to produce an alignment between lunar almanacs and other sources. In Almanac 47 it separates the owl and macaw heralds by twenty-one days, putting the moon in Sagittarius for the owl. A syntactic reading of

the Madrid almanac puts sixteen days between its two owls, so that if the moon were in Sagittarius for the first owl, it would be in Gemini for the second, with neither owl corresponding to that of the Venus table. Alternatively, if the first Madrid owl were the one from the Venus table, with the moon in western Pisces, the second owl would find the moon in a position very similar to the one a tabular reading produced for the owl of Almanac 47 (see Figure 4.24). But the only way to argue that this apparent match between the two almanacs is meaningful is to suppose that the Madrid almanac was meant to read by the syntactic method, whereas the Dresden almanac was meant to be read by the tabular method.

21. In this case there is no difference between a tabular and a syntactic reading; either way, the macaw and the bat (or bat-like bird) are separated by thirteen days.

22. Because of this picture, Schele and Grube (1997: 122) go to some length to interpret the corresponding name as that of a bird. They read the prefix as *ya,* but instead of reading the main sign as a logograph for *sots',* "bat," as we do, they read it as a syllabic sign for *xu* (a value which has yet to be generally accepted) and then read the suffix written in its mouth as *na*. Normally this suffix reads *il* or *li,* but the *na* reading may be justified (see Note 6). They read the present glyph as a whole as *yaxun* and gloss it as a term for the cotinga, but neither the word *yaxun* nor any terms for the cotinga appears in the sources available to us. The cotinga has bright blue feathers and *yax* is the term for "blue," but the normal way to spell *yaxun* would be to combine the common logogram for the color *yax* with a syllabic sign for *un* (or *nu*).

23. The relationship between these two characters is known mainly from the Popol Vuh, where the twin heroes are named Junajpu, equivalent to Hun Ahaw, and Xb'alanq'e, "Little Jaguar Sun" (D. Tedlock 1996: 238–240).

24. A syntactic reading of this almanac lengthens the distance between the bat (or bat-like bird) and vulture from eight to thirteen days. This longer time span would mean relocating the vulture from Taurus to Leo, the home of Death, but his attributes do not include those of a vulture, and his auguries are different as well.

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CHAPTER FIVE

SUSAN MILBRATH

Astronomical Cycles in the Imagery of Codex Borgia 29–46

INTRODUCTION

The Codex Borgia, a Postclassic religious manuscript from Mexico (Anders et al. 1993), is replete with intriguing astronomical images. The role of astronomy in the Codex Borgia is the focus of a number of recent studies involving the interdisciplinary field of archaeoastronomy. This work, pioneered by Anthony F. Aveni, indicates that certain sections of the codex refer to actual astronomical events dating to the late Postclassic period (1300–1520).

Establishing the date and cultural context of the codex is an essential preface to any detailed study of the astronomical imagery. The evidence presented here indicates that the screenfold originated in the Puebla-Tlaxcala Valley in the central highlands during the Late Postclassic period. At that time, the central highlands of Mexico were dominated by the Aztec empire, which gradually expanded until it encircled the remaining independent polities in the Puebla-

Tlaxcala Valley. Cholula, a major pilgrimage center as far back as the Classic period, was the core of the southern Puebla polity. In Tlaxcala, an independent political enclave within the borders of the Aztec empire was formed by four major cities: Ocotelolco, Quiahuitzlan, Tepeticpac, and Tizatlán (Hassig 1988: 283n66). Borgia-style murals have been found at both Ocotelolco and Tizatlán (Sisson 1983; Noguera 1996: 33). Ocotelolco's murals date to 1400–1550, based on the span of dates for the site's short occupation (Contreras Martínez 1994). This information could delimit a range of dates for the Codex Borgia, but it represents only one line of evidence for dating the codex. For example, based on patterns of wear, Anne Cassidy (2004) suggested that the Codex Borgia was painted between 1450 and 1500 on a re-used manuscript.

Study of specific ceramic vessel forms represented in the Codex Borgia does not provide definitive evidence for dating. Some ceramics (most notably spiked incense burners) suggest an Early Postclassic date, whereas others, such as anthropomorphic incense burners, are clearly Late Postclassic (López de la Rosa and Rocha Segura 1997). The Codex Borgia shares many motifs with Cholula's Late Postclassic Catalina Polychrome ceramics (Coapan Laca), dating between 1350 and 1550 (Lind 1994; McCafferty 1996: 314, figure 16f–h; 2001: 54). Ceramic figurines representing Tlaloc "hand-stones," excavated at Cholula and known only from the Puebla-Tlaxcala Valley, are virtually identical to those depicted on Codex Borgia 27–28 (Uruñuela et al. 1997). Although no Borgia-style murals have been discovered to date at Cholula, there are large parts of this immense site that have not been excavated.

Discussing the related manuscripts of the Borgia Group, a set of five or six ritual manuscripts linked by both iconography and content (Glass 1975: 99–100), Elizabeth Boone (2000a: 71) suggests that the Codex Cospi was from Cholula and the Codex Borgia was from the Tehuacán Valley, a provenience originally suggested by Eduard Seler (1904: 370; 1963, 1: 103).[1] Seler pointed out similarities between deities represented in the Codex Borgia and the effigy censers (*xantiles*) from the Tehuacán Valley, and he noted that Venus imagery in the codex suggested a link with an important Venus cult in that valley.[2] Nonetheless, Venus imagery in the Codex Borgia also suggests a connection with Cholula, the focus of a Postclassic Venus cult linked to Quetzalcoatl (D. Carrasco 1982: 39; Nicholson 1994: 104, 114). Boone (2007) now favors the Puebla-Tlaxcala Valley as the origin point of the codex and suggests that Henry Nicholson (1994: 113–114) may be correct in assigning the Codex Borgia to Cholula.

Seler's (1904–1909) detailed German commentary on the Codex Borgia, which was translated into Spanish in 1963 (Seler 1963), provided a detailed analysis of the astronomical imagery in the Borgia Group. His extensive knowledge of the Borgia Group manuscripts allowed him to make many noteworthy contributions, and he was the first to identity the astronomical content of a number of almanacs in the Borgia Group. Seler (1904: 373–385) recognized that a section of the Codex Borgia (53–54) and parallel sections in two other Borgia Group manuscripts represent the heliacal rise of Venus over the course of 104 years. He proposed that other sections of the Codex Borgia also refer to Venus phases, such as the almanac on Borgia 15–17, which shows day signs spaced at four-day intervals appropriate for calculating dates in the 584-day Venus cycle (Seler 1904: 367–370). His most ambitious analysis focused on Venus imagery in a unique section of the Codex Borgia (29–46). Seler's work has been widely cited, but he has been criticized for employing an overly rigid framework and ignoring important variations in patterning. His astronomical interpretations are considered especially speculative, although scholars continue to cite his identifications of individual deities and interpretations of specific sections of the codex, including the Venus almanac on pages 53–54.

In the 1980s and early 1990s, scholarly research on the Codex Borgia seemed to move in a different direction. Astronomy was not reported as a topic of interest in studies of the Borgia Group conducted by members of the 1982 summer seminar at Dumbarton Oaks, who focused their attention on provenience, stylistic analysis, and iconography derived from ethnographic analogy (Sisson 1983). Nonetheless, ethnographic analogy provides abundant evidence of the important role of astronomy in Mesoamerican calendar rituals, the type of rituals clearly represented in the Borgia Group codices. It is clear that ancient astronomical concepts linked to the agricultural cycle and seasonal festivals survive even today in Mesoamerica (Coe 1975; Milbrath 1980: 290–291, 295; 1999; Aveni 1980: 40–45; 2001: 40–44; Broda 1991; Tedlock 1992).

In a review of Nowotny's (1976) Codex Borgia commentary, Maarten Jansen (1978: 115) dismissed the "astral theories of Seler and his followers" as "obsolete theoretical models," noting that Nowotny has "replaced the astral misinterpretations with an exact and scientific outline." Jansen's review largely predates the rapid developments in the field of Mesoamerican archaeoastronomy. A more detailed interpretation of the astronomical content of the Codex Borgia is now possible because computer-generated data allow us to define real-time astronomical events in the codices. With the work of Aveni and like-minded colleagues, we can now move beyond the descriptive "outline" approach to a new understanding of the astronomical content in the Codex Borgia, by far the richest sources of astronomical imagery in Precolumbian central Mexico.

"Real-time" astronomical events are paramount in the most recent interpretations of the Codex Borgia. Studies of pages 25–28, 49b–52b, 53c, and 53–54 suggest that the codex predicts or records actual Venus events (Aveni 1999; Bricker 2001; Hernández 2004, 2006). Victoria Bricker (2001: S30–S33) concluded that the Venus almanac on pages 53–54 begins with the year 1473, whereas page 25 may refer to the heliacal rise of Venus between 1382 and 1484, almost a century earlier. Venus events are also important on pages 27–28. Each of the five panels on page 27 represents a different image of Tlaloc holding a serpent and a hand-stone. A sequence of year dates appears below four of the Tlaloc figures. Each date is formed by a day from the 260-day calendar paired with one of the 52 year-bearer signs as follows: 1 Crocodile in the year 1 Reed, 1 Death in the year 1 Flint, 1 Monkey in the year 1 House, and 1 Vulture in the year 1 Rabbit. Seler (1963, 1: 257–261) was the first to recognize page 27 as a set of Calendar Round dates marking the quarters of the 52-year cycle, although he did not attempt to place these dates in the context of the Postclassic period. Aveni's (1999: S10; 2001: 71) research suggested that page 27 represents a complete a 52-year period that began on 1 Crocodile in the year 1 Reed, correlating with March 26, 1467 (April 4, 1467, Gregorian), the date of the last visibility of the Evening Star (ELAST).[3] The 52-year period ended on the next occurrence of 1 Crocodile 1 Reed in the year 1519 when Venus rose as the Morning Star (MFIRST). Christine Hernández (2004) contended that the almanac on Borgia 49b–52b, 53c has a fourfold calendrical structure, similar to that of Borgia 27, that refers to dates in a 52-year cycle spanning AD 1457 to 1509. Both she and Bricker (Hernández and Bricker 2004: 299; Hernández 2004: 346–347) also identified an iconographic reference to a Venus ELAST event that coincides with a Calendar Round date on Borgia 51b, 4 Crocodile 4 Reed. This corresponds to the Gregorian date March 31, 1483. The ELAST date associated with Borgia 51b occurs sixteen years (or two Venus cycles) after the ELAST event predicted for 1 Crocodile 1 Reed on Borgia 27, according to Hernández. By using the term "predicted," she suggested the events had not yet occurred. Aveni, on the other hand, clearly refers to observed events that were recorded in the codex.

Page 28 also has a similar appearance, with five different figures of Tlaloc positioned above bands with associated dates. According to Seler's (1963, 1: 263–265) analysis, page 28 represents an almanac recording five solar years and three synodic Venus cycles, counted from 4 Movement in the year 1 Reed, a date only partially preserved on the lower right, to 1 Water in the year 5 Reed, the first of two dates in the center of the page. On the other hand, Aveni (1999: S7–S13; 2001: 71) reconstructed the opening date as 5 Movement in the year

1 Reed, noting that this date marks EFIRST on February 5, 1468 (Julian calendar) (Aveni 1999: S10, fig. 7). He concluded that astronomer-priests produced an almanac on page 28 to record celestial observations that began with the first appearance of the Evening Star. He also pointed out that other dates on page 28 allude to significant astronomical events. The date 10 Rain in the year 2 Flint marks an alignment of Venus, Mars, and Jupiter in Gemini on June 6, 1468, and the date 9 Water 4 Rabbit correlates with the day the Morning Star disappeared. Aveni (1999: tables 3, 4) noted that the last two recorded dates (in the center of the page) are also linked with Venus events. The date 1 Water in the year 5 Reed correlates approximately with the first appearance of the Evening Star, followed by the conjunction of Venus and Jupiter on 13 Deer in the year 5 Reed (August 19, 1471). Hernández (2004, 2006) interpreted page 28 as primarily an agricultural almanac that runs from 1467 through 1471 and begins with the first occurrence of 5 Movement in year 1 Reed that corresponds to May 30, 1467 (Gregorian).

PREVIOUS INTERPRETATIONS OF BORGIA 29–46

Pages 27–28 seem to form a sort of preface to the narrative section (29–46) that follows (see Figures 5.1–5.7). Astronomy also seems to play an important role in this unique section of the codex, originally recognized by Seler as a celestial narrative involving the transformation of Venus as it passes through the underworld. Seler (1963, 2: 9–61) concluded that pages 29–46 represent all four phases of the 584-day Venus cycle, beginning with the disappearance of Venus as the Morning Star and ending with its reemergence as the Morning Star. Nicholson (1966: 130–132) notes that Seler's explanation of these pages cannot be regarded as satisfactory because his interpretations are often speculative and forced. Seler developed his interpretations in sixty-one densely worded pages, forcing an iconographic interpretation based on the four cardinal directions and overlooking data that did not support his theories. In fact, the day signs most common in the pages are not related to the day signs typical of a Venus calendar, which are spaced at intervals of four days. Instead the dates are spaced at intervals of five days, a format useful in calculating dates in the solar year of 365 days, which has a remainder of five days when integrated with the twenty repeating day signs of the *tonalpohualli* (Nowotny 1961: 246–247; 1976: 26–27).

In *Tlacuilolli*, Karl Nowotny (1961) wrote an extensive analysis of Codex Borgia imagery and subsequently published a condensed commentary on the entire codex in a 1976 facsimile. Nowotny added many interpretive insights but largely ignored Seler's astronomical interpretations, except for the most obvious representation of Venus imagery on Borgia 53–54. Nowotny (1961: 248; 1976) interpreted pages 29–46 as representations of rituals like those described in post-Conquest Mexican sources, identifying most images as seasonal festivals or rituals. He recognized a fire ceremony on page 46 as a possible representation of the New Fire ceremony closing the 52-year cycle (Nowotny 1976: 30). Even though the New Fire ceremony was timed by the midnight zenith of the Pleiades (Sahagún 1950–1982, 4: 143; Milbrath 1980; Broda 1982; Krupp 1982), he did not mention any relationship to astronomical events. He identified page 45 (Figure 5.6) as representation of the cult of the Morning Star but avoided any discussion of specific Venus events (Nowotny 1961: 250, 253; 1976: 45).

The most prominent deity in the narrative sequence of eighteen pages is Quetzalcoatl, a god generally linked with Venus (Aveni 2001: 26, 145). The Codex Vaticanus A (9v) says that Quetzalcoatl was transformed into Venus as the Morning Star (Anders et al. 1993: 241n22). The *Anales de Cuauhtitlan* recounts that after Quetzalcoatl fled, he died and spent eight days in the underworld before being transformed into the Morning Star, called Tlahuizcalpantecuhtli, "Lord of the Dawn" (Nicholson 1971: 429; Bierhorst 1992: 32–36). The Quetzalcoatl myth describes the transformation of Venus during the period of inferior conjunction, when the planet spends an average of eight days invisible in conjunction with the sun before reappearing as the Morning Star (Seler 1963, 2: 19; Aveni 2001: 186).

My 1989 study concluded that Seler had many insights in identifying imagery related to different Venus phases, but the actual alignment of phases he suggested is incorrect (Milbrath 1989: figure 1).[4] My research suggested that pages 29–46 depict Venus events in the context of a single year and the eighteen *veintenas* (twenty-day "months") determine the structure of the sequence (Milbrath 1989). These festivals were recorded at the time of the Conquest in a number of Aztec sources from central Mexico, and a parallel sequence with similar Nahuatl names appears in the *Relaciones Geográficas de Tlaxcala* (Caso 1967: table 11). Nonetheless, because we lack festival calendars dating to the pre-Conquest period, we have no clear documentation of visual representations of the festivals, apart from images of isolated festivals such as the Xipe impersonator sacrifice in Tlacaxipehualiztli (Codex Nuttall 1974: 84). My contention that the festival cycle is incorporated in the visual imagery of pages 29–46 has found support in the work of Ellen Baird (1993: 116, 160). She noted that one of the earliest known visual representations of the festival calendar, Sahagún's *Primeros Memoriales,* dating to around 1559–1560 (Sahagún 1993;

Jiménez Moreno 1974), has a number of structural parallels with pages 29–46 of the Codex Borgia. Citing my 1989 study, she concluded: "A comparable pictorial combination of sequentially narrative and static scenes is found in the pre-Conquest Codex Borgia Venus sequence (pages 29–46), which also shares other formal characteristics with the *Primeros Memoriales* veintena sequence" (Baird 1993: 160). The sequence of pages 29–46 is not only unique in its narrative quality but also has a different orientation from the rest of the manuscript, being aligned vertically like *Primeros Memoriales*. This unique section on pages 29–46 is to be read top to bottom, an arrangement that Baird (1993: 116) noted is parallel to the sequence of events represented for individual festivals in *Primeros Memoriales.*

The Borgia commentaries written in the 1990s generally avoid discussion of studies that employ astronomical interpretations and shy away from the topic of astronomy, except for some general references to Venus (Anders et al. 1993; Byland 1993; Pohl 1997). This aversion can be explained, in part, by the specialized knowledge required in any discussion of archaeoastronomy and a reaction against the dominance of Seler's work. Bruce Byland (1993: xxiii–xxvi) incorporated some aspects of Seler's analysis, but he did not recognize images of the Venus cycle in his interpretation of pages 29–46, which he identified as a sequence of ceremonial events involving priests interacting with deities and the supernatural journey of a personage called "Stripe-Eye." John Pohl's (1997: 55) brief commentary on the Codex Borgia seems to suggest that the Codex Borgia sequence represents a narrative of supernatural passage between different geographical locations, like that seen in the Mixtec codices. Although he linked the codex to the Puebla-Tlaxcala area, he also implied a relationship with Mixtec manuscripts that chronicle the life of Eight Deer and other dynastic figures. Apart from Tonatiuh, the Sun God, Pohl ignored the astronomical deities. The star-covered deity forming the border on many pages, interpreted as a sky goddess by Nowotny (1976), is described as the earth goddess by Pohl. Although he discussed a link between Quetzalcoatl and Venus in the imagery on pages 53–54, he does not explore this connection in relation to the narrative sequence on 29–46.

Ferdinand Anders, Maarten Jansen, and Luis Reyes García (1993: 48, 175–245) interpret the principal images in Codex Borgia 29–46 as priests dressed as deities who perform rituals and reenact mythological events recorded in Aztec and Tlaxcalan chronicles, including a core myth of the sun's birth in a cosmic fire. They identified a series of eight rituals performed in different temples. One ritual is displayed in an expanded fashion over six pages while others extend over a few pages. Still others are confined to a single page. Rite 1 on pages 29–32 is dedicated to the temple of Cihuacoatl. Rite 2 on pages 33–38 represents the temples of the sky and the sacred bundles. Rite 3 on pages 39–40 is the sacrifice of the new sun. Rite 4 on pages 41–42 is a sacrifice dedicated to Iztlacoliuhqui. Rite 5 on page 43 is dedicated to corn. Rite 6 on page 44 is a dynastic ceremony. Rite 7 on page 45 is dedicated to the altar of Venus. Rite 8 is the New Fire ceremony. Anders and his coauthors identify pages 46–49 as an extension of the narrative sequence (Rite 9), dedicated to the Tonalque and Cihuateteo. These pages do not seem to be part of the same sequence, but they are connected in some way, possibly encoding calendar periods referring to the end of the Evening Star (Milbrath 1989: 115).

Anders et al. (1993: 238–239) seem to be generally in accord with Seler's interpretations, but they also incorporate research by other scholars. Following Seler, they interpreted page 29 (Figure 5.1) as the death and subsequent invisibility of Venus, and the scene on page 30 is also interpreted as an image of Venus, although they do not clarify whether the planet was visible or invisible (Anders et al. 1993: 192–196). Whereas Seler (1963, 2: 14) interpreted the central image on page 30 as a jade stone representing the heart of Quetzalcoatl, framed in the plumed ornament of Quetzalcoatl, Anders and his coauthors identified this image as a brilliant circle of feathers symbolizing both Quetzalcoatl's headdress and Venus as a rayed orb, in accord with my research (Milbrath 1989). They also seem to agree with my identification of the border goddess as an image of the Milky Way (Anders et al. 1993: 206). They generally follow Nowotny in their interpretations of temple rituals, such as linking page 44 (Figure 5.5) to the nose-piercing ritual in the Historia Tolteca-Chichimeca and identifying page 46 (Figure 5.7) as an image of the Aztec New Fire ceremony. Pohl (1997) questioned their interpretations, noting that the rituals they described were taken out of context from different culture areas.

Most recently, Boone (2007), although seeming to support the general sequence established by Anders and his coauthors in their discussion of the eight rituals on pages 29–46, has identified the sequence as events from creation mythology rather than as rituals within the festival cycle. The key cosmological events identified by Boone are the birth of the sun, the birth of maize, and the birth of humankind. Episode 1 on pages 29–32, equivalent to Rite 1 in Anders et al. 1993, relates to a sequence of events that Boone has identified as follows: Beginnings, Birth of the Day Count, Other Essences, and the Birth of the Tezcatlipocas and Quetzalcoatl (page 32). Episode 2 on pages 33–38 includes Temples of Heaven and the Birth of the Sun, and the Ritual Bundle and Birth

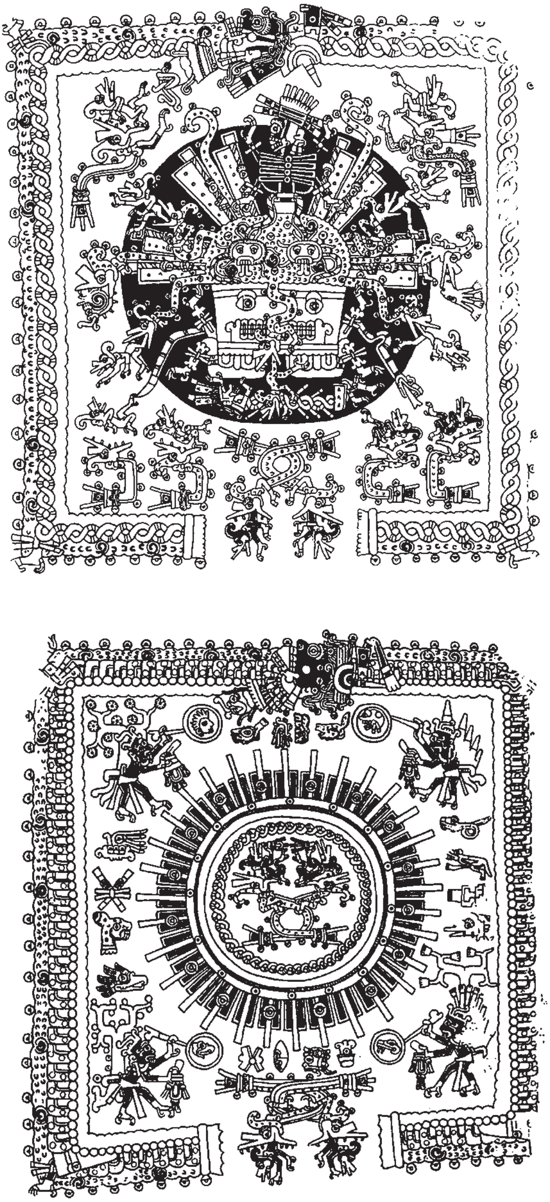

Figure 5.1. Codex Borgia pages 29–30. Ehecatl-Quetzalcoatl's heart is burned, symbolizing the transformation of Venus taking place during inferior conjunction in the month of the winter solstice, corresponding to the sixteenth veintena, Atemoztli. During the seventeenth veintena, Venus reemerges as the Morning Star, seen below on page 30 as a resplendent rayed disk. (Modified after Anders et al. 1993.)

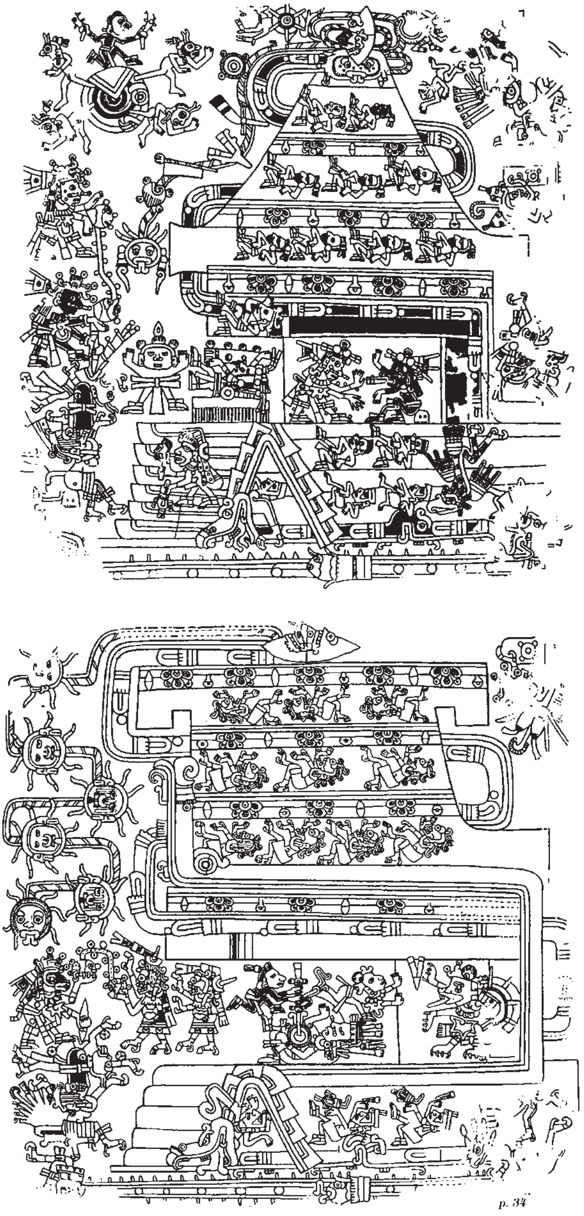

Figure 5.2. Codex Borgia pages 33–34. Xipe Totec is sacrificed in front of the temple during the month of the spring equinox, corresponding to the second veintena, Tlacaxipehualiztli. Venus appears in dual aspects as the Morning Star enthroned on high in a pyramid temple. Xolotl, hidden behind the temple, may represent Mercury. Page 34 (below) shows the third veintena with Xolotl wearing sun disk as a sign of Mercury's conjunction. (Modified after Anders et al. 1993.)

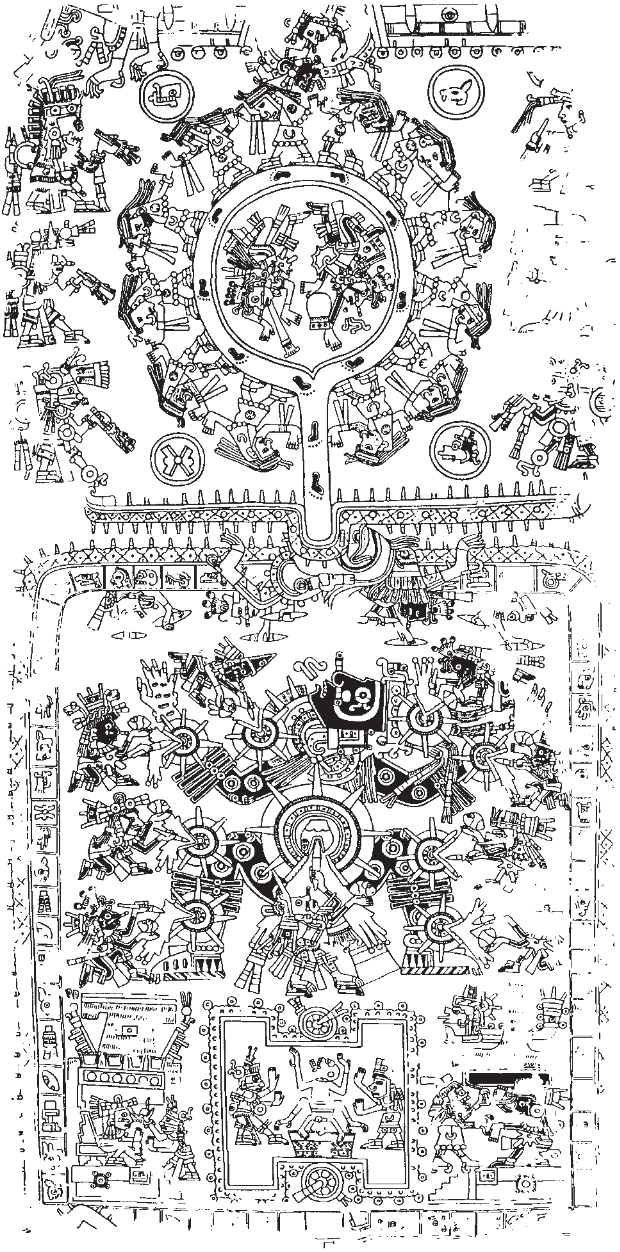

Figure 5.3. Codex Borgia 39–40. Quetzalcoatl as "Stripe-Eye" descends with a red Quetzalcoatl during the eighth veintena, entering the earth monster during the ninth veintena. At this point, the solar god is attacked by multiple guises of Quetzalcoatl, representing Venus as the agent of solar eclipse. (Modified after Anders et al. 1993.)

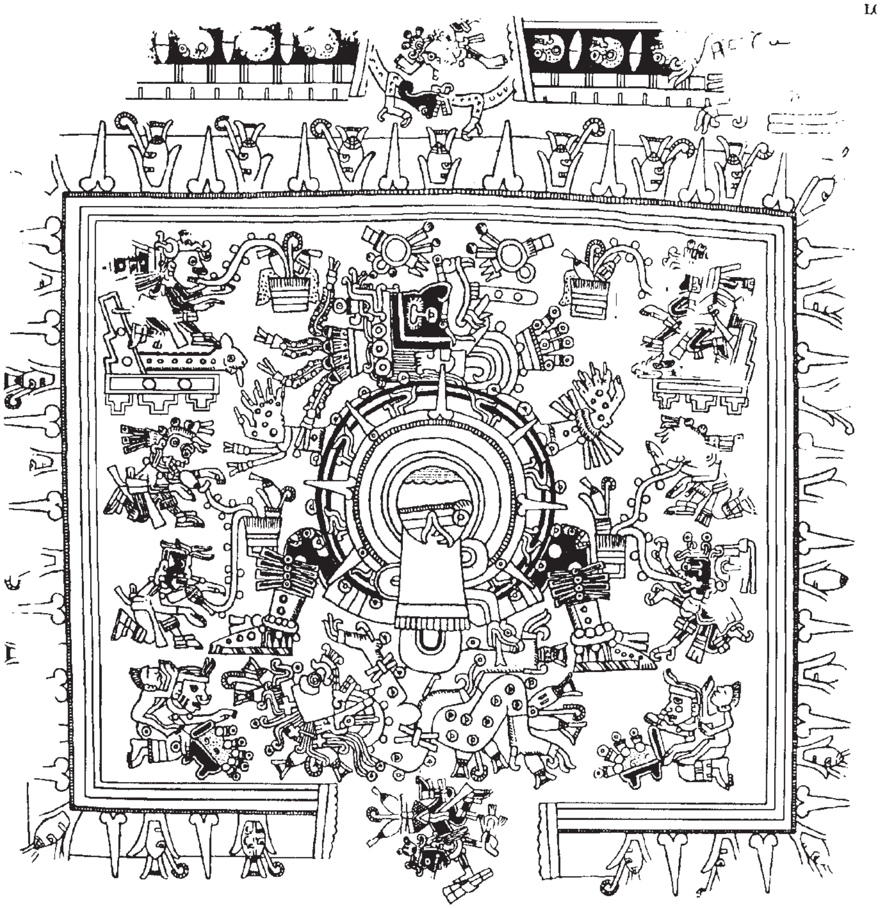

Figure 5.4. Codex Borgia 43. A rectangle of ripe maize refers to the twelfth veintena, Pachtontli, when the maize harvest began in October. During this month in 1496, both Venus and Mercury were in superior conjunction, invisible in the solar glare. This conjunction event seems to be represented by Xolotl covered by a solar disk. (Modified after Anders et al. 1993.)

of Humans. Episode 3 on pages 39–40 represents the Heart Sacrifice of the Sun. Episode 4 on pages 41–42 represents Human Sacrifice, tracing the transformation of the deceased victim to an image of resurrection. Episode 5, the Acquisition of Maize on page 43, is a single-page episode. The remaining pages (44–46) are all attributed to different episodes, as in Anders et al. 1993. Boone has followed their lead in interpreting page 46 as a New Fire ceremony (Figure 5.7). She differs from Anders and his coauthors, however, in identifying page 44 as a ritual dedicated to Xochiquetzal (Figure 5.5), in accord with my research

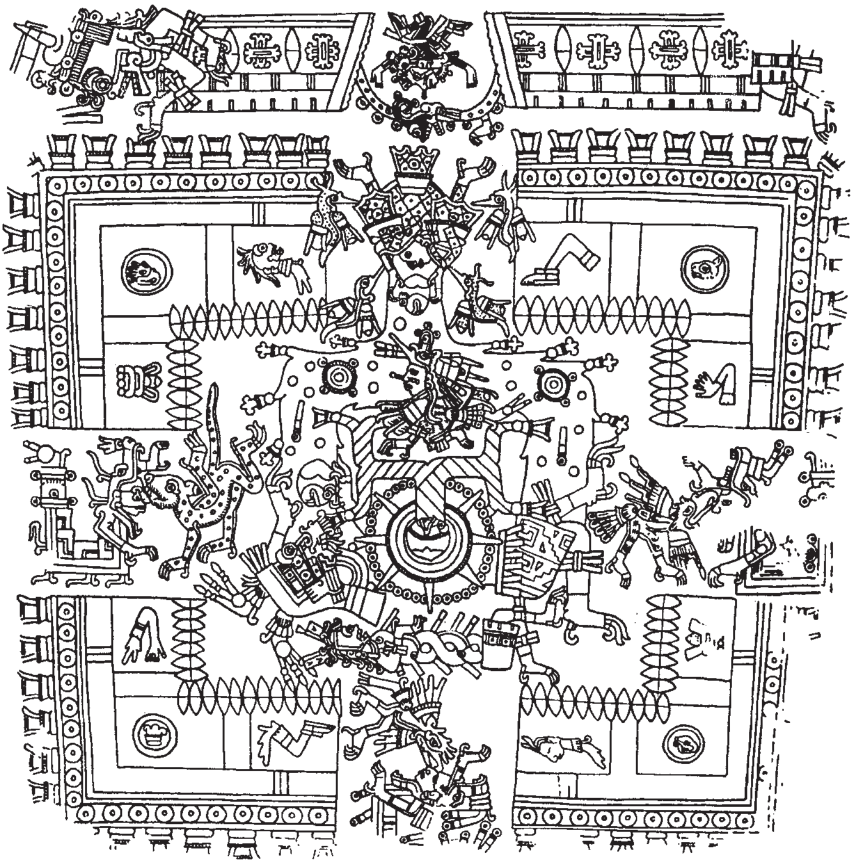

Figure 5.5. Codex Borgia 44. The thirteenth festival, Hueypachtli honoring Xochiquetzal and the Tlaloque seems to be represented in the combined image of Xochiquetzal and Tlaloc in the center of the page. The imagery also alludes to the Atamalcualiztli ceremony, honoring Xochiquetzal and the tree of Tamoanchan, celebrated every eight years in Hueypachtli. The cloud serpent, Mixcoatl, represented alongside the tree, may allude to a festival in the next month Quecholli. (Modified after Anders et al. 1993.)

(Milbrath 2000: 44). She agrees with Anders and his coauthors that page 45 is dedicated to Venus as the Morning Star (Tlahuizcalpantecuhtli), but she has not explored connections between Quetzalcoatl and Venus (Figure 5.6). Because I link Quetzalcoatl to Venus imagery and the narrative sequence to Venus events in the context of the annual festival calendar, I disagree with many aspects of Boone's interpretation. Nonetheless, it is possible that the mythology of creation she explores is embedded in rituals of the festival calendar represented

Figure 5.6. Codex Borgia 45. This page corresponds to the period of the fourteenth festival, Quecholli, but the imagery focuses on the transformation of Venus. In 1496, this month was the last twenty days of the superior conjunction phase, and Venus was soon to reappear as the Morning Star. (Modified after Anders et al. 1993.)

in the Codex Borgia. A similar pattern is seen in Old World rituals, where cosmic myths are dramatized in an annual cycle of rituals, as documented in Theodor H. Gaster's *Thespis* (Gaster 1961).

ANNUAL FESTIVALS IN CODEX BORGIA 29–46

In my 1989 publication, I proposed that the eighteen-page Borgia sequence depicts Venus observations in relation to the annual festivals of the central Mexican festival calendar, with each page representing a twenty-day veintena

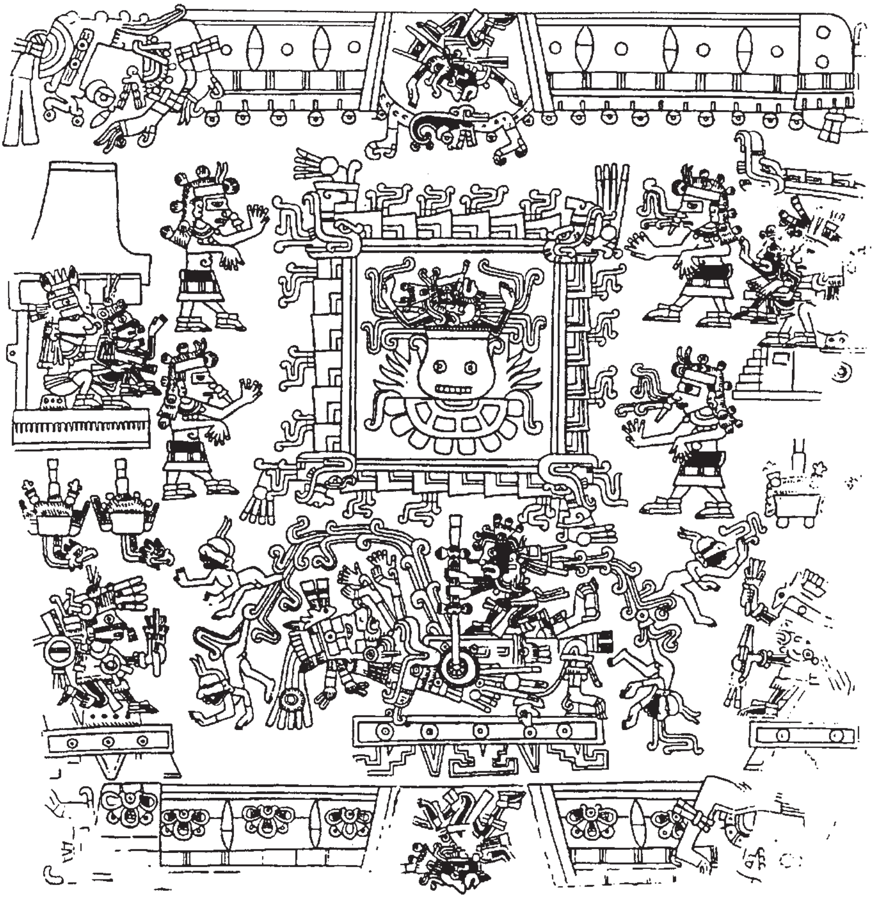

Figure 5.7. Codex Borgia 46. Venus rising from the solar fire, representing the newly emerged Evening Star during Panquetzaliztli, the fifteenth veintena, here marking the end of the astronomical sequence. The imagery focuses on both the fire festival celebrated in Panquetzaliztli and the transformation of Venus in the solar fire as it reemerges as the Evening Star. (Modified after Anders et al. 1993.)

of the 365-day calendar (18 × 20 + 5 *nemontemi* days). This sequence of festivals is drawn from central Mexican sources synthesized by Nicholson (1971: table 4). The same sequence of Nahuatl festivals was recorded in a number of cities throughout the Aztec domain, as well as those in the independent province of Tlaxcala and in Oaxaca at Teotitlán del Camino, just south of the Tehuacán Valley (Caso 1967: table 11).[5]

Variations in dates are evident in different versions of the Aztec and Tlaxcalan festival calendars.[6] These variations may reflect the fact that the calendars were adjusted periodically to realign with the seasons, and priests in different cities probably determined when to make such adjustments. The months of the 365-day festival calendar moved ahead of the solar year (365.25 days) at a rate of one day every four years (13 days every 52 years). Many scholars believe that there was a correction to the festival calendar, either through some sort of regular intercalation or a periodic adjustment of the festival calendar (Umberger 1981; Broda 1982: 93; Aveni et al. 1988: 289–290). Sahagún (1950–1982, 4: 144) suggests that an adjustment was made by adding one day every four years (like the European leap year), most probably during the ear-piercing ceremony of Pillauanaliztli, held in honor of the fire god. Another alternative is that the festival calendar was adjusted by adding a thirteen-day period during the New Fire ceremony at the end of each 52-year cycle (Milbrath 1980).[7]

The 260-day cycle of the tonalpohualli involved no intercalation and continued uninterrupted, providing a fixed framework in the year count. Each year was named for the tonalpohualli day that fell on the 360th day of the year, before the five-day nemontemi period (Caso 1971). The 360th day also corresponded to the last day of the eighteenth month, if no adjustments were made in that year. Nonetheless, the festival calendar could easily be shifted in the 365-day year because of the way the Aztecs recorded dates. Whereas the Maya wrote shorthand Calendar Round dates that linked a numbered day sign with a numbered festival or veintena, forming dates that repeated every 52 years, there are no recorded central Mexican dates using veintena glyphs to form dates in pre-Conquest times. The fact that the festivals are not part of the recorded Aztec calendar dates means that the festivals could be adjusted without affecting the 52-year cycle of the calendar dates (Milbrath 1999: 6).

Like the Aztecs, the Codex Borgia scribes recorded the year with year bearers, one of four days in the 260-day calendar that could end the year. These year bearers were paired with a numbered day sign from the sequence of 260 days in the calendar. It is important to clarify that these dates follow the central Mexican system, rather than the Mixtec pattern. The year 1507, the last time the New Fire ceremony was celebrated, was a 2 Reed in the central Mexican system, whereas the same European date corresponded to 1 Reed is the Mixtec system (Caso 1967).

The images of the gods and ceremonies in the Codex Borgia provide a framework for aligning the eighteen-page sequence with the central Mexican festival calendar (Milbrath 1989). Ten of the eighteen pages have a central design that helps to define the main focus of the page. Many of these central designs are clearly astronomical images, but five pages represent deity images that can be linked with the sequence of festivals in the central Mexican festival calendar (pages 33, 37, 40, 44, 46). This helps to lock in the alignment of festivals, because each page represents a twenty-day period corresponding to specific festivals in the sequence.

The sequence I proposed in 1989 begins on page 29 (Figure 5.1, top) with the sixteenth festival veintena, around the winter solstice, and ends on page 46 (Figure 5.7) with the fifteenth veintena in November, coinciding with the beginning of the dry season and solar nadir passage. Even though the Aztecs and Tlaxcalans began their festival calendar in February or March, their astronomical year probably began on an important solar date. The winter solstice, marking the turning point of the sun's journey to the south, is a noteworthy event that could have marked the beginning of the astronomical year. As will be seen, Venus events may also have helped determine that the calendar began around the winter solstice in the Codex Borgia sequence.

Another significant solar event in the Borgia calendar is a festival to Xipe on page 33, linked with the month of Tlacaxipehualiztli, the month of the spring equinox (Figure 5.2, top; Milbrath 1989). Tlacaxipehualiztli is widely recognized as a spring equinox festival (Aveni 1980: 245–248; 2001: 236–238; Aguilera 1989; Milbrath 1989). This link with the March (21 or 22) equinox is confirmed by festival dates compiled by Nicholson (1971), Caso (1971), and P. Carrasco (1979). Dates for Tlacaxipehualiztli in *Primeros Memoriales* (February 26–March 17, Julian; March 8–27, Gregorian), although earlier, also correlate with the spring equinox.

Nowotny (1961: 249) described the central deity in front of the temple on page 33 (Figure 5.2) as a Xipe figure covered with a cloth on a round stone, but he did not recognize links to the annual festival honoring Xipe Totec. In the colonial period codices, Xipe Totec appears exclusively in representations of the Tlacaxipehualiztli festival. Descriptions and visual images indicate that victims representing Xipe Totec were tied to a round stone and sacrificed while engaged in a ritual of gladiatorial combat (Sahagún 1950–1982, 2: 50–53; Codex Magliabechiano 1970: 30r; Codex Borbonicus 1974: 24). The Codex Nuttall (1974: 83–84) represents an image of this event and bears a Nahuatl gloss that refers to Tlacaxipehualiztli. Codex Borgia 33 represents another image of the Tlacaxipehualiztli ceremony, depicting the ceremony after the sacrifice with Xipe lying dead on a round stone (Milbrath 1989). A prominent image of the sun disk and lunar crescent on page 33 may refer to celestial observations on the spring equinox. This imagery suggests a relationship with Motolinía's account of the Aztec Tlacaxipehualiztli festival that took place when the "sun stood in the middle of [the Temple of] Huitzilopochtli, which was the equinox" (Aveni 1980: 245–248; 2001: 236–238; Aveni et al. 1988). As Aveni notes, the Aztecs oriented the twin temples on their main pyramid so that the sun disk would rise between the temples on the spring equinox during the Tlacaxipehualiztli festival. The sun disk above the peaked temple roof on Borgia 33 could indicate the sun was observed rising behind the temple on the spring equinox. Venus imagery, also prominent on this page, will be discussed presently in the context of the Venus cycle.

The image of the rain god Tlaloc four pages (120 days) later on page 37 relates to the festival in the sixth veintena, that of Etzalcualiztli, which honored the rain god Tlaloc as the principal deity when the rains were abundant around the summer solstice. Most Aztec pictorials represent the sixth festival with an image of the rain god Tlaloc. On Borgia 37, Tlaloc is positioned in the center of the page, providing a focus point in the composition. Borgia 37 also depicts Xolotl and Quetzalcoatl, two of the secondary gods mentioned in Nicholson's (1971: table 4) synthesis of the Etzalcualiztli ceremonies. Their role in the imagery will be discussed below.

On page 40 (Figure 5.3, lower half), three pages (sixty days) later, Quetzalcoatl wearing a hummingbird disguise evokes a link with the Aztec god Huitzilopochtli, honored in the ninth festival. Huitzilopochtli and Tezcatlipoca are listed as the principal deities honored in the ninth veintena (Miccailhuitontli), according to Nicholson's (1971: table 4) synthesis. Huitzilopochtli, the totemic god of the Mexica (imperial Aztec), would not be represented in a codex from the Puebla-Tlaxcala Valley, which remained independent of the Aztec empire. Quetzalcoatl in a hummingbird guise may usurp Huitzilopochtli's role as a hummingbird god in the ninth festival. Some festival calendars from central Mexico feature Tezcatlipoca as the principal deity in this veintena (Codex Magliabechiano 1970: 36v–37r). Borgia 40 depicts Tezcatlipoca on the ball court below Quetzalcoatl, suggesting another link to the ninth veintena. Although there are allusions to the principal gods of the ninth veintena, with the hummingbird god in the center of the page and Tezcatlipoca just below, page 40 is an especially complex astronomical image that will be the focus of discussion in the next section.

Boone (2007) identifies page 43 as an episode depicting the birth of maize, noting that the border of this page emphasizes ripe maize (Figure 5.4). My 1989 analysis indicates that page 43 refers to the twelfth month, Pachtontli, when maize was maturing in October (see Table 5.2). The central image on page 43, discussed below, represents an astronomical image related to planetary conjunction. Although the imagery on 29–46 alludes to the festival calendar and seasonal events at various intervals in the sequence, the main focus of the imagery is specific astronomical events that occurred in the context of the annual cycle.

In the center of page 44 (twenty days later), we see a deity combining attributes of Tlaloc and Xochiquetzal, the principal deities honored in the thirteenth veintena, Hueypachtli (Figure 5.5; Nicholson 1971: table 4; Milbrath 1989: 107–108). Codex Borbonicus (1974: 32) represents this festival with an image of Tlaloc in a temple, whereas Codex Magliabechiano 41r portrays the goddess Xochiquetzal. Codex Telleriano-Remensis shows Tlaloc on a hill, but the gloss mentions Xochiquetzal (Quiñones Keber 1995: 146). Codex Borgia 44 depicts Xochiquetzal, wearing her characteristic mouth mask (Seler 1963: 54), but she also has fangs and star eyes like Tlaloc, suggesting a combined image that links worship of both deities in Hueypachtli.[8] My research also indicates a correlation between the imagery on Borgia 44 and the Atamalcualiztli ceremony, celebrated every eight years in Hueypachtli (Sahagún 1950–1982, 4: 144; Milbrath 2000: 44). The song of Atamalcualiztli recorded by Sahagún (1950–1982, 2: 238) refers to the flowering tree in Tamoanchan, which seems to be represented in the center of page 44 by a tree in flower. It is notable that the timing of the Atamalcualiztli ceremony incorporates the eight-year period of the Venus almanac (Milbrath 1999: 158; 2000: 44).

As noted earlier, a number of commentators link page 46 to the New Fire ceremony, called Toxiuhmolpilia ("tying of years"), performed every fifty-two years (Figure 5.7). During the New Fire ceremony a priest drilled a fire on the chest of a sacrificial victim at the close of the 52-year calendar cycle when the Pleiades reached zenith at midnight (Sahagún 1950–1982, 4: 143; 7: 25–32). The chroniclers Mendieta (1971: 101) and Motolinía (1967: 42, 57–58) both note that the New Fire ceremony took place in Panquetzaliztli, the fifteenth month of the year (Broda 1980: 278). This placement is also confirmed by the New Fire ceremony in the month of Panquetzaliztli represented on Codex Borbonicus 34 (Nicholson 1971: figure 48). The central focus on Borbonicus 34 is a rectangular structure enclosing a hearth fire, evoking the fire-serpent enclosure on Borgia 46. In my 1989 study, I followed the lead of Nowotny, linking page 46 to the New Fire ceremony. An equally plausible alternative is that the image refers to the annual festival of Panquetzaliztli when fire serpents were immolated (Sahagún 1950–1982, 2: 147).

In the center of Borgia 46, burning fire serpents form an enclosure that houses a hearth-fire with an olla containing Quetzalcoatl (Figure 5.7). In the scene below, Quetzalcoatl drills a fire on the back of a fire serpent enclosing the body of Xiuhtecuhtli, an important deity in the Panquetzaliztli festival. Page 46 also depicts Tezcatlipoca in two temples flanking the central scene. Borgia 46 clearly represents images of Tezcatlipoca, Xiuhtecuhtli, and the fire serpent, providing a good correspondence to the fifteenth veintena, Panquetzaliztli. Nicholson (1971: table 4) identifies Huitzilopochtli and Tezcatlipoca as the principal gods in this veintena. The corresponding image in Codex Borbonicus 34 depicts Huitzilopochtli holding the fire serpent. *Primeros Memoriale*s (Sahagún 1993: 252v) also shows Huitzilopochtli holding the fire serpent, a reference to the fire serpent as a symbol of Panquetzaliztli. Imperial Aztec (Mexica) myths tell how Huitzilopochtli used the fire serpent to slay Coyolxauhqui (the moon goddess; Milbrath 1997). Outside the Mexica capital of Tenochtitlan, other gods were dominant, as in Chalco, where Tezcatlipoca was the principal god in this festival (Quiñones Keber 1995: 148). In the Codex Telleriano-Remensis 6v, the deity representing Panquetzaliztli is a combined image of Tezcatlipoca and Huitzilopochtli, but the commentary also mentions the importance of Xiuhtecuhtli in this festival (ibid.: 148). Identifying page 46 as an image of the Panquetzaliztli festival indicates another link to the festival calendar spaced at the correct interval. The fire serpents and Quetzalcoatl share the center stage because this page apparently refers to both the monthly festivals and an important event involving Venus (discussed later).

The deities featured as the center of the composition in five of the eighteen pages (33, 37, 40, 44, and 46) can be linked to the principal deities honored as the god in the corresponding Aztec month or veintena. All seem in accord with the sequence of festivals described in Aztec sources, except for page 40, which shows Quetzalcoatl in a hummingbird aspect in place of Huitzilopochtli, possibly reflecting a festival localized in the Puebla-Tlaxcala area, where Quetzalcoatl was the paramount god. As noted in my 1989 study, the remaining pages in the sequence on Borgia 29–46 appear to depict Venus events in the context of the festival calendar, and these astronomical events seem to be the determining factor in the representational images. My 1989 study provided preliminary discussion of the significant Venus events, but it is now possible to study the astronomical sequence in much greater detail and identify a previously unrecognized solar eclipse event.

The Venus events and solar imagery on pages 29–46 must be reconstructed largely from the visual imagery because this unique sequence of eighteen pages records astronomical data using very few calendar glyphs, and none of them is a Calendar Round date. Day signs from the tonalpohualli first appear in four cartouches on page 30, which seems to refer to a complete period of twenty days (Anders et al. 1993: 196). Other pages have different sets of four day signs (pages 32, 39, 41). Page 44 repeats the same sequence seen on page 30. Only page 31 seems to present a variation of the pattern, presenting two different sets of four day signs beginning with the day sign Wind, the second day sign in the 20-day series. This set runs 2, 7, 11, 17, and a second set below (beginning with the day sign Lizard) records the sequence 4, 9, 13, 19. It is noteworthy that these represent virtually the same sets recorded on page 40 in an eclipse sequence discussed below, where five-day intervals alternate with occasional intervals of four and six days (see Figure 5.10c).

ECLIPSE IMAGERY ON CODEX BORGIA 40

Solar eclipses are only rarely represented in Precolumbian codices from central Mexico.[9] This comes as a surprise because eclipse images are relatively common in colonial period manuscripts from central Mexico. Sahagún's *Primeros Memoriales* (Sahagún 1993: 282r) shows a European-style moon symbol partially covering the sun disk, reflecting the true nature of a solar eclipse, but the accompanying Aztec account explains that the moon is eating the sun during the eclipse. Early colonial period annals often represent eclipse images as a solar disk with a pie-wedge cut out, symbolizing the sun's diminished light. Usually the wedge is dark and sometimes stars and the moon are represented in the background (Figure 5.8). On Borgia 40, a group of nine gods cut wedge-shaped wounds in nine solar disks on a central deity whose body is covered with stars, suggesting an image of solar eclipse (Figure 5.3). The imagery of gods attacking the sun disks with knives suggests links with ethnographic accounts that describe the sun being attacked during a solar eclipse (Milbrath 1999: 25–27). Furthermore, the knife itself may allude to the moon covering the sun's light, for a knife symbolizes the heart of the moon on Borgia 18 and 50. Quetzalcoatl (Stripe-Eye), in a hummingbird guise, stabs a heart at the center of the largest sun disk on the torso of the solar deity. The attackers all wear the curved shell earrings associated with Quetzalcoatl, and three also wear his spiral, conch-shell pendant. Most are crowned by Quetzalcoatl's distinctive headdress ornament with red rays on a black background of stars. This headdress symbolizes a wedge section of the Venus disk, which appears in full form as a round-rayed disk on Borgia 30 (Milbrath 1989: 113; 1999: 180, fig. 54e). The proximity of Venus gods to the eclipsed sun recalls imagery, on page 58 of the Dresden Codex eclipse tables, that shows the Venus god alongside the eclipsed

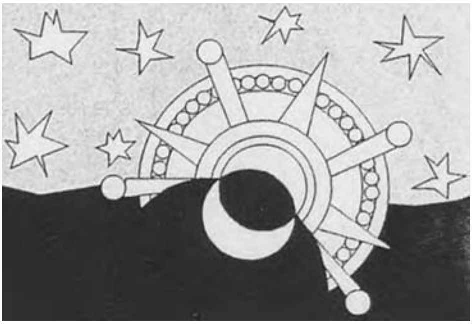

Figure 5.8. The solar eclipse in 1496 in Codex Telleriano-Remensis 40v. (Modified after Quiñones Keber 1995: 319–320.)

sun, suggesting Venus is the cause or agent of solar eclipse events (Milbrath 1999: 161, figure 5.1a).

A Precolumbian solar eclipse image from central Mexico carved on the Bilimek Vessel shares some features with Borgia 40 (Figure 5.9; Taube 1993; Milbrath 1997). The eclipsed sun appears with a large cut-out wedge filled with stars, which are represented in a typical form as round, heavy-lidded "eyes of the night." This pulque vessel bears a 2 Reed year date and an image of the principal goddess in the Tititl festival, linking the imagery to a solar eclipse in the veintena Tititl (Milbrath 1997: 202). This association suggests a relationship to a solar eclipse that took place on January 2, 1508, at the end of 2 Reed, the year of the Aztec New Fire ceremony. Xolotl and Tlahuizcalpantecuhtli appear alongside the solar eclipse sign (Taube 1993: figure 12), alluding to Venus as an eclipse agent. The image on Borgia 40 also represents Venus gods, suggesting links with some Mesoamerican accounts that attribute solar eclipses to Venus attacking the sun (Milbrath 1999: 26–27). The Bilimek Vessel depicts the eclipsed sun disk descending into the jaws of the earth monster, paralleling the underworld location of the solar eclipse on page 40.

The central figure on page 40 is actually enclosed in a crocodilian image of the earth, clearly indicating an underworld location. The figure wears the wind-shell earrings of Quetzalcoatl (and Xolotl) and has skulls at his joints like Aztec images of the earth monster. Like the sun god, he wears a serpent diadem (Borgia 7, 9, 21) and a headdress of tasseled white feathers (Borgia 70). He also wears the obsidian sandals of Tezcatlipoca (Borgia 17, 21). Stars on his body and his round star-eyes signal his nocturnal aspect. Seler (1963, 2: 42) identified the central figure on Borgia 40 as the solar god of the underworld. The splay-legged pose is one associated with the earth monster, especially in Aztec images of the underworld on the underside of relief sculptures, but is also related to birth imagery in some contexts (Klein 1976). The bleeding sun disks allude to death and blood sacrifice, but also to renewal, for it is blood sacrifice that feeds the sun. Boone (2007) interprets the image as the newborn sun (posed in the birthing posture) with pustule-covered skin on his hands

Figure 5.9. Bilimek Vessel showing an eclipse image over the head of a skeletal goddess: (a) detail of the eclipse image itself; (b) the whole vessel. (Modified after Seler 1960–1961, 2: 921, Abb. 1, 22.)

identifying him as Nanahuatzin, the deity who threw himself in the fire to become the sun (Sahagún 1950–1982, 7: 3–7). The central figure is clearly complex, conflating attributes of a number of deities, as Cecelia Klein (1976: 8–11) recognized long ago. Klein concluded that this same image represents the "dead night sun" in the underworld fused with a dead or underworld Venus god, symbolizing the end of a great cycle of 104 years that linked the Venus and solar calendars. Her interpretation of the conflated deity attributes remains valid, but the key cosmic event seems to be a solar eclipse that was visualized as the death and rebirth of the sun.

ECLIPSE SEQUENCE IN DAY SIGNS

In 1996, while studying the Codex Borgia in the Vatican library, I realized that published commentaries all contain errors in the reconstruction of a crucial set of day signs surrounding an image of the "night sun" on pages 39–40 (Figures 5.10a, b). I recognized that the central image was related to Aztec eclipse imagery and that there was a possible eclipse interval in the sequence of day signs (Figure 5.10c). The recent discovery of real-time events in the Codex Borgia provides the inspiration for a new look at the astronomical imagery represented on pages 29–46. As a result of this research, I have concluded that Borgia 40 depicts a total solar eclipse that occurred very close to the time of the Conquest.

Before discussing the specific eclipse events, an analysis of the day signs is in order. On pages 39–40, the vertical alignment of the pages indicates that the reading of day signs goes around the body of the earth monster, beginning at the top with the head on page 39 (Figures 5.3, top; 5.10a). The right side is fairly straightforward as a repeating sequence of the twenty day signs. The sequence of day signs begins at the top, reading in clockwise order. The second day sign, *ehécatl* (or Wind), can be seen under the earth monster's clawed paw. Byland (1993: xxv) notes that Tonacatecuhtli's head obscures the first day sign (*cipactli*). This day sign may be represented symbolically by the head of the earth monster itself with its gaping crocodilian jaw forming an entry to the underworld. The clockwise sequence continues with all twenty day signs represented. A new sequence begins alongside the temple on the right side of the page but only displays the first thirteen days. My sequence generally follows Seler's (Figure 5.10a), except that I see space for another day sign (the tenth day, Dog) between the ninth and eleventh days at the bottom of the page and an added day sign at the end of the sequence, the thirteenth day (Reed). The ninth day sign, Water, is erroneously reconstructed as the nineteenth day sign Rain in the Dover edition, and in place of the tenth day sign the artist has drawn Rabbit, with its head facing in the wrong direction. The eleventh day sign Monkey follows next, as is confirmed by all three facsimiles, but the Dover edition renders the head facing in the wrong direction and transforms the earplugs into a nose and fangs. Anders et al. (1993) end the sequence on the twelfth day sign, in accord with Seler (Figures 5.10a, b), but there is actually space for another day sign. Here, my reconstruction is like the Dover edition, showing both the twelfth and thirteenth day signs, for a total sequence of 20 days plus 13, the two basic numerical units in the tonalpohualli.

Seler (1963, 2: 42) noted that the order of the day signs along the left side of the earth monster's body is strange, and he concluded that the day signs merely serve as "fillers." Seler's analysis of pages 39–40, summarized in the illustration published with the 1963 edition, adds parentheses to designate reconstructed day signs noted with their Nahuatl names (Figure 5.10a). Study of the original and the published facsimiles indicates that the first day sign in the second set (next to the uppermost black line in Figure 5.10a) should be cipactli (I), rather

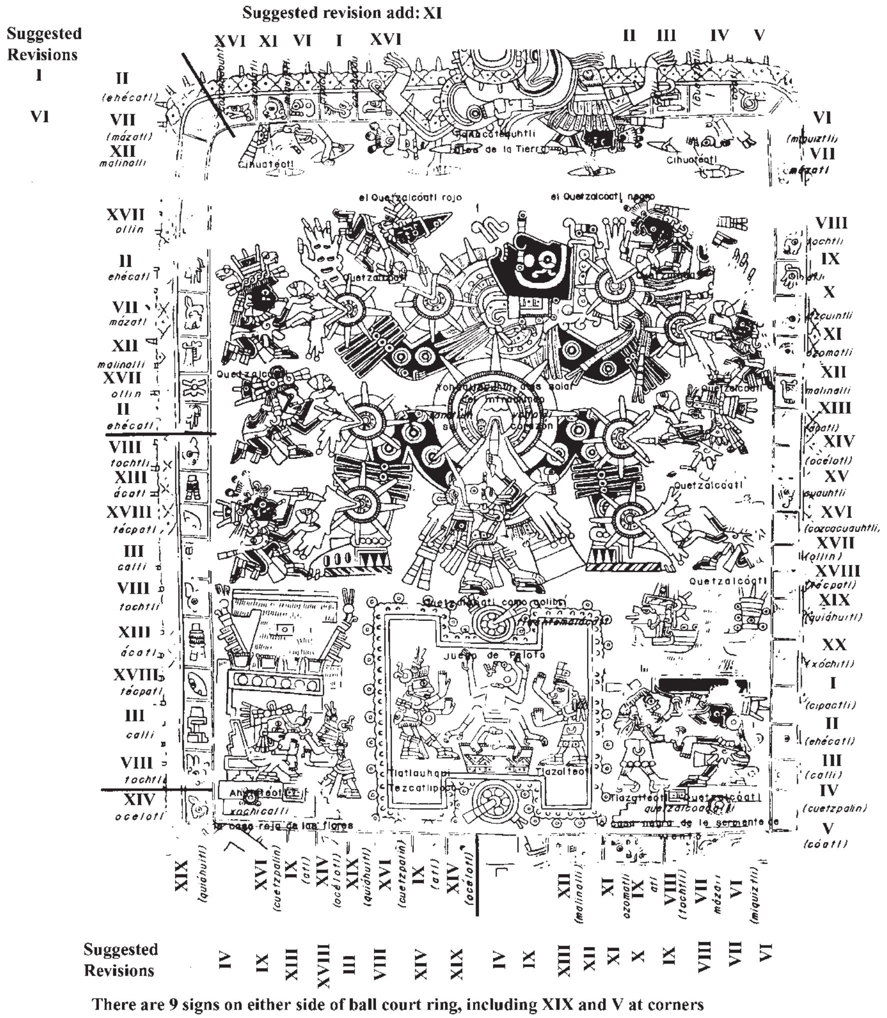

Figure 5.10 (a). Codex Borgia 39–40 diagrammed to show names of preserved day signs along with reconstructed signs in parentheses as published by Seler (1963). Roman numerals are added to show their position in the sequence of twenty repeating days of the tonalpohualli. A second column of Roman numerals designates those day signs that are revisions of Seler's reconstructed day signs. (Modified after Seler 1963.)

than ehécatl (II). Traces of the crocodile's teeth remain along with part of its jaw, conforming to the image of cipactli represented elsewhere on pages 39–40. Although Anders et al. (1993: 224) and Nowotny (1961: 250) repeated Seler's error, Boone (2007: table 17.1), Kingsborough (1831–1848), and the reconstruction

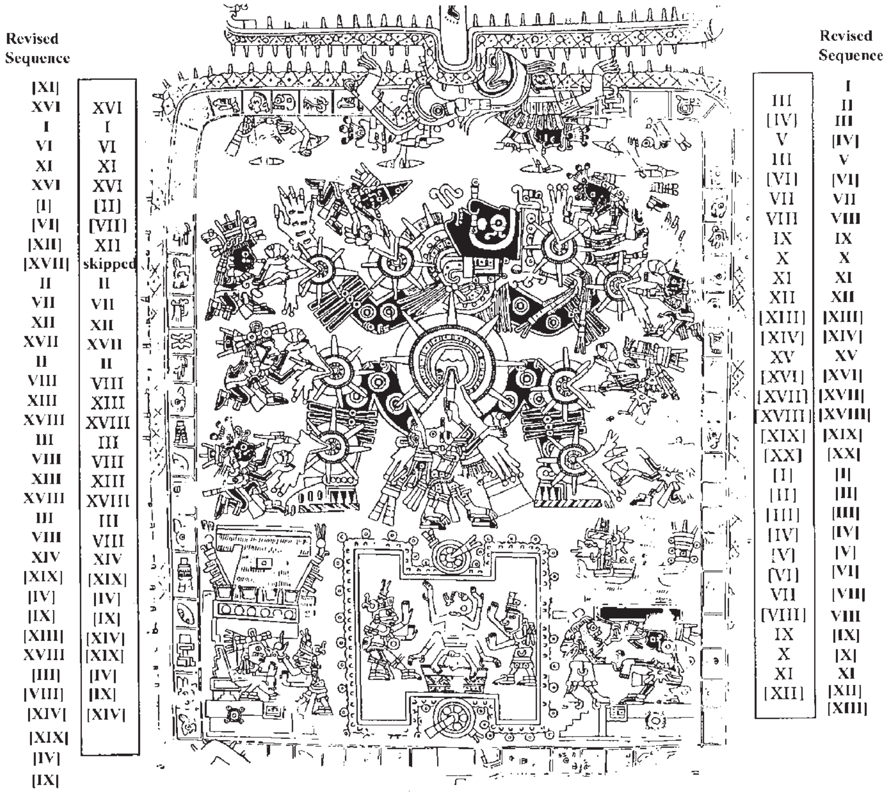

Figure 5.10(b). Codex Borgia 39–40. Boxed day signs with Roman numerals are from Anders et al. (1993: 224) with reconstructed day signs in square brackets. The revised sequence appears alongside. (Modified after Anders et al. 1993.)

in the 1993 Dover edition all confirm that the partially effaced day sign is cipactli (Díaz and Rodgers 1993: plate 40). Seler and Anders and his coauthors also failed to recognize the clear representation of *técpatl* (Flint, the eighteenth day sign) along the bottom row (Figures 5.10a, b), an identification confirmed by Kingsborough, the Dover edition, and Boone's analysis.

Boone (2007: table 17.1) summarizes the different interpretations of this sequence of day signs. Following Kingsborough's sequence, she does not attempt to reconstruct missing day signs. The day sequence boxed in two columns in Figure 5.10b presents a revision of the sequence published by Anders et al. (1993). Their reconstructed day signs are represented in square brackets. I also note where they skipped a day sign. Another column alongside shows my own reconstruction deduced by recognizing the repeats in patterning, generally at

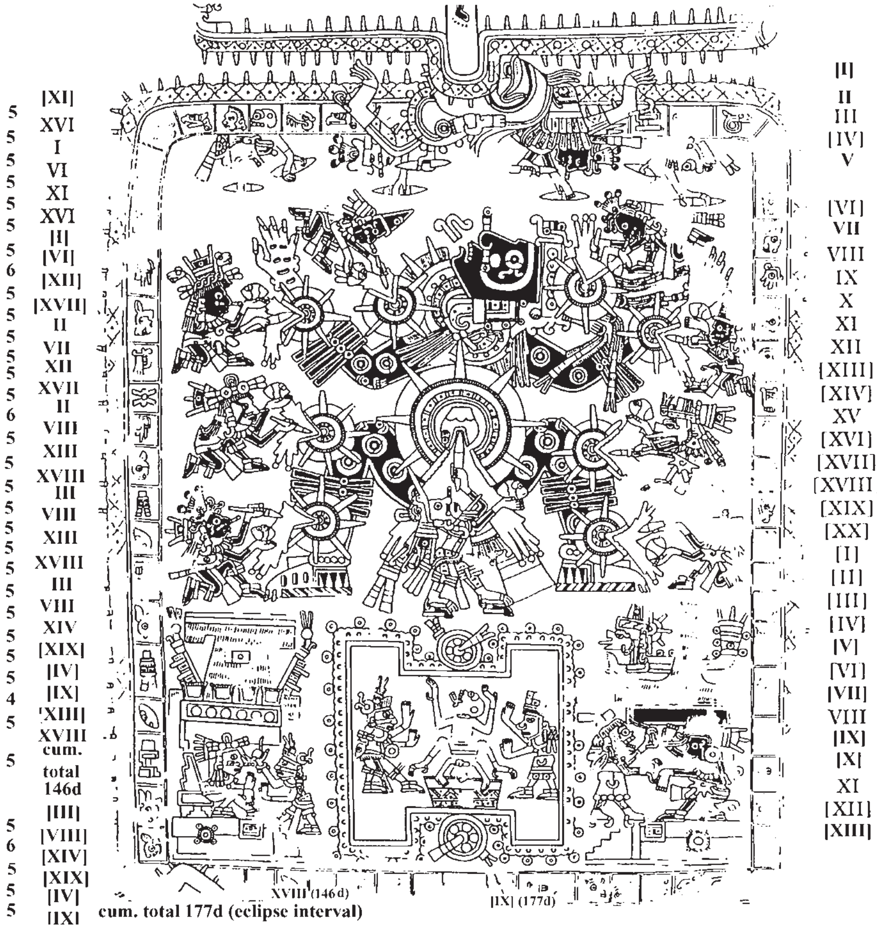

Figure 5.10(c). Codex Borgia 39–40, showing the revised sequence of day signs (with reconstructed days in square brackets). Days on the right side are read clockwise following the direction that the animal heads are facing. The sequence on the left side reads counterclockwise, following the same convention. Arabic numbers in the margins show the intervals between the day signs and the cumulative totals, ending at the ball court with an eclipse interval of 177 days. (Modified after Anders et al. 1993.)

intervals of five days (Figures 5.10b, c). Reconstructed day signs are represented in square brackets in Figures 5.10b and 5.10c. Day signs run in a counterclockwise count in a series of frames around the border on the left, within the frame of the earth monster's skin.[10]

The patterning shows repeated sets, and all the sets (except the last) can be confirmed by the presence of at least one preserved day sign that provides the key to the patterning. Visible day signs are in bold whereas reconstructed ones are in parentheses.

(11,) **16, 1, 6** // **11, 16,** (1, 6 // 12, 17), **2, 7** // **12, 17, 2, 8** // **13, 18, 3, 8**
(//) **13, 18, 3, 8 // 14,** (19, 4, 9 // 13,) **18,** (3, 8 // 14, 19, 4, 9)

My reconstruction on the left side is closest to the Dover edition but differs in several respects. Most notably, I propose that the space between the earth monster's jaw and left claw allows room for a missing day sign. I reconstruct the beginning point of the count as the eleventh day sign, Monkey, spaced at a five-day interval from the first visible sign, the sixteenth day sign, Buzzard. Near the end of the sequence, following the well-preserved day sign Jaguar at the lower left corner, the sequence is largely destroyed, except for the day sign Flint just discussed. On the left side (Figure 5.10a), Seler and the Dover edition have only eight day signs whereas I reconstruct a total of nine plus two signs beneath the ball-court ring (Figure 5.10c).

In my reconstruction, the first interval is five days, followed by repeated sets of five-day intervals (Figure 5.10c). Generally, all the intervals are five days, except for three intervals of six days and a four-day interval that appears near the end of the sequence. Such numerical variations are essential to form cumulative totals that are not multiples of five. The sequence is anchored by a majority of signs that remain preserved and a repeating set of five days. On the left side, the sequence begins with the eleventh day sign (Monkey), an effaced day sign that is reconstructed for the now empty first frame ([XI] in Figure 5.10c). Presuming intervals of five predominate, we can add all the reconstructed day signs to those visible along the side to arrive at a cumulative total of 146 days, marked by the only well-preserved day sign along the bottom (Flint). This total is two days short of an eclipse interval documented in the Dresden Codex (Milbrath 1999: plate 3). Adding four more day signs for the effaced signs in cartouches to the right would bring the count to 166 days, if intervals of five days are used. If one interval of six days is used, as occurs elsewhere in the sequence, the cumulative total is 167 days. Below the ball court, there are two rectangles similar in size to the day-sign cartouches. The one on the right is partially covered by plumes decorating the ball-court ring and the other on the left is filled in with red paint (Figure 5.10c). If the standard five-day intervals established on the left side extend symbolically into these two spaces, there could be two more day signs at intervals of five days, carrying the cumulative total on the left side forward to 177 days, representing a six-month eclipse interval. This is an intriguing possibility because the Dresden

Codex also ends the eclipse cycle with an interval of 177 days (Milbrath 1999: plate 3). Alternatively, the red space may have symbolized a flexible interval that would allow the cumulative total to alternate between 177 and 178 days, two eclipse intervals well documented in the Dresden Codex (Aveni 2001: 179). The eclipse intervals cannot be definitively demonstrated, but the eclipse imagery on page 40 certainly suggests that the day count refers to the eclipse cycle.

It could be that the sequences on the two sides of the earth monster's body are intended to literally join together at the ball court. If the last day on the left is the ninth day sign, in accord with a previously recorded set, the interval from the ninth to the thirteenth sign ending the count on the right would be four days, an interval seen elsewhere in the sequence on the left side. Possibly there was a reversal from one counting sequence to the other at the ball court. It is noteworthy that in modern survivals of the ball game, the notion of numerical reversal is implicit in the scoring (Leyenaar 1978: 62–69).

DATING THE ECLIPSE EVENT ON CODEX BORGIA 40

The eclipse imagery and the possible eclipse intervals on pages 39–40 may be grounded in real events. In their analysis, Anthony Aveni and Edward Calnek (1999: table 4) document solar eclipse references in central Mexican sources that date between AD 1198 and 1523. Some of these were not actually visible in central Mexico but are nonetheless represented in their table because there are documentary references to the eclipse. A few not mentioned in their list appear in Roland Weiztel's (1951) study. He worked from an opposite point of view, finding eclipse events listed in Oppolzer's catalogue of 1887 (Oppolzer 1962), noting whether they were visible in central Mexico, and then examining the Aztec codices and ethnohistoric sources for references to these eclipses.

Because I hypothesize that the Borgia eclipse was an observed event, my search for the solar eclipse represented on page 40 focuses on visible eclipses (those with a magnitude[11] greater than 1 percent). Aveni and Calnek record ten visible solar eclipses between AD 1300 and 1521, a period overlapping the broadest range of dates suggested for the Codex Borgia. Weitzel's study records two added solar eclipses during this period, one on October 30, 1426 (78 percent magnitude) and another on January 13, 1477 (89 percent magnitude). With a total of twelve eclipses visible in central Mexico during the Late Postclassic period, other parameters are required to identify the most likely eclipse event on page 40.

The link between the eighteen-page sequence and the festival calendar provides additional criteria to narrow the choices. The analysis here will test a number of alternatives to place both the festival calendar and the eclipse event in relation to the solar year. The range of dates for these festivals is well documented by Conquest period sources. As noted earlier, a periodic adjustment of the festival calendar probably kept the veintenas approximately in the position recorded in Nicholson's (1971) synthesis (see Table 5.2, columns 2 and 3).

Since the sequence of veintenas is invariable, in any given year the spacing between months can be predicted. Page 46, the last page in the sequence, clearly represents a fire ceremony as the focus event (Figure 5.7). As noted earlier, the best correlation seems to be with Panquetzaliztli, the fifteenth festival, but we should test other fire ceremonies to study the relationship between the veintena sequence and eclipse events. According to Sahagún's (1950–1982, 2) record of the Aztec festivals and Nicholson's (1971: table 4) synthesis, annual fire ceremonies were performed only in the tenth, twelfth, fifteenth, and eighteenth veintenas. If page 46 depicts one of the four festivals known to be associated with a fire ceremony, the interval of six veintenas between pages 40 and 46 indicates that the solar eclipse on page 40 must be one dating 120 days before one of these fire ceremonies.

The parameter designated here, then, requires that the solar eclipse be paired with a fire ceremony occurring six "months" (120 days) later. A reasonable proposition might be that the fire ceremony on page 46 represents Izcalli, a logical choice because this is the eighteenth festival, ending the sequence of eighteen veintenas in Nicholson's table, just as page 46 ends the sequence of eighteen pages in the Codex Borgia. The imagery on page 46, showing a fire drilled on the fire serpent encasing the fire god, Xiuhtecuhtli, certainly seems appropriate because descriptions of Izcalli say that the priests drilled a fire in front of an image of the fire god Xiuhtecuhtli (Sahagún 1950–1982, 2: 159–160). This alignment does not produce a promising result, however, because there were no visible eclipses in central Mexico falling 120 days prior to Izcalli. In fact, Table 5.1 shows that only four solar eclipses occurred 120 days before one of the annual fire ceremonies: those in 1455, 1492, 1496, and 1499.[12]

The 1455 eclipse is an apt choice because it corresponds to a 2 Reed year, the year of the New Fire ceremony. This eclipse was only of 38 percent magnitude but would certainly be noteworthy because it fell in the year that ended the 52-year cycle. The Aztecs greatly feared solar eclipses in the year of a New Fire ceremony, for they predicted the world would be destroyed during a solar eclipse at end of the 52-year cycle (Milbrath 1997). The date of the 1455 eclipse in the fourth festival, or "month," is linked to a fire ceremony 120 days later, but it is not the anticipated New Fire ceremony. Instead, the 120-day interval from page 40 to page 46 brings us to the tenth month (Hueymiccailhuitl), when victims were roasted in fire and their hearts torn out as a fire sacrifice to Xiuhtecuhtli. Although this form of sacrifice is not represented on page 46, Xiuhtecuhtli is prominently represented as the deity encased in the fire serpent. The same alignment with the festival calendar is evident by linking page 40 to the 1492 eclipse, and it was also an eclipse of relatively low magnitude (40 percent; Table 5.1).

A more impressive eclipse of 70 percent magnitude took place in 1499 during the sixth festival. The positioning of this eclipse in the festival calendar indicates it would be paired with a fire ceremony in the twelfth month (called Pachtontli or Teotleco) 120 days later (Table 5.1). Sahagún's (1950–1982, 2: 127–130) description of this ceremony indicates a possible overlap with the imagery on page 46, because Xiuhtecuhtli is prominent in the ceremony and victims were cast into the fire, evoking a link with the image of a figure roasting in the fire on page 46 (Figure 5.7).

The most dramatic eclipse visible in central Mexico was a solar eclipse of 96 percent magnitude on August 8, 1496, during the ninth festival (Table 5.1; Aveni and Calnek 1999: table 4). If the 1496 solar eclipse is the one depicted on page 40, it confirms the festival sequence I outlined in 1989. The year 1496 correlates with the year 4 Flint, a year bearer represented on page 51 with a date of 1496, according to Hernández's analysis (2004: table 11.7). This eclipse presents a particularly strong candidate, because it was the eclipse of greatest magnitude during the epoch of the Aztec empire (1325–1521). In this case, page 46 would represent the Panquetzaliztli fire ceremony with burning fire serpents recorded by Sahagún in the fifteenth veintena.

VENUS IN CODEX BORGIA 29–46

There are other parameters to test whether the 1496 solar eclipse fits the imagery. Page 40 clearly shows Quetzalcoatl in multiple aspects attacking sun disks in an underworld enclosure formed by the earth monster (Figure 5.3). The sun inside the earth monster's body, traditionally interpreted as the "night sun" in its nocturnal journey through the underworld, may actually represent the eclipsed sun. The imagery suggests that Venus-Quetzalcoatl suddenly attacked the sun as the solar eclipse turned day into night. Venus is always relatively close to the sun, and so cannot normally be seen during the day. The only time

TABLE 5.1. Placement of Codex Borgia 46 fire ceremony in relation to central Mexican eclipse events between 1350 and 1521. Visible solar eclipses are based on Aveni and Calnek (1999: table 4) and Weitzel (1951); fire ceremonies and dates of veintenas (twenty-day "months") are based on Nicholson's (1971: table 4) dates in the Julian calendar. The festivals were probably adjusted periodically to synchronize with the seasons.

If page 46 represents the fire ceremony in the tenth month (Aug 13–Sep 1),
  then page 40 falls six veintenas (120 days) earlier,
  corresponding to the fourth month, called Hueytozoztli
  or "first fruits" dating to Apr 15–May 4.
Visible eclipses in fourth month:
  Apr 16, 1455; magnitude 38%; 2 Reed year
  Apr 26, 1492; magnitude 40%; 13 Flint year

If page 46 represents the fire ceremony in the twelfth month (Sep 22–Oct 11),
  then page 40 falls six veintenas (120 days) earlier,
  corresponding to the sixth month, called Etzalcualiztli
  or "eating of etzalcualli" (a maize-bean porridge) dating to May 25–Jun 13.
Visible eclipses in sixth month:
  Jun 8, 1499; magnitude 70%; 7 Reed year

If page 46 represents the New Fire ceremony in the fifteenth month (Nov 21–Dec 10),
  then page 40 falls six veintenas (120 days) earlier,
  corresponding to the ninth month, called Miccailhuitontli
  or "small feast day of the dead" dating to Jul 24–Aug 12.
Visible eclipses in ninth month:
  Aug 8, 1496; magnitude 96%; 4 Flint year

If page 46 represents the New Fire ceremony in the fourteenth month (Nov 1–Nov 20),
  then page 40 falls six veintenas (120 days) earlier,
  corresponding to the eighth month, called Hueytecuilhuitl
  or "great feast of the lords" dating to Jul 4–Jul 23.
Visible eclipses in eighth month:
  None between 1300 and 1521

If page 46 represents the fire ceremony at year end in the eighteenth month (Jan 20–Feb 8),
  then page 40 falls six veintenas (120 days) earlier,
  corresponding to the twelfth month, called Pachtontli
  or Teotleco ("arrival of the gods") dating to Sep 22–Oct 11.
Visible eclipses in twelfth month:
  None between 1300 and 1521

Venus would be seen close to the sun during daytime hours would be in the event of a solar eclipse of magnitude about 96 percent or greater (E. C. Krupp, personal communication, 2003). This constraint narrows our choices because only the eclipse of August 8, 1496 (at 96 percent magnitude) meets this criterion, reinforcing the interpretation of page 40 as a representation of Venus appearing alongside the sun during a solar eclipse.[13] Chimalpahin describes the 1496 solar eclipse as follows: "a complete eclipse of the sun, so that it was as dark as the deepest night, and the stars were seen with complete clarity" (Aveni and Calnek 1999: table 5, note *o*). This same image is evoked by the Codex Telleriano-Remensis, which represents the 1496 eclipse with the sun amid a background of stars, a noteworthy detail because other pre-Conquest solar eclipses are represented without stars in the same codex (Figure 5.8). The eclipsed solar god on Borgia 40, covered with stars, suggests a similar type of image.

Study of the Venus imagery on pages 39–40 provides additional parameters to test the four most likely eclipse events (Figure 5.3). On page 39, representing the period just before the eclipse event on page 40, two gods wearing Quetzalcoatl's wind-shell earrings and pendants dive toward the horizon, traveling along a footprint path leading to the open jaws of the earth monster. The downward footpath and diving Venus gods suggest that page 39 depicts the planet Venus descending toward the horizon. The image of Venus attacking the sun on page 40 suggests that Venus was in conjunction with the sun or nearby at the time of the solar eclipse. Studying the astronomical events that led up to the 1455 eclipse, we find that Venus disappeared in superior conjunction in early March 1455, more than forty days before the eclipse on April 16. This does not seem to fit the imagery of Venus descending toward the horizon on page 39. The April 26, 1492, eclipse is not a good candidate because Venus was the newly emerged Evening Star on this date, a position that does not correlate with the imagery of descent. Nor is the June 8, 1499, eclipse a good fit because Venus was the Morning Star, positioned relatively high in the sky. In fact, Venus did not descend to the horizon until six months later when the planet disappeared in conjunction. The 1496 eclipse, in contrast, provides a perfect fit with the Venus events (Table 5.2). Venus was in the last period of its Morning Star phase just before the 1496 eclipse, so it was rapidly descending toward the sun and would disappear in the next month. As the descending Morning Star, Venus was visible in eastern sky at dawn for a brief time before disappearing in the solar glare, indicating an apt correlation with the imagery of Quetzalcoatl descending toward the sun on page 39. On the day of the 1496 eclipse, Venus disappeared shortly after sunrise, but the planet suddenly reappeared in the western sky near the sun when the eclipse took place at 3:36 PM. This last fact fits well with the imagery on page 40 depicting Venus-Quetzalcoatl attacking the sun. Venus was only about fifteen degrees from the sun at the time of the eclipse on August 8. When the planet suddenly appeared alongside the eclipsed sun in the afternoon, it was visualized as an eclipse monster attacking the sun.

Both my 1989 analysis and the revised sequence presented here indicate that the Venus events are recorded during a single year. The main difference is the interpretation of Venus imagery on pages 29–30 and pages 39–45. Originally, I proposed that imagery of Quetzalcoatl descending into the jaws of the earth monster on page 39 depicts Venus as the Morning Star disappearing in superior conjunction. With the realignment of phases shown in Table 5.2, page 39 could represent the descending Morning Star (MS) hovering above the horizon just prior to becoming invisible during superior conjunction. Pages 39–43 were originally interpreted as representations of an idealized period of superior conjunction (SC) spanning ninety days, in accord with the superior conjunction interval recorded in the Dresden Codex. It now seems more likely that the events are based on real-time observations with the superior conjunction phase lasting around 75 days.

The Venus events in Table 5.2 are correlated with two sets of veintena dates. The dates in column 4 refer to 1495–1496, presuming that there was no adjustment to the festival calendar. These dates are six days later than those recorded for the period 1519–1520 derived from H. B. Nicholson's (1971) synthesis of central Mexican calendars, which are shown in column 3. If the calendar had been adjusted some time between 1496 and 1519, the festival dates would be fairly close to those in column 3. Table 5.2 shows the actual Venus events as they occurred in 1495–1496, plotted along with the festival cycle of eighteen veintenas on Codex Borgia 29–46. The Venus events in column 5 are aligned with the festival dates in 1495–1496 (column 4), which reflect a calendar with no intercalation. If there were an intercalation, the Venus events would shift by six days in the festival cycle. For example, the first appearance of the Evening Star (EFIRST), dated to the first day of the fifteenth month in column 5, would actually have taken place on the seventh day of the fifteenth month, if the calendar had been adjusted to the same seasonal position seen in 1519–1520. Because the events recorded are real-time events, I have proposed minor changes in the Venus events diagramed in my 1989 publication. Both sequences are displayed in parallel columns in Table 5.2 for comparison. The revised sequence of the Venus imagery helps explain a number of the Venus-Quetzalcoatl transformations and also fits in the 52-year sequence outlined on the preceding pages 27 and 28 (Aveni 1999; Bricker 2001).

With the 1496 eclipse on page 40 locking in the sequence of real-time events, the alignment of solar and Venus cycles indicates that page 29 represents the transition from Evening Star to inferior conjunction around the winter solstice in 1495 (Table 5.2). Page 29 shows Venus-Quetzalcoatl burning in a *cuauhxicalli*,

TABLE 5.2. Veintena festivals 1495–1496 and Venus phases in Borgia 29–46.

	Festival number and dates[1]				
Page	*Aztec sequence for 1519–1520*		*Estimates of the first day in 1495–1496*	*Revision of Venus Phases*[2]	*Venus Phases in Milbrath 1989*[2]
29	16th	Dec 11–Dec 30	Dec 17	ES (last 16 days) IC (4 days)	MS (days 20–40)
30	17th	Dec 31–Jan 19	Jan 6	IC (7 days) MS (days 1–13)	MS (days 40–60)
31	18th + 5 days	Jan 20–Feb 13	Jan 26	MS (days 14–38)	MS (days 60–80)
32	1st	Feb 14–Mar 5	Feb 20	MS (days 39–68)	MS (days 80–105)
33	2nd	Mar 6–Mar 25	Mar 12	MS (days 69–88)	MS (days 105–125)
34	3rd	Mar 26–Apr 14	Apr 1	MS (days 89–108)	MS (days 125–145)
35	4th	Apr 15–May 4	Apr 21	MS (days 109–128)	MS (days 145–165)
36	5th	May 5–May 24	May 11	MS (days 129–148)	MS (days 165–185)
37	6th	May 25–Jun 13	May 31	MS (days 149–168)	MS (days 185–205)
38	7th	Jun 14–Jul 3	Jun 20	MS (days 169–188)	MS (days 205–225)
39	8th	Jul 4–Jul 23	Jul 10	MS (days 189–208)	MS–SC (days 225–235; 0–10)
40	9th	Jul 24–Aug 12	Jul 30	MS (days 209–228)	SC (days 10–30)
41	10th	Aug 13–Sep 1	Aug 19	MS (days 229–248)	SC (days 30–50)
42	11th	Sep 2–Sep 21	Sep 8	MS (days 249–254) SC (14 days)	SC (days 50–70
43	12th	Sep 22–Oct 11	Sep 28	SC (days 15–34)	SC (days 70–90)
44	13th	Oct 12–Oct 31	Oct 18	SC (days 35–54)	ES (days 0–20)
45	14th	Nov 1–Nov 20	Nov 7	SC (days 55–74)	ES (days 20–40)
46	15th	Nov 21–Dec 10	Nov 27	ES (days 1–20)	ES (days 40–60)

1. Veintena numbers and Julian dates in columns 2 and 3 are the Aztec sequence for 1519–1520 in Caso (1971: table 4) and Nicholson (1971: table 4). The same sequence of veintenas is known from Tlaxcala and Teotitlán del Camino (Caso 1967: table 11). The dates in the fourth column are estimates of the first day of the given festival in 1495–1496, presuming that there were no intervening leap years or other forms of intercalation. Counting from 1519 back to 1495 (a 24-year period) results in six days of calendrical shift at a rate of one day every four years. All dates noted are in the Julian calendar. To determine the dates in our Gregorian calendar add 10 days.
2. ES = Evening star; IC = Inferior Conjunction; MS = Morning Star; SC = Superior Conjunction. Venus phases in my 1989 sequence are idealized periods based on the intervals recorded in the Dresden Codex. The revised sequence incorporates actual events as they occurred in 1495–1496, correlated with veintena positions in those years. These were calculated by Anthony Aveni (personal communication, 2005), but he cautions that the actual observed event could shift 2–3 days for Inferior Conjunction and a few days more for Superior Conjunction. Inferior Conjunction began on January 2, 1496, and ended on January 12, 1496, when Venus emerged as the Morning Star. Based on the midpoint of Superior Conjunction on October 20, 1496, the approximate date when the planet disappeared in Superior Conjunction was September 13, 1496, and its reappearance as the Evening Star is dated to November 27, 1496. The Venus intervals in this table are coordinated with the dates of festivals in 1495–1496 (columns 4 and 5).

a stone bowl designed to hold the hearts of sacrificial victims (Figure 5.1). Anders et al. (1993: 192–193) follow Seler in identifying the imagery of Quetzalcoatl as the death and rebirth of Venus as part of the cycle of Venus phases, but they do not specify which phase. Seler (1963, 2: 14) views the image on page 29 as the death of the Morning Star, but the imagery seems more appropriate to the transformation of the Evening Star into the Morning Star, in accord with an important passage in the *Anales de Cuauhtitlan* (Velazquéz 1945: 10–11; Bierhorst 1992: 36). This account tells how Quetzalcoatl set himself on fire and was transformed into the Morning Star after eight days in the underworld. His transfiguration is a metaphor for the transformation of Venus as it was burned by the solar fire during a brief period of invisibility (inferior conjunction averages eight days), soon to reemerge as the Morning Star (MFIRST).

Table 5.2 indicates that the imagery of Venus emerging as the Morning Star corresponds to page 30, aligned with the seventeenth month (December 31–January 19 or January 6–19). The actual heliacal rise date coincides with the period represented on page 30, which depicts Venus as a rayed disk representing the newly emerged Morning Star (Figure 5.1). Anthony Aveni (personal communication, 2005) calculates that Venus emerged as the Morning Star on January 12, 1496, a calculation very close to the date determined by Victoria Bricker (2001: table 2). The rayed disk on page 30 is the Morning Star, and Quetzalcoatl's rayed headdress (compare Borgia 9, 19, and 30) is clearly a segment of the Venus disk.

Tracking the sequence of Venus imagery and associated dates (Table 5.2), we see that page 33 (Figure 5.2) shows dual Venus gods at the top of a pyramid temple. At this time, the Morning Star was very high in the sky, just days after its maximum altitude (February 27, 1496; Jean Meeus, personal communication, 2005). One Venus god is Tlahuizcalpantecuhtli, "Lord of Dawn," and the other is the black Quetzalcoatl, apparently a different aspect of the Morning Star. Perhaps the dual images relate to the transition of Venus at this point in its trajectory, with the ascending Morning Star transformed into the descending Morning Star.

The "Stripe-Eye" Quetzalcoatl appearing in the eight-page sequence (35–42) represents the descending Morning Star during a period of 160 days (eight veintenas). On page 35, Stripe-Eye makes his first appearance in the fourth veintena (April 15–May 4 or April 21–May 10). Here he is a ballplayer on the ball court. Alongside, the black Quetzalcoatl walks down a footprint path with a companion representing Tezcatlipoca, who has a lunar aspect in some contexts (Milbrath 1995). Seler (1963, 2: 30–31) suggests that the imagery on Borgia 35 represents the Evening Star accompanied by Tezcatlipoca as image of the waxing (youthful) moon in the west. In my analysis, page 35 corresponds to days 109–128 of the Morning Star phase, when the planet began a very slow descent, appearing each morning a little closer to the horizon (Table 5.2). The full moon took place on April 27 in 1496 (Julian), so the moon was seen both during its waxing and waning phases over the course of the month, and the moon actually passed by the Morning Star during the waning phase near the end of the veintena. A night-sky band on page 36 represents a continuing path of descent emanating like ashes from a burning bundle. The path carries Stripe-Eye down to page 38. Here he emerges at the end of the path through the jaws of his avatar, Ehecatl-Quetzalcoatl, reflecting another Venus transformation.

Page 39 shows paired Venus gods descending toward the horizon, in accord with the actual position of Venus as the descending Morning Star (Figure 5.3). This scene depicts Tlazolteotl (the moon goddess; Milbrath 1995) wearing her lunar skirt, circling around the Quetzalcoatl twins. She may represent the waning moon as a natural companion to the Morning Star at dawn, when both are seen close to the western horizon. The twelve images of Tlazolteotl possibly refer to the waning moon during the last twelve days in the lunar month, when the moon moves closer to the sun as it approaches conjunction at the new moon. This interpretation seems possible because page 39 represents the eighth veintena, with the new moon falling on July 10 (Table 5.2).

Page 40 correlates with a time when Venus was still the descending Morning Star, but the eclipse occurred in the afternoon, when the Morning Star had already set (descended into the underworld). Venus suddenly reappeared near the sun in the afternoon when the sun was eclipsed on the new moon of August 8. The sun was now surrounded by darkness, hence the earth monster—covered with stars on a black background and bleeding sun disks—surrounds the central figure (Figure 5.3).

Pages 42–45 trace the Venus events linked to the superior conjunction phase in the Borgia sequence. Page 42 shows Quetzalcoatl's sacrifice on the ball court and a skeletal manifestation of the god on at the bottom of the page. The "death" of the Morning Star occurs during the period represented on page 42, when the Morning Star disappeared in superior conjunction in early September (Table 5.2n2). The imagery seems to show the transformation of the Morning Star as it enters the underworld. Venus appears in multiple representations on page 45 (Figure 5.6). Quetzalcoatl, wearing the Venus symbol as a crown, is seated on an obsidian throne with flowery blood flowing from his buttocks.

All around are images referring to the death of the Morning Star, represented by decapitated heads of Tlahuizcalpantecuhtli, identified by distinctive quincunx face paint (compare Codex Borgia 19). An eagle warrior tears out the Morning Star's heart, while a skeletal Morning Star stands on a skull rack alongside. Images of Tlahuizcalpantecuhtli on this page show that the death of the Morning Star is a form of transformation that leads to the emergence of the Evening Star, an event that may be foreshadowed by the enthroned figure of Quetzalcoatl wearing a Venus headdress at the bottom of page 45. Following the dictate that the lower scenes are later on pages 29–46 (see previous discussion), this Venus image represents the last events of the veintena, coinciding with the day before the Evening Star reemerged (day 75; Table 5.2).

Page 46 represents the newly emerged Evening Star (EFIRST), still low on the horizon in the month of Panquetzaliztli (Table 5.2). Venus-Quetzalcoatl rises from a hearth fire in the center of the page. He then drills a fire on the fire serpent's body, in accord with descriptions of the Panquetzaliztli festival, when an effigy of the fire serpent was burned (Figure 5.7). In Aztec images, the fire serpent is apparently linked with Scorpius, a constellation that moved into conjunction with the sun in November during Panquetzaliztli (Milbrath 1980, 1989, 1997, 1999: 264–265). It seems significant that Venus was positioned near this constellation during Panquetzaliztli in November 1496, the festival ending the festival cycle on Borgia 46. Quetzalcoatl drilled a fire on the fire serpent just as Venus reappeared as the Evening Star and the last stars of Scorpius were about to disappear into the solar glare.

As a final test of the sequence proposed here, we can look at the possible connection between Xolotl's representation and positions of Mercury. Xolotl ("precious twin"), traditionally interpreted as Quetzalcoatl's twin and an aspect of the Evening Star (Seler 1960–1961, 3: 455; Klein 1976: 11), may actually represent Mercury (González Torres 1975: 113). Although he wears Quetzalcoatl's wind-shell jewelry and rayed headdress (Borgia 65), his canine attributes are quite distinct from the ophidian features associated with Quetzalcoatl. Xolotl may be Quetzalcoatl's "twin" because Mercury, also an inferior planet, has a four-phase cycle like Venus (Milbrath 1999: 162). Mercury, the planet that makes the most frequent trips to the underworld, may have a canine aspect because dogs are natural messengers to the underworld, often digging holes in the earth when they bury bones. Indeed, Seler (1960–1961, 4: 448) notes that dogs are companions to the dead in central Mexican cosmology.

Xolotl first appears at the rear of a temple on page 33, an image associated with the twenty-day period that includes the spring equinox (Figure 5.2). This is the period when Mercury disappeared in the morning sky (Table 5.2; March 12–31, 1496). Appropriately, Xolotl seems to be hiding behind the temple, apparently invisible. Page 34, representing the next twenty-day period, shows Xolotl facing a different direction, positioned in the interior of the temple. This image may indicate Mercury is about to shift to the Evening Star position. Xolotl wears a solar disk as a sign he is invisible in conjunction with the sun (Figure 5.2). We next see Xolotl on page 37, seated in a flaming temple during the annual festival that began on May 31, 1496 (Table 5.2). This date corresponds to the period when Mercury reached its maximum altitude in the morning sky (June 3, 1496; Meeus, personal communication 2005). Xolotl moves from the heights of the temple pyramid to a platform on the horizon (the open jaws of the earth monster) at the bottom of page 37. Alongside, there is a descending path that continues onto the top of page 38, where Xolotl tumbles off a platform. Page 38 represents the place where Xolotl ends his descent and the period (June 20–July 9) when Mercury disappeared in conjunction. The last image of Xolotl on this page shows him as a skeletal god transformed in a watery underworld. This imagery seems to refer to Mercury's descent toward the horizon over the course of a twenty-day period, a relatively accurate figure given that the average total visibility of Mercury is only about 38 days (Aveni 2001: table 6).

Xolotl's path of descent parallels the one with Stripe-Eye on pages 35–38, only Stripe-Eye's path is clearly longer, just as it takes Venus longer to descend than Mercury. The two paths of descent in the Codex Borgia show twin trajectories, pairing the movements of Venus and Mercury as descending evening stars during this period. Table 5.2 places pages 37–38 in the period running from May 31 to July 9, 1496. At the beginning of this period the planets were close together as morning stars, separated by only 13 degrees in late May.

Xolotl next appears in the center of page 43 (Figure 5.4), which depicts a border of tasseled maize appropriate to this period in the maize cycle (Table 5.2; September 28–October 17). Xolotl wears a round emblem with a heart in the center surrounded by a corona of solar rays, flames, and stars. His skin seems to be burned by fire. At this point in time, both Mercury and Venus were in conjunction with the sun. Solar rays and stars on the central disk allude to the sun disk covering over Venus and Mercury, making them invisible in conjunction. The sequence of Xolotl images fits perfectly with the real-time astronomical events and the related seasonal events, offering another compelling example of how the sequence of images coordinates with astronomical and seasonal events.

CONCLUDING REMARKS

The interdisciplinary study of Mesoamerican archaeoastronomy, a field pioneered by Anthony Aveni, helps to elucidate the meaning of astronomical images in the Codex Borgia. Study of the seasonal cycles and Venus events is essential to advancing our understanding of the magnificent narrative paintings on Borgia 29–46. Many different interpretations of Borgia 29–46 have been published over the past century, but scholars must recognize that an understanding of the art forms and astronomy is a prerequisite to interpreting the complex images in this narrative sequence. The multiple lines of evidence presented here provide convincing links with real-time events, but it may take a new generation of scholars trained in both astronomy and iconography to fully appreciate what is conveyed by the most eloquent picture-writing in the Codex Borgia.

The ability of Mexican artists to represent complex ideas using representational images means that glyphic writing was not an essential component to conveying astronomical knowledge. Nevertheless, an ability to "read" the pictures probably was a specialized form of knowledge. In order to understand the images, we must adopt the framework used by the calendar priests, one that incorporated a knowledge of astronomy; the events in the seasonal cycle; the movements of their most revered planet, Venus; and their most feared cosmic threat, solar eclipse.

The dramatic imagery on page 40 depicts the most important solar eclipse event in central Mexican history, an almost total solar eclipse in August 1496 recorded in numerous sources. The 1496 eclipse coincided with the ninth month of the central Mexican festival calendar. Its representation on page 40 confirms the sequence of festivals I proposed in 1989. Overlaps with the sequence of events in the festival calendar include a festival to Xipe Totec on page 33 and another to Xochiquetzal on page 44, all spaced at the appropriate intervals. The imagery on Borgia 46 also represents burning the fire serpent, a prominent feature of the fifteenth veintena, Panquetzaliztli. The Codex Borgia festival calendar is aligned with the solar seasons, so that page 29 opens with a period incorporating the winter solstice in the sixteenth veintena, and page 46 closes with the fifteenth veintena, the period of an annual fire ceremony around the time of the solar nadir. The calendar sequence also confirms the general discussion of Venus phases developed in 1989, but provides a closer link between the iconography and actual Venus events. The Evening Star is burned in a funerary bundle on page 29, just at the time that the Evening Star is transformed into the Morning Star during the sixteenth veintena (Table 5.2).

About a year later, the Evening Star reemerged during the fifteenth veintena in 1496, in accord with the Venus imagery on page 46, where Quetzalcoatl is transformed by being burned in a pot.

Pages 29–46 detail only one year of the eight-year Venus almanac, but the year highlighted is of considerable astronomical significance because there was a rough correspondence between the winter solstice and the beginning of a new Venus cycle.[14] In this year, Atamalcualiztli, the main festival of the Venus almanac, was celebrated at the midpoint of superior conjunction in October. The Venus almanac year ended shortly after the solar nadir in November, when Venus reemerged as the Evening Star. Moreover, this almanac year incorporated the solar eclipse of greatest magnitude visible in central Mexico during the entire period of the Aztec empire.

NOTES

1. Boone (2007) includes a sixth codex, the Porfirio Díaz Reverse, which she links most closely with the Borgia and Cospi. She finds the Laud, Vaticanus B, and Fejéváry-Mayer share more common features, including day signs and a number of thatched roof types that are closest to the Mixtec historical codices. Others have proposed this second group is linked with the Gulf Coast, whereas the Codex Borgia and its closest counterparts originated in the highlands of central Mexico (Sisson 1983). None of the Borgia Group codices is Aztec, but it must be noted that there are no known pre-Conquest codices from the Valley of Mexico (Robertson 1959; Boone 1983: 3). The earliest known pictorial Aztec codex, the Codex Borbonicus, dates shortly after the Spanish Conquest, probably between 1521 and 1541 (Boone 1982: 157; 2000b: 23). Boone (1982: 158) pointed out that, despite stylistic differences, the Codex Borgia and Codex Borbonicus are similar in content.

2. Late Postclassic murals at Tehuacán Viejo and ceramics from Tehuacán's Venta Salada phase (AD 1300–1520) also evoke specific comparisons with the Codex Borgia (Chadwick and MacNeish 1967: 114–115; Sisson and Lilly 1994a, 1994b). Tehuacán (Teohuacán) was conquered by the Aztecs during the reign of Moctezuma Ilhuicamina (Hassig 1988: 170) but Cholula, in Puebla, and the small neighboring state of Tlaxcala remained independent.

3. Aveni (1999: S9) also proposed that the 1 Crocodile 1 Reed date could mark the synchronic rise of Venus, when it rose exactly with the sun. This would represent the approximate midpoint of the short period between the last visibility as Evening Star and the first rise of the Morning Star in an eight-day canonical interval of inferior conjunction. Victoria Bricker (personal communication, 2002) pointed out that in April 1467, the actual disappearance interval was only six days, so the date in question must refer to ELAST.

4. Studying images of Quetzalcoatl, Seler argued that pages 29–38 cover three Venus phases; pages 39–44 portray Venus invisible in inferior conjunction over an eight-day period, and the last two pages (45 and 46) represent the reemerging Morning Star (Milbrath 1989: figure 1). Although Seler recognized the importance of changing Venus phases in the sequence of pages, he assigned arbitrary periods of time to each page. He did not recognize that the narrative is clearly divided into eighteen parts by the actual number of pages, as well as by framing elements used on many of the pages (Milbrath 1989).

5. My proposed sequence of festivals is identical to the one I published in 1989, with page 29 corresponding to Atemozltli, the same month that began the annual festival calendar in Tlaxcala (Caso 1967: 39; 1971: 343). The Tlaxcalan sequence is shown pictorially in the Veytia Calendar 5, which represents the five nemontemi ("unlucky days") directly preceding Atemoztli (Glass 1975: figure 75). In a Tlaxcalan festival calendar recorded around 1581, Atemoztli began on December 27 (Acuña 1984: 228), ten days later than the Aztec dates estimated for 1495–1496 (Figure 5.2). The Tlaxcalan festival names are the same as the ones from Aztec sources except for the substitution of two names considered to be regional variants (Nicholson 1971: table 4n1). These substitutions are Xilomanaliztli for Cuauhuitlehua and Coailhuitl for Tlacaxipehualiztli.

6. There is up to four weeks' variation in the dates ascribed to the months in the central Mexican festival calendar. The calendar dates recorded in Sahagún's *Primeros Memoriales,* composed between 1559 and 1561 using data gathered at Tepepulco, are eight days earlier than those in the majority of other calendars. *Primeros Memoriales* dates Xilomanaliztli to February 6–25 (Jiménez Moreno 1974), whereas Caso's (1971: 344–345) and Nicholson's (1971: table 4) syntheses begin this month on February 14. Sahagún's (1950–1982, 2) Florentine Codex uses dates only one day later than *Primeros Memoriales.* Although the Codex Magliabechiano apparently predates Sahagún's texts and may be based on information recorded as early as 1529, its dates are much less reliable and the months are not grouped consistently into twenty-day periods (Boone 1983: 3–4, table 20). The dates for Xilomanalitzli are March 1–20 and the remaining veintenas are likewise about two weeks later than most sources. *Relaciones Geográficas del Siglo XVI: Tlaxcala* (ca. 1581) corresponds fairly closely to the Codex Magliabechiano, beginning the same veintena on March 2 (Acuña 1984: 226). Despite variation in the dates, the sequence of months is generally the same, and the few exceptions appear to be errors. For example, *Relaciones Geográficas* mistakenly records Panquetzaliztli (the fifteenth month) in place of Pachtontli (the twelfth month).

7. Caso (1967: table 15) believed that the festivals continued without any adjustment so that they migrated through the seasons over many centuries, but the calendars he studied were actually all from the early to mid-sixteenth century. Some form of adjustment to the festival calendar is implicit in the alignment of the astronomical events in the New Fire ceremony with the festival of Panquetzaliztli, the fifteenth veintena. The New Fire ceremony coincided with the midnight zenith passage of the Pleiades and the solar passage through the nadir at the beginning of the dry season,

just as the solar zenith passage six months later marked the beginning of the rainy season (Milbrath 1980). The Aztecs calculated when the sun was in its lowest position at midnight (the solar nadir) by observing when the ecliptic arched directly overhead at the midnight zenith passage of the Pleiades (Milbrath 1980, 1989: 106; Broda 1982; Krupp 1982). The solar nadir passage fell on November 11 or 12 (November 21 or 22 in the Gregorian calendar). In Sahagún's *Primeros Memoriales,* the fifteenth veintena (Panquetzaliztli) began on November 12 (November 22, Gregorian), coinciding with the solar nadir passage on that date (Milbrath 1989: 106, figure 1). In the 1519–1520 version of the festival calendar, the astronomical events in question would fall in the fourteenth veintena (Quecholli), dated from November 1–20 (Table 5.2; Nicholson 1971: table 4). Indeed, Broda (1980) suggests that the New Fire ceremony could be celebrated in either Quecholli or Panquetzaliztli. If a leap-year adjustment were made every four years, the key stellar event would shift between those two months.

8. Xochiquetzal is a lunar goddess, which may be why Seler (1963, 2: 55–56) identified the rayed disk on her torso in Borgia 44 (Figure 5.5) as the moon disk, even though it bears little resemblance to the moon (compare Borgia 10, 18, 50) and seems instead to be the sun disk (compare Borgia 23, 40, 49). A lunar goddess wearing the sun disk may be an image showing conjunction between the sun and the moon at the time of the new moon (Milbrath 2000: 44).

9. Star imagery abounds in the Precolumbian codices of central Mexico, but eclipse imagery has not been definitively documented. According to Gordon Brotherston (1979: 105–108), Codex Laud 1 shows a solar eclipse with the sun disk covered by a stream of darkness. Originally interpreted as a preventative or cure for a solar eclipse, showing the death god sucking darkness from the sun disk, Brotherston (1995: 150, figure 148) now describes the same image as Mictlantecuhtli exhaling darkness, causing the solar eclipse. Another possible image of a solar eclipse appears on page 26 of the Codex Vaticanus B (Hernández and Bricker 2004: 299, figure 10.12c).

10. José Corona Núñez (1989: 44) suggests that the day signs contain a previously unrecognized lunar calendar. He interprets the day signs as a series as eight sets with fifteen-day intervals between for a total of 3 × 8 = 24 × 15 = 360 days, or 12 lunar months of 30 days, with five extra days added at the end (the nemontemi). He reads the day signs in a clockwise direction, starting to the right of the earth monster's head (Figure 5.10a). He continues to read around the entire body of earth monster figure in the same direction, even though the faces of the day signs change orientation on the left side of the earth monster frame. The way the heads face indicates the normal reading order throughout the Codex Borgia, and I see no reason to propose a varied reading here. As has been recognized in most published interpretations of the day sequence on 39–40, the orientation of the day signs indicates there are two separate counts that move in opposite directions, beginning at the monster's head and ending below at the ball court.

11. The magnitude of a solar eclipse is the maximum percentage of the sun's diameter covered by the moon during the eclipse.

12. We can exclude all but four of the recorded eclipses because they do not conform to the defined parameters. For example, the eclipse of 1426 fell in the thirteenth month (Hueypachtli). Adding 120 days brings us to the first festival of the year (Atlcahualo), a month that does not have a recorded fire ceremony. The 1477 eclipse fell in the seventeenth month (13 Tititl with an intercalation and 3 Tititl without such an adjustment). Counting forward from this month brings us back around to the fifth veintena, also not one associated with a fire ceremony. This reconstruction presumes that there was some form of intercalation. If there was no seasonal adjustment to the calendar, the eclipse in October 1426 fell near the end of the twelfth month (18 Pachtontli). Adding 120 days brings us to the eighteenth month (18 Izcalli). This month had a fire ceremony, but this placement in the calendar is unlikely because scholars have concluded that there is some form of adjustment to the central Mexican calendar that kept it in alignment with the seasons (see Note 7).

13. An eclipse on February 9, 1301, of a similar magnitude (98 percent) seems too early to be a candidate, given the focus on sixteenth-century events suggested by studies of real-time events on pages 27–28 (Aveni 1999). Furthermore, if we link page 40 to the 1301 eclipse and add a 120-day interval, we do not find a veintena with a corresponding fire ceremony described in the central Mexican festival calendar. The 1301 eclipse coincided with the beginning of the five-day nemontemi period that ended the year in the Conquest period calendar (Nicholson 1971: table 4). Six veintenas later would correspond to the sixth month (Etzalcualiztli), a festival not associated with a fire ceremony. In the unlikely event that there was no seasonal adjustment to the festival calendar, the 1301 eclipse date would fall in the sixteenth veintena (Atemoztli), a festival that began on February 3 in the years 1300–1303 according to Caso's (1971) calendar. Counting six veintenas later brings us to the fourth veintena, which is not one associated with a fire ceremony.

14. A given day in the Venus cycle of 584 days correlates with a specific day of the solar cycle only once every eight years. The Aztecs had a special ceremony called Atamalcualiztli that is linked with this eight-year period (Sahagún 1950–1982, 4: 144; Milbrath 2000). There is a seasonal pattern of Venus phases and positions that repeats every eight years, a period known as the Venus almanac, but the solar and Venus events gradually shift over time (Milbrath 1999: 186).

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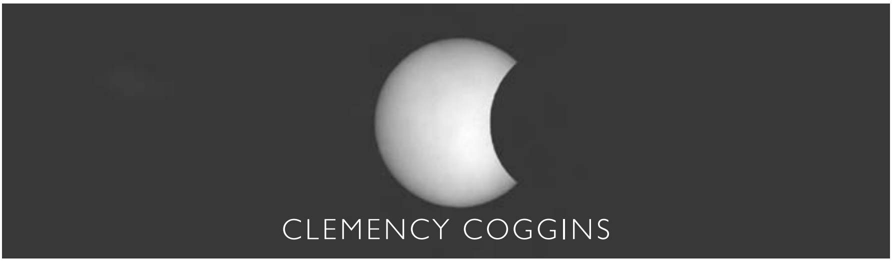
CHAPTER SIX



CLEMENCY COGGINS

The Measure of Man

INTRODUCTION

In August 1977, I participated in a conference at Colgate University on Teotihuacan and Classic Mesoamerica—a topic that has consumed much of my professional life. My paper, titled "The Shape of Time" (Coggins 1980), considered evidence for an Early Classic Teotihuacan presence at Tikal, Guatemala, and postulated that the Mesoamerican calendar had played a significant role in the interaction between intrusive central Mexicans and the Lowland Maya of Petén during the Early Classic period: the pecked crosses at Uaxactun figured in this hypothesis (Figure 6.1). Anthony Aveni, an organizer of the conference, was surprised to find someone exploring a topic closely related to his own research. He was about to publish his initial work on pecked crosses (Aveni, Hartung, and Buckingham 1978) and was not aware anyone else had noticed the ones at Uaxactun or that they might figure in that conference. Pecked crosses were

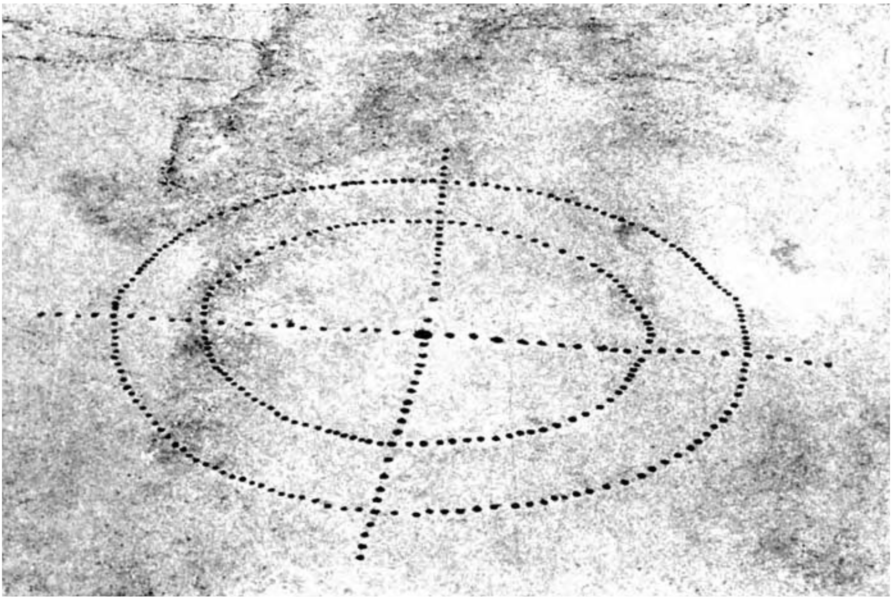


Figure 6.1. Pecked cross on stucco floor; diam. approx. 2.5 m; Structure A-V, Phase 1c-e, Uaxactun, Petén, Guatemala; Early Classic. North at top; photo from south, at angle. (From A. L. Smith 1950: figure 15a.)

important tools for religious professionals and this paper uses them as concrete evidence for a broader interpretation of Mesoamerican religion. These hypotheses involve the universal calendar and basic systems of bodily measurement used throughout Mesoamerican prehistory—traced here, frequently backward, from central Mexico to the Maya and finally to the Olmec.

PECKED CROSSES AND THE COUNT OF 20

In addition to advice Aveni gave me concerning site orientation at Dzibilchaltun (Coggins and Drucker 1988), two themes in his many papers on Mesoamerican astronomy have interested me particularly. These are the role of calendars, and how the count of 20 was a gauge for the ancient skywatcher and priest. The fundamental importance of the count of 20 is evident in the Mesoamerican calendar where it denotes the basic number of days, whether in the ritual count of 260 days or in the synchronous solar/agricultural calendar of 365 days. In his initial article on pecked crosses, Aveni and his coauthors, Horst Hartung and Beth Buckingham, emphasized that "the central theme of the [Calendar

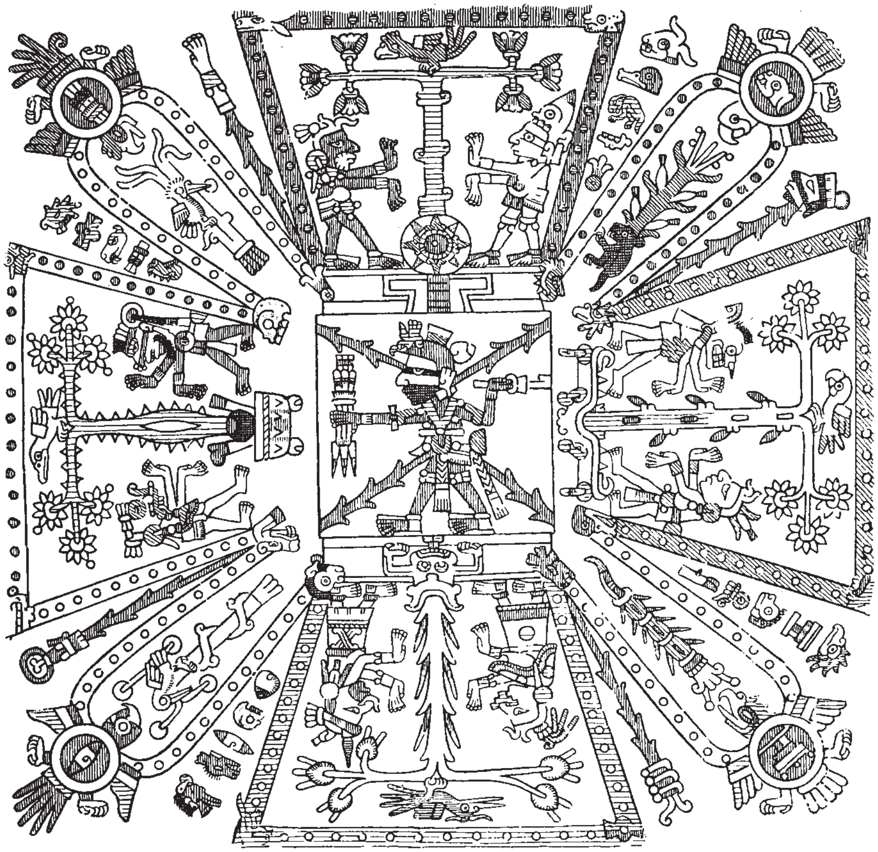


Figure 6.2. (a) Calendrical and directional diagram, Codex Fejérváry-Mayer, p. 44. Painted animal skin screenfold, h. 17.5 cm, l. 4.00 m; Mexico; Mixteca-Puebla; Pre-Conquest. East at top. (From Danzel 1922: plate 53.)

Round is] the unification of the two counts" (Aveni, Hartung, and Buckingham 1978: 277). The pecked crosses, they postulated, served as calendars, as orientational devices, and perhaps also as religious games involving divination. Aveni stood by this analysis in his 2001 revision of *Skywatchers,* by which time more than two hundred pecked crosses had been found and measured (Aveni 2001: 226–233, 329–334). A pecked cross is formed by pecking small depressions into stone or a plaster floor, to outline a figure usually consisting of a cross centered on two concentric circles. The depressions or holes may be counted in different ways, but a common arrangement involves patterns readable as either 20 or 18, although 260 is also found: all three are basic components of the Calendar

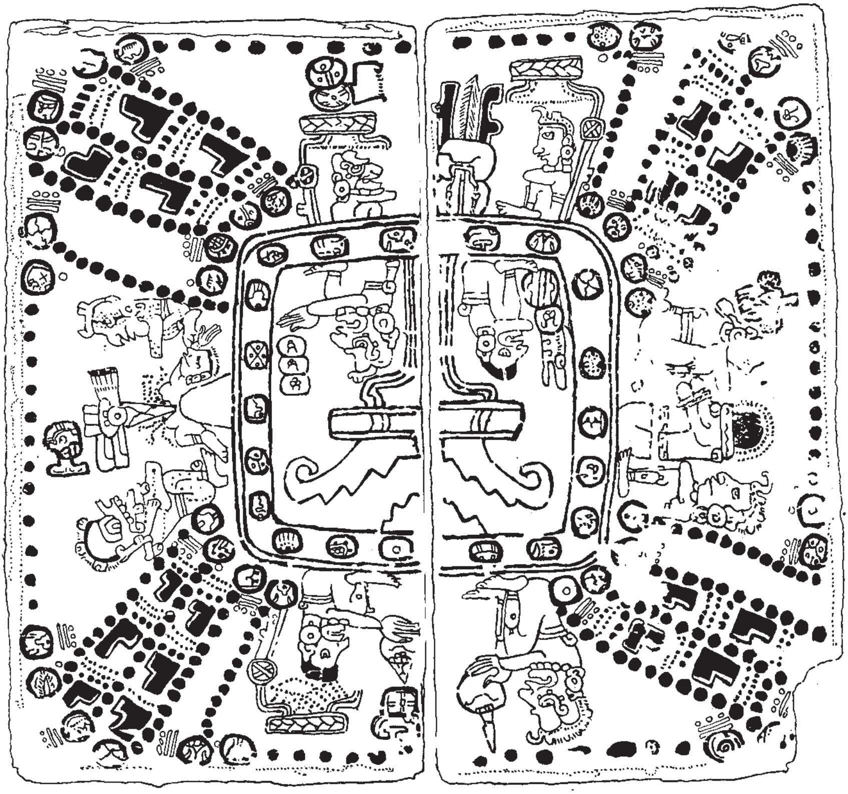


Figure 6.2. (b) Calendrical and directional diagram, Madrid Codex, pp. 76–75. Bark paper screenfold, h. 23 cm, l. 6.82 m; Yucatán, Mexico; Maya; Pre-Conquest. East at top (for orientation, see Paxton 2001: figure 3.2a). (From Villacorta and Villacorta 1933: 374–376.)

Round. Other pecked cross counts were probably determined by the dates of local solar observations and were thus more variable, as Aveni has found at Uaxactun (Aveni, Dowd, and Vining 2003: 171).

In his discussions of pecked crosses, Aveni has used the frontispiece of the central Mexican Codex Fejérváry-Mayer to explain how the crosses may have worked, since one at Teotihuacan closely resembles the Maltese Cross form of that Late Postclassic diagram (Figure 6.2a; Aveni, Hartung, and Buckingham 1978: 276; Aveni 1989: S109; 2000: 259–265). An analogous Maya example is found in the Late Postclassic Madrid Codex (Figure 6.2b*);* together, they provide stunning evidence, a millennium or more after Teotihuacan, of the persistence of fundamental and enduring Mesoamerican rituals that involved both temporal and spatial dimensions and were exemplified by the calendar.

Reflecting upon two pecked cross–like pages, in the Madrid Codex and in the Colonial Maya *Book of Chilam Balam of Kaua,* Aveni and Hartung investigated the role and significance of the solar calendar and of 20-day periods in the orientation of Maya sites in the Puuc, Yucatán (Aveni and Hartung 1986). As they note, "an orientation is an alignment with a purpose" (ibid.: 2). At Uxmal they found, among other observations, that the *haab,* or solar/agricultural calendar of 360 + 5 days, was segmented into 20-day intervals to mark the sunset alignment that had determined the orientation of the Pyramid of the Magician (ibid.: 37). They concluded that "the orientation calendar pivoted about the axes of the sun in the zenith [and that] the calendar was organized to indicate these events by marking the rising/setting positions of the sun at 20-day intervals, leading up to the first of the year" (ibid.: 59).

At Teotihuacan, Aveni found that the site's principal orientation is aligned to sunset on the two critical mythohistorical dates of April 29 and August 12. These alignments mark dates that figure in units of 20 days separating the equinoxes and the dates of solar zenith passage. These calculations are reflected in the pecked crosses that Aveni emphasizes are not astronomical and, further, that the alignments may have been less important than the counting itself (Aveni 2000: 254–259; lecture at Boston University, March 9, 2004). Counts of 20 days may have determined orientation and organized calendrical ritual in central Mexico as they apparently also did in the Maya regions. In his recent work with orientations and calendars, Aveni has returned to his earlier investigation, with Horst Hartung, of "E-groups" at Uaxactun and elsewhere (Aveni 1989). Exemplified by Group E at Uaxactun, such groups are thought to have served the ancient Maya as observatories in which a pyramidal viewing structure on the west and a long platform on the east were constructed to mark the points of sunrise at the equinoxes at the center and the solstices at either end of the eastern platform (Figure 6.3). There are many such groups in northern Petén, and it has been debated how many, if any, were accurate observatories or perhaps nonfunctional replicas of such groups. Aveni and Hartung concluded in 1989 that most of the twenty-eight they investigated were not precise and thus did not work as solar observatories, at least of the Group E type. Recently, however, Aveni and colleagues Anne S. Dowd and Benjamin Vining have remeasured an additional twelve E-groups and concluded many were indeed functional: they used a calendar calibrated in 20-day intervals that led up to the first solar zenith, which falls on May 10 in northeast Petén (Aveni, Dowd, and Vining 2003: 163). However, they also found that in Preclassic times this calendar had been preceded by another, exemplified by the prototypical

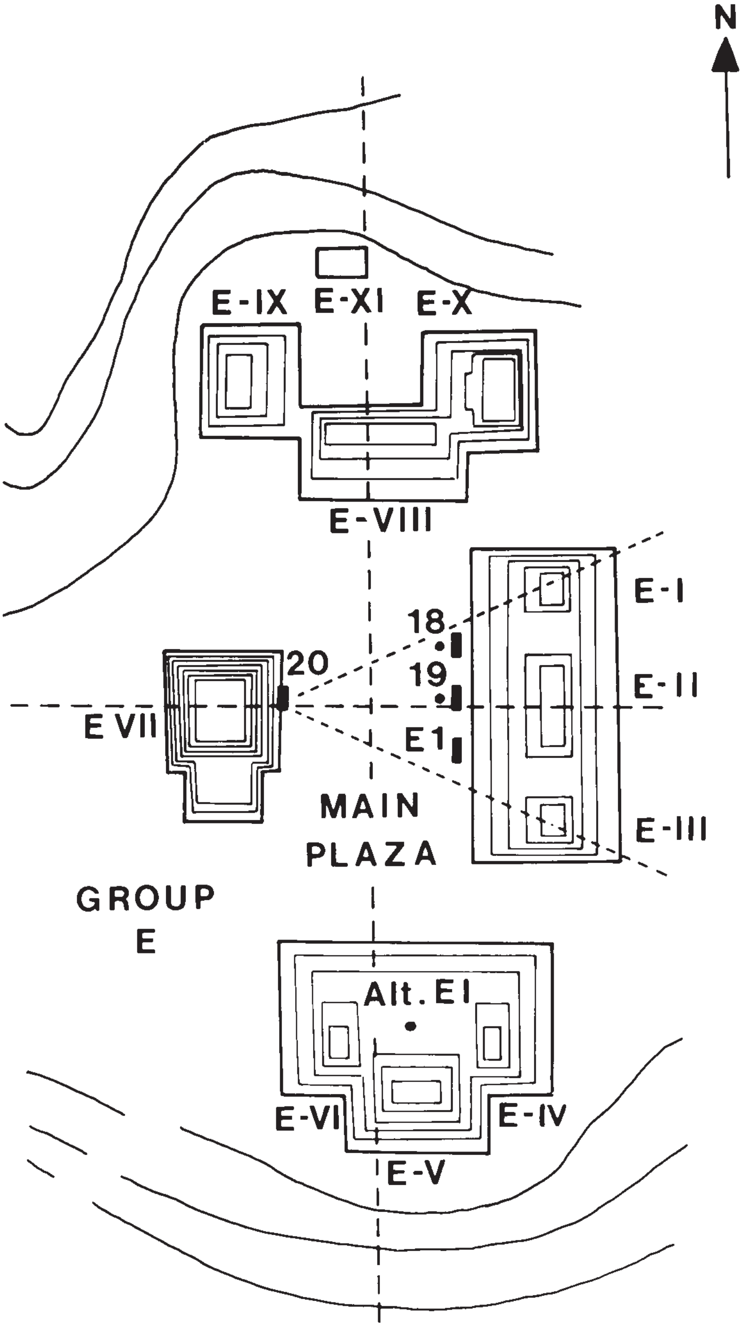


Figure 6.3. Uaxactun, "E-group"; Classic period modification of group. (From Coggins 1980: figure 5, after Ricketson and Ricketson 1937: figure 68).

Uaxactun E-group, which focused on equinoxes and solstices rather than on solar zenith dates. They concluded there were two types of E-groups, and that a change in calendrical observation had occurred when a central Mexican model was introduced during the Early Classic period. I had proposed the same idea in the paper I gave at Colgate in 1977, although I lacked the observational data to document it.

THE VIGESIMAL COUNT

Many cultures, ancient and modern, have used 20 as their basic unit for counting, although most European cultures used a decimal rather than a vigesimal system. In the northern hemisphere, the Inuit and groups through California down to southern Central America counted vigesimally, as did the Ainu, Gaelic speakers, and the Basque, among others (Farris 1990: 173). The broad distribution of vigesimal counting has a certain geographic logic, although in some cases the two systems coexisted as neighbors, as they did among indigenous groups in California (ibid.: 175). All Mesoamerican counting was vigesimal, often called "quinary-vigesimal," since the five fingers of one hand are the basic unit of the count of 20 (Nykl 1926). Indeed, the vigesimal count is the sum of man, or of his parts, and the word for 20 is virtually synonymous with the word for "man," or person, in many vigesimal cultures, including the Maya.

More than a century ago, in his discussion of Mesoamerican vigesimal counting, Cyrus Thomas explained that the basic structural implications of the system involved reduction to its component four and five units when applied to the organization of time and space—as in the four divisions of the calendar and the center plus four cosmic directions—which he termed "the cult of the quarters" (Thomas 1900: 948–953). However, he observes, the count "seems to have reference to no natural phenomena, save the earth's annual rotation" (ibid.: 953). The earth's annual rotation and the sun's seasonal movement were, in fact, exactly the phenomena that were correlated with vigesimal counts as documented in the pecked crosses, and E-groups, as well as elsewhere in Mesoamerica.

The body and especially the hands are the original mnemonic devices; they are always available and, by virtue of its numbers, the hand can create knowledge and structure memory as it transmits information with the added possibility of expressing emotion through gesture. The hand mediates between the individual and the natural world; it is agent of the head (Sherman 2000: 13). Aristotle observed the "hand is for the body as the intellect is for the soul." Furthermore, the hand distinguishes man from the animals (Kemp 2000:

22): numeracy equals culture. The hand, both as expression and as the basic counting unit, may stand for the whole person. Such metonymic principles, or *pars pro toto,* are basic to Mesoamerican symbolism. The Mexican periodical *Arqueología Mexicana* has recently devoted an issue (12:71 [2005]) to hands and feet as pre-Conquest symbols found in most ancient Mesoamerican cultures.

It has been suggested that counting to 20, and learning to multiply this unit to high numbers, might have developed in cultural contexts where beads or shells were counted as measures of wealth and exchange (Farris 1990: 186). In a trading culture, counting the days was a measure of both time and distance, and perhaps the origins of a calendar. The birth of such a measure of time and distance was the first act of creation for the Yucatec Maya, as we shall see. It is important, however, to understand that such counting designates things, like days or tribute. The numbers are not abstractions (ibid.: 189).

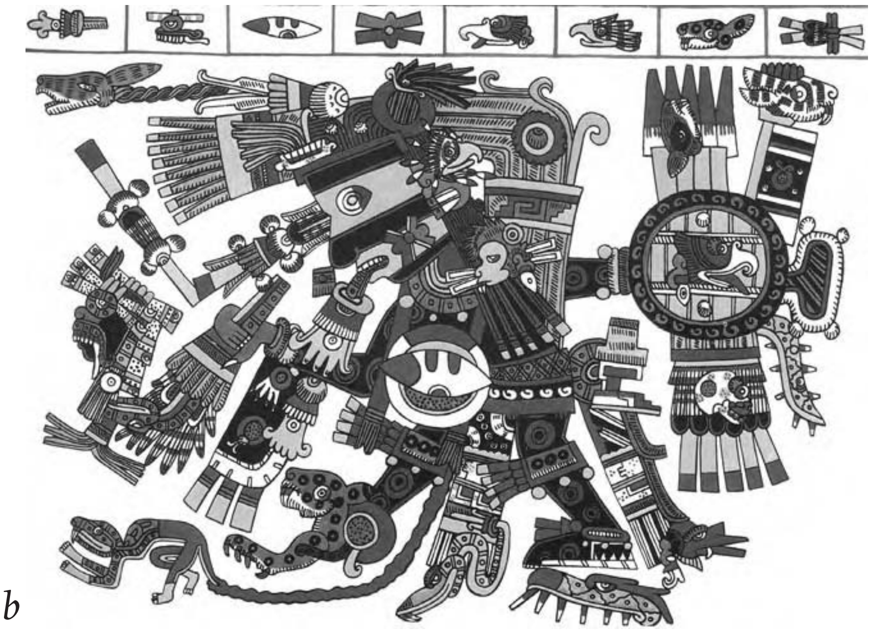
THE VIGESIMAL COUNT IN MEXICO

Perhaps the most fundamental conceptual characteristic among Mesoamerican cultures, irrespective of language spoken, was the Calendar Round, which comprised two synchronous counts. The first, of 260 days composed of twenty named days and thirteen numbers, was divinatory in purpose. The second, of 365 days, was solar and agricultural; this was composed of eighteen months of twenty days, plus five days. In Mexico, there is abundant visual evidence of the role of the two concurrent calendars in the Postclassic Mixtec and "Mixteca-Puebla" codices, and details of its structure and ritual were recorded in the sixteenth century by Spanish friars. During the Classic period, however, the evidence is indirect and perhaps most convincing at Teotihuacan where it may be inferred from the number schemes of the pecked crosses.

For the Aztec, *cempoalli* denoted one complete count. The basic Aztec calendrical period of twenty days was called *cempoalilhuitl* (Siméon 1988: xliv, 81)—a count of days. Cempoalli did not signify man, or person, although the number five, or *macuilli,* was the equivalent of one hand, and four of these, each with five fingers, constituted one count (Payne and Closs 1986: 215). Another word for 20 was *pantli,* signifying a file of twenty things but represented by a flag on a short staff; this term was used to designate counts of tribute, as seen in the Codex Mendoza (Berdan and Anawalt 1997*)* and other Colonial manuscripts.

Although the Aztec, and the creators of the Mixteca-Puebla Borgia Group of codices, may not have had the same word for man (or person) as for 20, there was an equivalence. This is particularly evident in the images of deities with

Figure 6.4. (a) Tezcatlipoca with twenty day signs attached to body, from Codex Borgia. Painted animal skin screenfold, h. 27 cm, l. 10.3 m; Mexico; Mixteca-Puebla; ca. 1500. (From Díaz and Rodgers 1993: plate 17; courtesy of Gisele Díaz and Alan Rodgers.) (b) Death/wind god with twenty day signs attached to body, from Codex Vaticanus 3773, p. 75. Painted animal-skin screenfold, h. 13 cm, l. 7.35 m; Mixteca-Puebla; Pre-Conquest. (From Danzel 1922: plate 18.)



the twenty day signs emanating from parts of the body, as found in the Late Postclassic Codex Borgia (Figure 6.4a) and the Codex Vaticanus 3773, among others (Figure 6.4b). Specific signs are not always attached to the same parts of the body or clothing, but their arrangement suggests the close identification and equivalence of the twenty day signs with the total persona and its constituents. Day signs are predictive of bad and sometimes good fortune, and such schematic images would have been guides to prognostication just as contemporary European soothsayers associated the signs of the zodiac with parts of the body.

In the sixteenth century, Sahagún explained the importance of the numbers four and five for the Aztec as the basic factors of 20, in the four year bearers that organized the solar calendar, and in each twenty-day month that was divided into four "weeks" of five days used to regulate the market schedule (Sahagún 1957: 137, 138 [appendix]). On a more cosmic level, the Aztec story of creation was structured in such a five-point (quincunx) schema, with the four previous ages, or Suns, framing the fifth—the present—Sun, centered within the endless cycling of the twenty day signs that encircled the complex didactic and allegorical Aztec Calendar Stone.

Like most cultures in Mesoamerica and the world, the Aztec probably measured their world by units derived from their own bodies. Traditionally, in European culture the standardized measurements based on the natural units of the body were essential, hence the measure from fingertip to fingertip was a fathom; cubits and yards had similar origins (Leach 1954: 110). In Colonial times, the Spanish *vara* of 84 cm was used; this unit corresponded to the distance from breastbone to fingertip, two of these equaling a *braza* or *brazada* of about 1.68 cm from fingertip to fingertip—although these lengths apparently varied by locality (Gibson 1964: 257–258).

It is significant that this is essentially the same measure used to lay out ancient Teotihuacan, probably in the first century of our era. Following the lead of others who had postulated a measure that determined the strictly regular plan of Teotihuacan, archaeologist Saburo Sugiyama found the unit was close to 83 cm. Like the vara, this unit described the distance from breastbone to fingertip (Sugiyama 1993). Multiples of this measure, which Sugiyama has named the TMU (Teotihuacan Measurement Unit), were used to lay out the site in numbers that corresponded to the days of solar and planetary cycles, to the sacred numbers that compose the basic units of the Calendar Round, and to the 52 years that make up the central Mexican "century." The ancient existence of this measure has recently been confirmed by the fractal analysis of a radar image and aerial photos of Teotihuacan (Oleschko et al. 2000). Thus, at Teotihuacan we have evidence in pecked crosses for the significant role of the count of 20, derived from the human body, in measuring the days and for multiples of length for planning the city that were used almost two millennia earlier on the Gulf Coast of Mexico. Such measurements of the human body probably determined the basic units of Olmec linear measurement, as in subsequent cultures. Archaeologist John Clark has postulated that the Olmec site of La Venta, Tabasco, was laid out with a brazada measuring 1.54 m (Clark 2001: 201). This measurement implies a vara 77 cm long—6 cm shorter than the Teotihuacan unit and 7 cm shorter than the Colonial one—a discrepancy that might be explained by variation in body size over a millennium, if not simply by local variation. In fact, Clark suggests that the elongated north/south center of La Venta, comprising the monumental architecture, was laid out in the same proportion he notes on some Olmec jade figurines where the head is one quarter of the whole body (ibid.: 183).[1] The ceremonial core of La Venta would thus correspond to an ideal human form (Figure 6.5). Beatriz de la Fuente, in her studies of monumental Olmec sculpture, always emphasized that man was the principal subject of Olmec art and culture (de la Fuente 1981: 83). Beginning with the anatomically based brazada, Clark believes the La Venta plan was designed with a basic 80 m module that was multiplied by 52 (the number of years in the 52-year calendar cycle) (Clark 2001: 196, 203), and that the plan was copied by later major Middle Preclassic sites that apparently share this elongated template based on the human form. It is noteworthy that in this anthropomorphic plan at La Venta, and perhaps elsewhere, the bottom (foot) position is occupied by an E-group (ibid.: 184–195).

We have some evidence of measurements based on the body in Middle Preclassic Olmec times, at Classic period Teotihuacan, and probably for the Postclassic Aztec, as well as indications of the significance of the body-derived Mesoamerican count of 20. For the Colonial Yucatec Maya, two varas were the equivalent of a braza, or *sap* (Barrera Vásquez 1980: 717), and the 20-*mecate* measurement of a *milpa* (or field) might be described as a *uinic* (man) (Álvarez 1984: 116).[2] Such ideas about the body were common currency in Europe around 1510 when Cornelius Agrippa, a German mystic and alchemist, wrote his *De Occulta Philosophiae,* including a chapter titled "On the Proportion, Harmony, and Measure of the Human Body." Agrippa explains that man "contains and sustains in himself all numbers, measures, weights, motions, elements and other components of his nature. . . . The common measures of all the body's parts are proportionate and consonant, thereby conforming to the parts of the cosmos and to the measures of the Archetype" (Copenhaver 2000: 51).

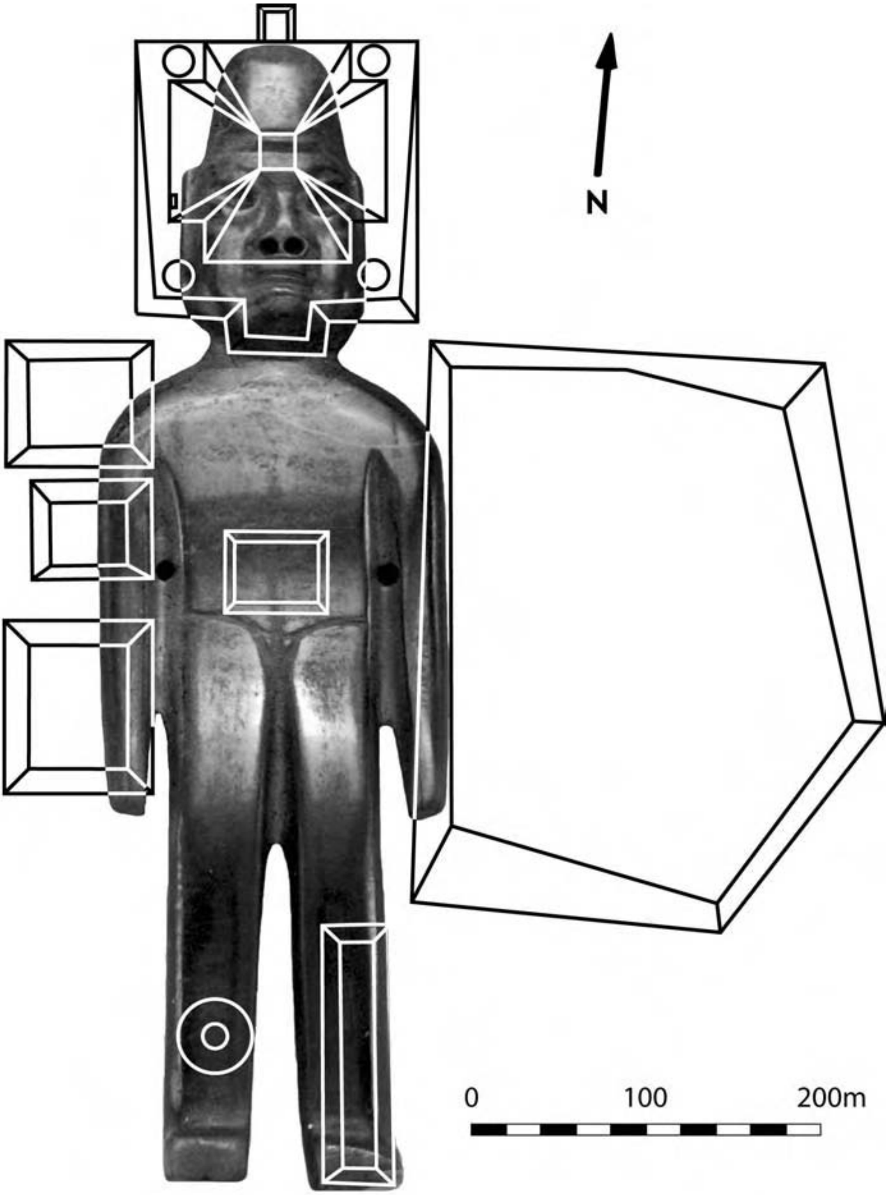


Figure 6.5. Olmec figure and plan of central La Venta, Tabasco. Figurine, jade, h. 23.8 cm; Middle Preclassic. Courtesy of John E. Clark.

THE VIGESIMAL COUNT AND THE MAYA

The Maya shared the general Mesoamerican Calendar Round and thus based their day counts on cycles of twenty days, as did virtually all peoples living in this continent between about 14° and 23° north latitude. In most Mayan languages, however, unlike most cultures to the north, the word for a period of twenty days, *uinal,* and the word for man or person, *uinik,* were variations on the same root (Seler 1887).[3] Twenty days, and longer vigesimally defined periods of time, form the basic structure of the uniquely Maya Long Count. Another Mayan word for 20 is *k'al,* which refers to a count of twenty, not unlike the Aztec *cempoalli.* In the word *k'atun, k'a(l)* indicates a period of twenty *tuns* (twenty 360-day years) in the Long Count. "Katun" is a key word and a fundamental concept, since the periodic ceremony associated with the completion of a katun dominated Maya ritual and religion from about AD 400 to 1800. The word for the completion of a complete cycle of thirteen katuns (or 260 tuns) was *may* (Edmonson 1988: 195), and this word may have been the origin of the name Maya, designating these people as celebrants of the thirteen-katun cycle. One significant characteristic of katun cycles involved the Maya understanding of time as a burden; time on its journey was carried on the back of a period of time by a tumpline around the forehead, as was any load. The burden was put down only at the completion of the journey, or cycle, before the next one was taken up (Thompson 1960: 59–61).

The Uinal

Probably the oldest and most important conflation of man and time, however, was the identity of twenty-digit man, divine or not, as uinic—the twenty days of the uinal being the basic period in the solar haab. This concept is illustrated, I suggest, in Early Classic stucco masks, 1.3–2.9 m high, that flank three levels of the western stairway of the Pyramid of the Masks at Kohunlich, Quintana Roo. The lowest-level masks and one of the second level represent a solar deity with uinal glyphs for eyes (Figure 6.6; Segovia 1969: 4–7). These glyphs identify them as players in a seasonal calendrical program, perhaps punctuated by sunsets marked to the west over major aligned structures (Nalda 2003: figure 19). An early form of the Pyramid of the Masks already existed in the Middle Preclassic period (ibid.: figure 10), and such an observational function probably governed its form and decoration, as has been suggested for the Late Preclassic pyramidal substructure, Structure 5C-2nd at Cerros, Belize, not

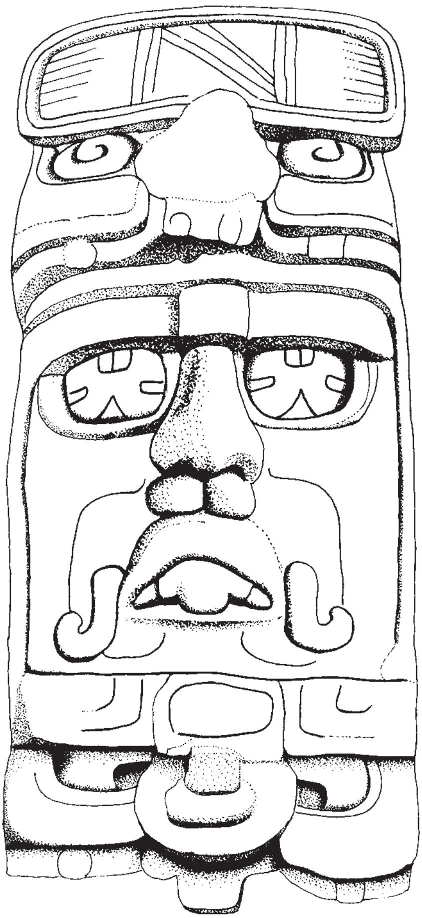


Figure 6.6. Mask, Stucco, h. 3.1 m; lowest mask, north side of stairway, Pyrámide de las Mascaras, Kohunlich, Quintana Roo; Early Classic. (Drawing by Steven Morandi after Segovia 1969: foto 8 and Nalda and Velázquez 1994: 41.)

far to the southeast (Schele and Freidel 1990: 104–116).

The Beginning of Time

In the beginning, for the northern Maya, time began with the first day of the first count of the uinal, as recounted in the Book of Chilam Balam of Chumayel written at the town of Chumayel, south of Mérida, Yucatán. The book contained the enigmatic writings of a Colonial Maya calendar priest who recorded history and prophecy—essentially the same concept for the Maya—within the framework of the count of katuns. Recorded early in the nineteenth century in Yucatec Maya written in the European alphabet, the Chilam Balam of Chumayel was translated into Spanish by Antonio Mediz Bolio (1985) and into English by Ralph Roys (1967) and Munro Edmonson (1986). The beauty and scriptural significance of one particular passage were first illuminated for me by Gordon Brotherston in an article in which he illustrated the esoteric and poetic use of puns, so characteristic of Mayan languages, in his translation of the section he titled "The Beginning of Time" (Brotherston 1979: 248–256). Edmonson (1986: 120) named this story "The Birth of the Uinal" and Victoria Bricker (2002: 14–18) called it "The Creation of the Maya Week." This Maya narrative describes how time began before the creation of the world. Time began with the spontaneous motion of the anthropomorphic uinal who moved along with "a mesh of feminine beings" (Brotherston 1979: 253), namely, "his mother's mother, and her mother, his mother's sister and his sister-in-law" (ibid.: 249).[4] When they arrived in the east, they found footprints and matched the rhythm of the step of an unknown being. They measured the footprint of this divine being and counted the whole world by footsteps, while creating the twenty days (ibid.: 249). Edmonson translates:

> This was the beginning of saying
> The count of the world by footsteps.
> This was / 12 Oc [Foot].
> This is the account of his birth.
> For 13 Oc [Foot] occurred,
> And they matched each other's paces
> And arrived
> There
> At the east. They said his name,
> Since the days had no name then,
> And he traveled on with [the women, and then] The month was born,
> And the day name was born,
> And the sky was born,
> And the earth. (Edmonson 1986: 121–122)

After further acts of creation

> On 1 Monkey (Chuen) he manifested
> Himself
> In his divinity
> And created heaven
> And earth.[5]
> On 2 Peak (Eb)
> He made the first pyramid. (Ibid.: 122)

This first day of creation was 13 Oc (Foot) and the creation continued day by day for the count of 20 named days.[6] Then

> On 12 Wind (Ik)
> Occurred the birth of breath
> or life, and the next day [13 Akbal]
> Then he moistened the earth
> And shaped it
> And made man. (Ibid.: 123–124)

On the last day, 6 Muluc, the uinal said

> Thirteen heaps
> And seven heaps make one (ibid.: 125)

which is a reference to the 13 + 7 numbers that make up the uinal. Then men spoke for the first time,

> And then they stood there
> In the middle of the country
> And divided it up
> into four parts, with the four Burner lords. (Ibid.: 125)

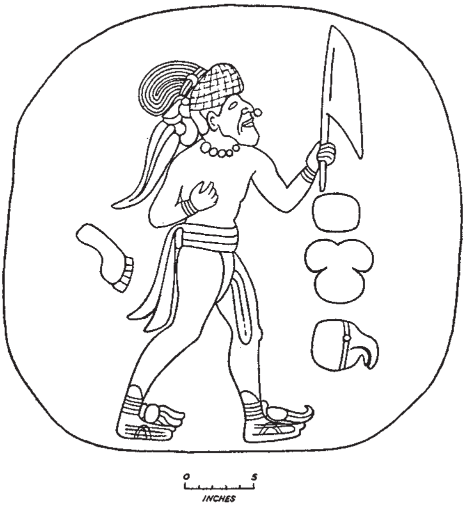
Brotherston explains:

> [I]n this Maya genesis the primary force is the uinal, the figure who embodies the 20 signs of Mesoamerican cultures. As a beginning, the uinal stirs in the absence of all else. The first proof of his existence is his movement. This movement is inherent and axiomatic. . . . In their origin theory [the Maya] avoided the problem of needing to set static space into motion by making movement itself the prime fact of the universe, prior to matter, structure, and even thought." (Brotherston 1979: 252–253)

This is the eternal movement of the sun, the perpetual cycle of the days that were the uinal. The only objective evidence of this movement is footprints, and Brotherston (ibid.: note 9) notes that "[Heinrich] Berlin (1958) commented on the frequent association of the uinal with the foot glyph."[7] In the Book of Chilam Balam of Chumayel, it is clear the count of 20, the uinal, was born in the east where he started walking and that creation occurred only as he moved, including the creation of man; at the end, the world was divided into four quarters, with four burners (patrons of the periods). The uinal preceded man and it comprised him; man is a part of the transcendent uinal, not vice versa, and he reflects its perfection in his own vigesimal composition.

By Colonial times in Yucatán the Classic Maya Long Count was reduced to a calendrical ritual involving the completion of katuns, or 20-tun periods. This periodic ceremony provided the temporal framework for prophecy, which involved past historic events as well as predicting the future, and the count also served to organize northern lowland towns hierarchically (Edmonson 1986: 37–39). Katun completion ritual had lost the Classic period association with specific Maya rulers and their lives that had begun in the southern lowlands late in the fourth century AD (Coggins 1979, 1980). I suggest that from Preclassic times the body of the ruler was seen to exemplify the elite Long Count period of twenty tuns (a katun) in the Gulf Coast and southern Guatemalan regions, as the body of everyman exemplified the twenty days of the uinal. On the Middle Preclassic Stela 13 at La Venta, a striding man is identified as the uinal by a footprint and probably also by the flag he carries that

Figure 6.7. Monument 13, basalt, diam. 70–80 cm; La Venta, Tabasco; Middle Preclassic. (From Drucker 1950: figure 61.)



may signify 20, as it did for the later Aztec (Figure 6.7).[8]

Beginning in the Early Classic period, the ruler on katun completion monuments was the personification of the katun, the more privileged count of 20. The ruler alone was described in terms of his katuns; on Stela 16, Jasaw Chan K'awil of Tikal is portrayed in the third katun of his life. However, the ruler signified the count of 20 long before the introduction of katun completion ritual. This was expressed in several ways at different times. In the northern Maya Lowlands, on the Middle Preclassic stela recently found at Cival, Petén, the figure is portrayed striding (Figure 6.8; Estrada-Belli et al. 2003). In Late Preclassic royal portraiture the ruler was still shown walking, in emulation of time itself, as in the Loltún (Yucatán) portrait where he is only identified with a Calendar Round date (Figure 6.9).[9] The katun is not part of this symbolism because these northern Maya lords were probably not using the Long Count. Later, to the south, in the Early Classic period, the ruler's accession, or seating, was expressed in terms of the seating of the vigesimal periods of Long Count time. This is clear on the back of the Leyden Plaque, where

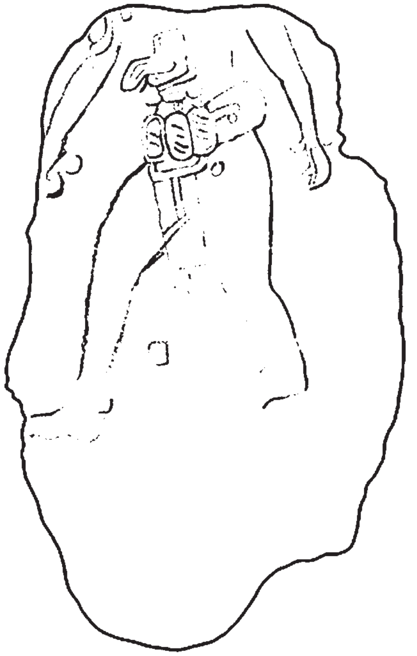


Figure 6.8. Stela 2, limestone, max. h. 177 cm ; Cival, Petén; Middle Preclassic. (From Estrada-Belli et al. 2003: figure 4. Drawing courtesy of Nikolai Grube.)

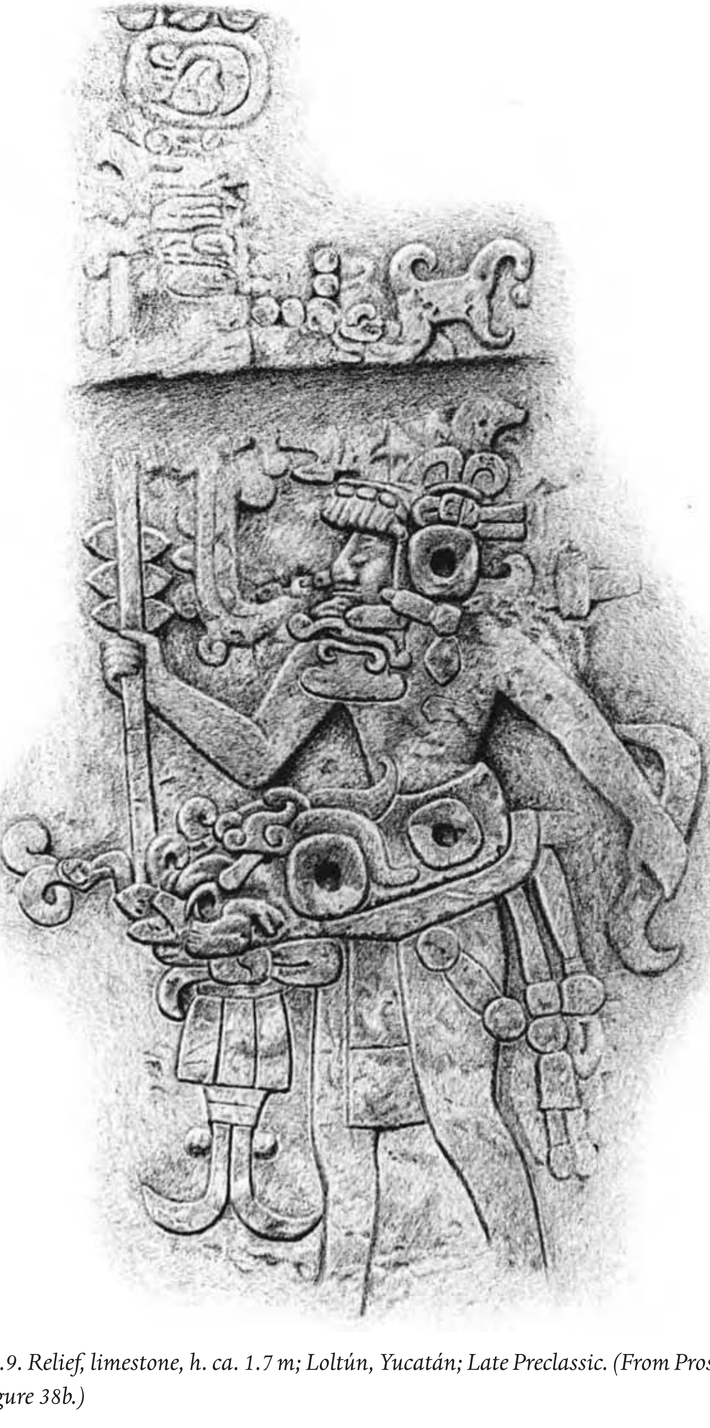


Figure 6.9. Relief, limestone, h. ca. 1.7 m; Loltún, Yucatán; Late Preclassic. (From Proskouriakoff 1950: figure 38b.)

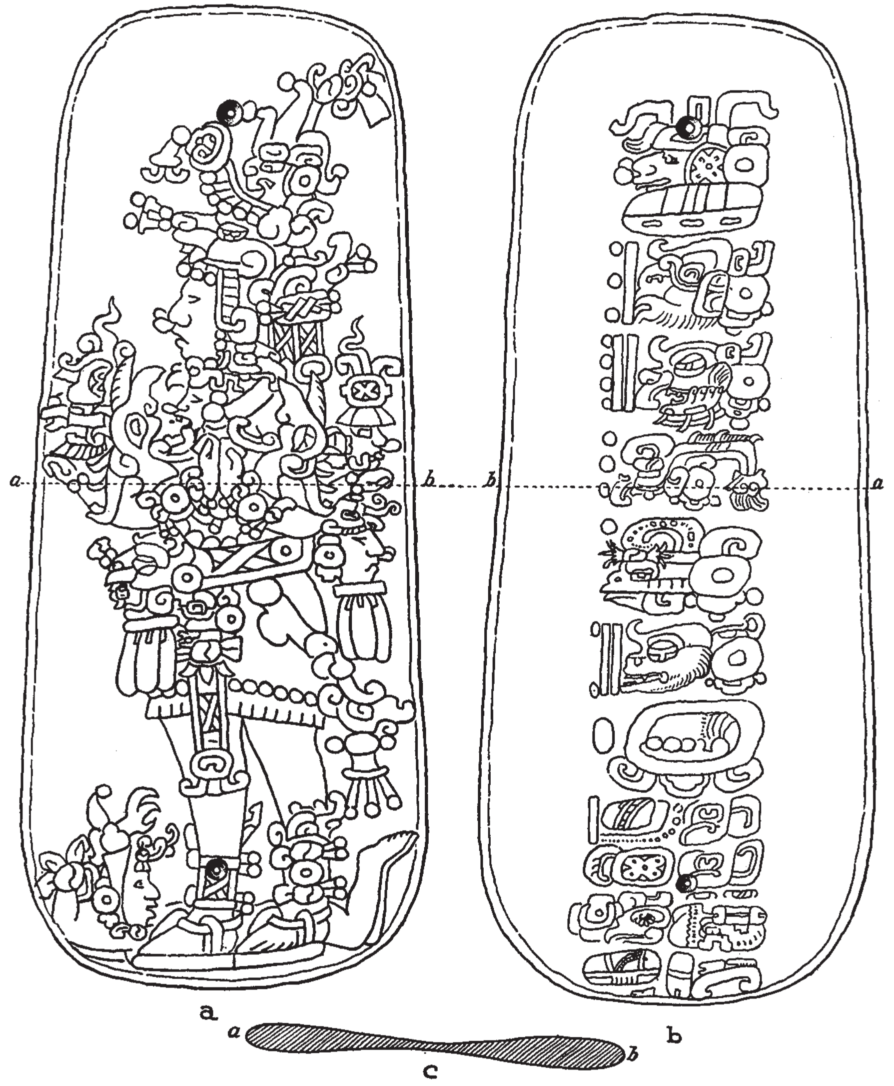


Figure 6.10. Leyden Plaque, jade, h. 21.7 cm; Puerto Barrios, Guatemala; Early Classic. The Long Count date is 8.14.3.1.12, 1 Eb, 0 Yaxkin (AD 320). (From Morley and Morley 1938: figure 2.)

the Initial Series inscription, day sign, and Lord of the Night are followed by the seating of the uinal (0 Yaxkin) and the seating of the ruler (Figure 6.10). The seating of the uinal and the seating of the ruler are recorded in the inscription as a couplet, making the two events analogous. Maya Long Count inscriptions also have a basic structural characteristic that establishes the primacy of the uinal. The head glyph for the patron of the "month," or uinal, crowns and thus precedes the Initial Series Introducing Glyph.[10] The uinal reigns above the Initial Series date and over all subsequent dates and historic information that follows in the inscription.

THE OLMEC AND THE COUNT OF 20

The Las Limas Figure

Identification between the lord, or principal male, and the uinal may be found in another Middle Preclassic monument. I suggest the Olmec Las Limas figure, seated in the characteristically Maya position shown to signify the seating verb in the Leyden Plaque inscription, also represents the seating of the uinal and by extension the seating of the agricultural year, or the Maya haab (Figure 6.11). It may be significant that fifteen of this figure's fingers and toes are visible, as are all twenty belonging to the "baby" on its lap (although not from the angle in Figure 6.11). In the past, discussion of this well-known Olmec sculpture has focused on the identity of the four profile heads on the figure's shoulders and knees, or on the "were jaguar" baby on his lap. David Joralemon, following Coe's hypothesis, identified these incised cleft heads with four separate deities and the baby with a fifth (Coe 1968: 111–115; Joralemon 1971, 1976). He believed the seated figure was a key to polytheistic Olmec iconography, but did not identify the principal figure itself even though Coe had suggested it was the maize god (Joralemon 1976: 33). Joralemon grouped the cleft-head baby and the seated figure's facial design in his God I complex, identified as the "Olmec Dragon."[11] The Olmec Dragon cluster includes associations with "earth, maize, agricultural fertility, clouds, rain, water, fire, and kingship" (ibid.: 58).

More recently, Karl Taube (1996) has explored maize symbolism, which he finds omnipresent in Mesoamerica and the key to Olmec iconography. He associates all jade celts or "axes" and cleft-head images with the corn cob in different phases of growth; thus, the Las Limas baby is the equivalent of seed corn, ready for planting, as well as the young maize deity itself (ibid.: 42, 44). Taube identifies the four cleft heads incised on the figure's shoulders and knees as personified celts, or corn, and sees the figure as signifying the axis mundi, as determined by these four celts that also represent the four directions (ibid.: 44, 61). He does not discuss the design incised on the face of the Las Limas figure, which includes the four diagnostic cleft celt forms on the forehead, around the mouth, and in elongated form framing the face. Although the Olmec who made the Las Limas figure probably did not speak a central Mexican or

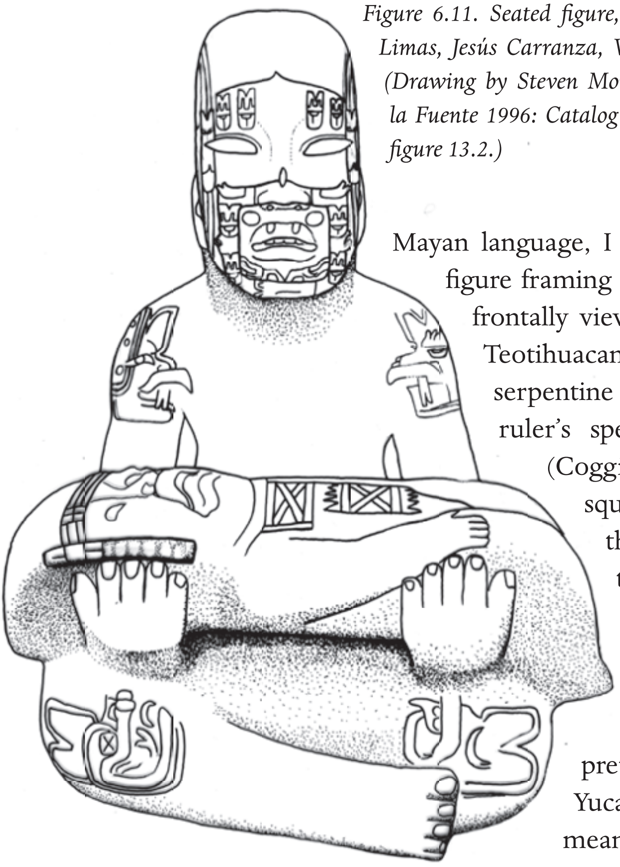


Figure 6.11. Seated figure, greenstone, h. 55 cm; Las Limas, Jesús Carranza, Veracruz; Middle Preclassic. (Drawing by Steven Morandi, after Benson and de la Fuente 1996: Catalog #9 and de la Fuente 1994: figure 13.2.)

Mayan language, I suggest the four-sided figure framing the mouth may be the frontally viewed equivalent of later Teotihuacan speech scrolls and a serpentine scroll representing the ruler's speech at Chichén Itzá (Coggins 1992: 102–104). The square frame described the forceful speech of the speaker (ruler or chief) and may also have described it as yellow (or ripe corn) speech. This interpretation is based on Yucatec Maya in which *kan* means "four" and may also mean "speech" and "to speak" as well as "forceful" while *Ah Kan* is "the Speaker."[12] Furthermore, kan may mean "ripe fruit" and "something yellow, like corn" (Barrera Vásquez 1980: 291, 374–375). Finally, the glyph for the day name Kan also denotes a corn offering in the Maya codices. Linguistic orthodoxy and prudence would argue against such homophones and near homophonies, especially centuries before Yucatecan was probably spoken, but these readings form a conceptual complex that may describe the role of this figure from Las Limas, a role that probably existed in a related earlier language spoken by the Olmec.

Although the most basic and persistent model, emblematic of deepest Mesoamerican structure, is found in the calendar, Olmec iconographers have tended to restrict their interpretations to the possible animal characteristics of heteromorphic Olmec imagery, or to its postulated diagrams of royalty and/or shamanic figures at the center of a four-cornered cosmos—all of which may be accurate. Joralemon (1976: 58) insisted that "the deep structure of the Mesoamerican religious system persists": such continuities have been sought in deity types and in perceptions of sacred space, but they are more likely to be found in the unchanging calendar. I suggest the Las Limas figure personified the uinal and 20, and specifically the seating of the uinal and the haab, perhaps during the five days before the New Year (as in the four Dresden New Year pages, 25–28 [Lee 1985: 51–52]). The New Year is represented by the baby. Taube's identification of this baby as seed corn is appropriate, since it denotes the agricultural potential of the entering year. Indeed, contemporary Quiche Maya associate the front of the body with birth and the future (Tedlock 1992: 140). The four incised faces on the shoulders and knees of the seated uinal figure divide the twenty days in quarters; they signify the heads of the lords of the four day signs that are the year bearers.

In 2001, Late Preclassic Maya murals that include numerous references to Olmec symbolism were found at the site of San Bartolo in Petén, Guatemala (Saturno, Taube, and Stuart 2005; Saturno 2006). Involved with deities, kingship, and creation, the paintings include a unique scene that depicts the explosive and bloody emergence of a "baby" from a womb-like vessel (Saturno, Taube, and Stuart 2005: figure 9). Four naked child-babies are blown into the air surrounding the newborn. They closely resemble images on the sides of La Venta Altar 5 where four such animated naked child-babies flank a figure that emerges from a cave holding a fifth baby on its lap (de la Fuente 1977: figures 48–50). Lineage and kingship ritual may be the subject of this Middle Preclassic Olmec and the Late Preclassic Maya imagery, but they share with the Las Limas figure the symbolism of birth framed by emblems of quadripartition. In the San Bartolo murals the birth scene is preceded by the four trees of the New Year, which signify the four-part division of time (Saturno 2006).

Like most Olmec human imagery, the Las Limas figure appears androgynous. Peter Furst (1995: 69) has suggested such apparent sexlessness was understood as representing a unity or whole, both genders in one, as when modern Quiche diviners are called "mother-father." The Las Limas figure may represent such a diviner and leader in charge of the calendrical ceremonies of his people. Susan Milbrath (personal communication) notes that the "altars" of San Lorenzo and La Venta may involve analogous symbolism with the presentation of live "babies" rather than sacrificial ones as so often suggested. Now generally acknowledged to represent table thrones, not altars, these monuments would, in this interpretation, have been dedicated to the living ruler seated above imagery celebrating the birth of the New Year from a cave in the

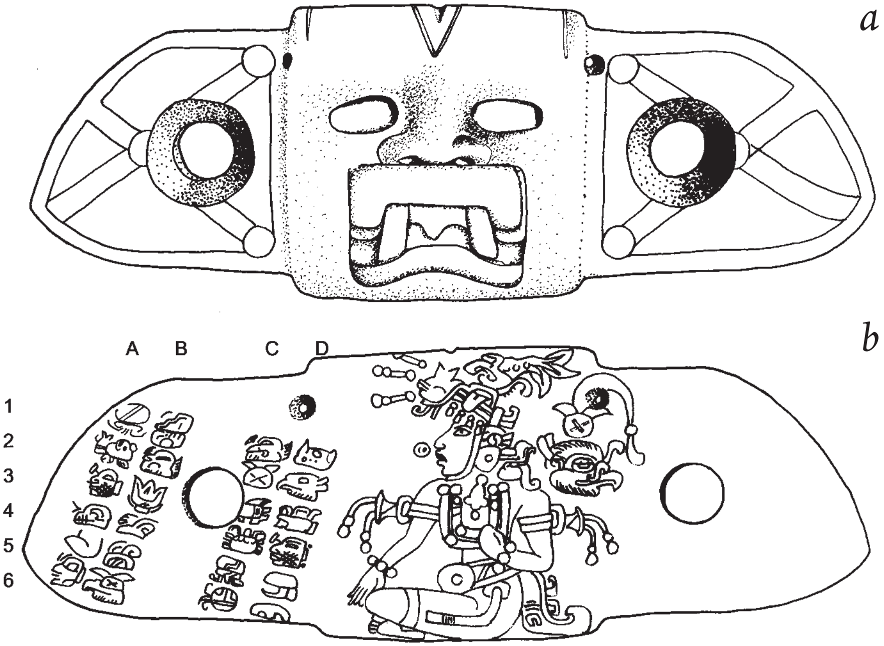


Figure 6.12. Pectoral, greenstone, w. 26.7 cm; Quintana Roo?, Mexico. Front (a): Olmec, Middle Preclassic; Back (b): Maya, Late Preclassic. (Drawing by Steven Morandi, after Coe 1966: figures 1, 2.)

earth below. On "altar" 4, the baby was also decorated with four corn tassels. Although they involve agricultural calendrical metaphors involving corn and renewal, these monuments, like later Maya stelae, were primarily testaments of royal accession and succession.

The conflation of the seating of the uinal with the seating of the leader endured into the Classic period as on the Leyden Plaque, but there is an intermediate image that may illustrate the ancestral connection between the Maya ruler and the Olmec. This image is found on a green quartzite pectoral from Yucatán, now in Dumbarton Oaks, which shows the cleft head Olmec Dragon/maize deity, or the new haab, on the face (Figure 6.12; Coe 1966: 6). The pectoral may have been the heirloom of the seated Maya lord who inscribed the reverse some five centuries later; he probably understood this Olmec face signified the seating of the haab, since on the back he portrayed his own seating as ruler, showing himself in the same seated position as the Las Limas figure—a pose also found in the later Maya glyph for seating. This glyph is found at A5 in the inscription where it records this ruler's accession to power (Coe 1966: 15).

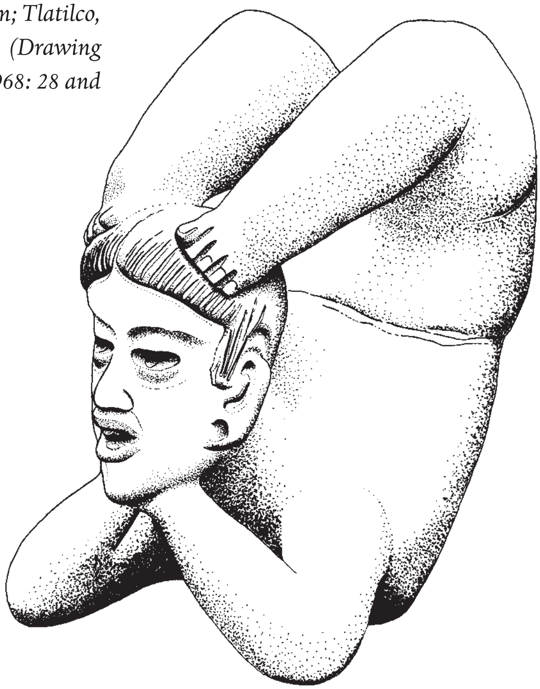


Figure 6.13. Acrobat, ceramic, h. 22 cm; Tlatilco, Basin of Mexico; Middle Preclassic. (Drawing by Steven Morandi, after B. Smith 1968: 28 and Serra Puche 1994: figure 11.11.)

Acrobats

Another metaphor for the man/uinal is found in Early to Middle Preclassic Mesoamerica. This imagery may be Olmec in origin, but it spread through less hierarchical contemporary cultures. In this early form the uinal is a wheel of time incarnate in the bodies of the "acrobats." Whether two- or three-dimensional, these figures rest on their elbows, with legs flipped up and backward so the feet rest on top of the head and the body forms a circle (Figure 6.13). The figures have been described as shamans in the ecstatic contortions of drug-induced, epileptic, or disciplined yogic transformation (Furst 1995; Tate 1995: 63–64). Although any of these states is possible, the goal of their contortions was to personify the unending cycle of the divine uinal rather than to acquire the jaguar or other animal personae usually suggested for shamanic transformation (Reilly 1995: 30–33).[13] There were doubtless specialized shamans, and these acrobats may have been the ones in charge of the calendar—that powerful, divine, and esoteric tool for organizing the lives of the people. Hollow ceramic acrobats of this type were found in the Early Preclassic burials of Tlatilco and Las Bocas (Serra Puche 1994: 184–185), where they might have evoked cyclic rebirth or even represented the role of calendar diviners with whom they were buried. The circular form of their bodies and the clear depiction of 10 or of 20 fingers and toes identify them with the twenty-day period. A blue-green steatite "acrobat" from Guerrero, with its feet on its head, shows all ten toes and ten fingers (Figure 6.14). Carolyn Tate (1995: 63) has explained that this figure "has detailed carving on all 4 sides [and] will stand on any side." Such a squared circular personification of the

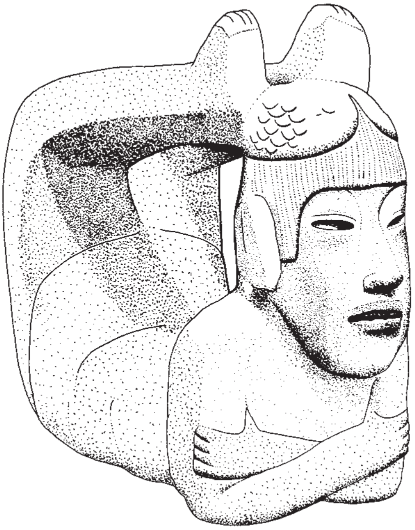


Figure 6.14. Acrobat, steatite, h. 23.5 cm; San Geronimo, Guerrero; Middle Preclassic. (Drawing by Steven Morandi, after Freidel et al. 1995: catalog #40.)

twenty days could be turned to rest in four different positions, possibly corresponding to the four year bearers and four directions.

By far the earliest known Mesoamerican Preclassic footprint was made of a beautiful greenstone (Ortíz and Rodríguez 1994: figure 5.14). It was found at the site of El Manatí, Veracruz, where Early Preclassic wooden busts of Olmecoid individuals were preserved in a spring evidently considered sacred since caching and sacrificial ritual were performed there for many centuries. Jade *hachas* (axes) were offered to the spring from about 1600 BC; toward the end, near 1200 BC, an hacha with a deeply worked and polished footprint was deposited at the same period as the wooden busts. In the preceding pages we have reviewed interpretations of footprints from a much later period; the following examples contain some evidence for analogous footprint symbolism in Olmec times.

Among the earliest known monumental examples of the acrobat is the flat circular Monument 16 from San Lorenzo, Veracruz, which measures more than six feet (185–194 cm) in diameter (Figure 6.15a).[14] Because of its style and use of stone resembling that at monuments at La Venta, Michael Coe and Richard Diehl describe it as post–San Lorenzo (Coe and Diehl 1980: 323), or Middle Preclassic, in date. Although the center of the design is obliterated, the soles of two feet, with ten toes (or two footprints), dominate the design at the top of the encircling border. They mark the east, dominant among the four directions and usually represented in the "up" position.[15] In reconstructing a metaphor based on this imagery we remember that the east is where the footprints first appeared before the birth of the uinal in the Colonial *Book of Chilam Balam of Chumayel* some two millennia later. On this relief, three pairs of bean pods, with three beans per pod, mark the other three directions, totaling 18 beans. In Yucatec Maya an evocative quartet of words might be applied to this acrobat. There are several meanings of the word *bul* (and *bu'ul*), but in this context they

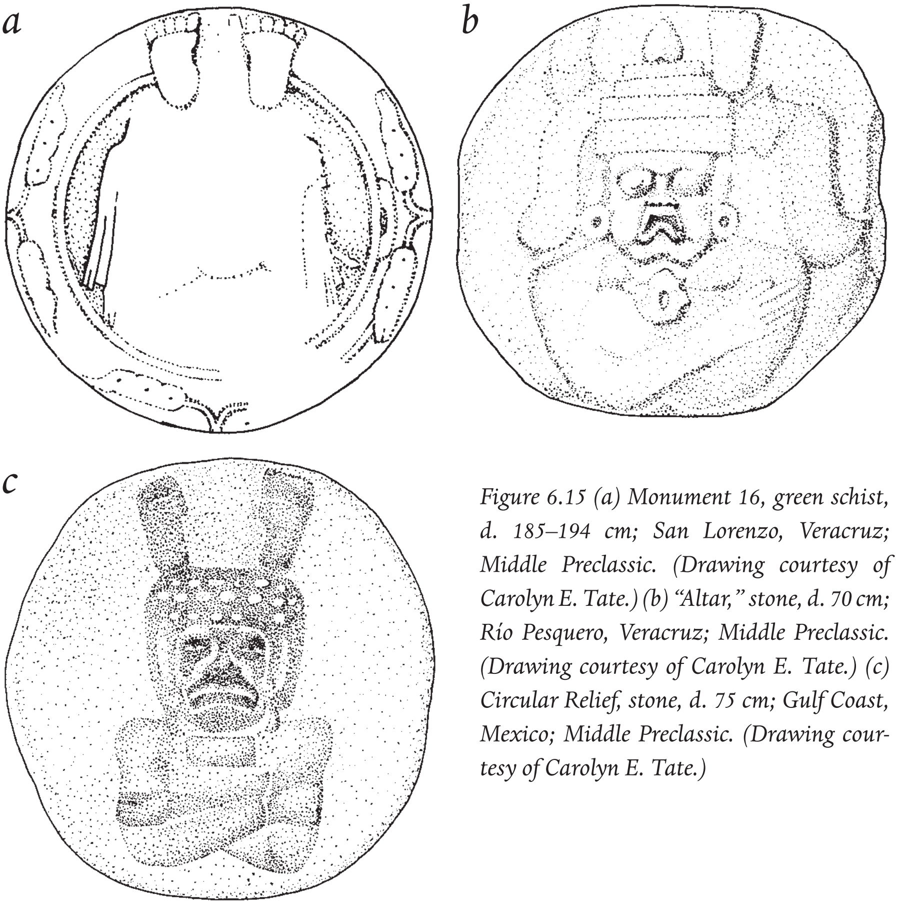


Figure 6.15 (a) Monument 16, green schist, d. 185–194 cm; San Lorenzo, Veracruz; Middle Preclassic. (Drawing courtesy of Carolyn E. Tate.) (b) "Altar," stone, d. 70 cm; Río Pesquero, Veracruz; Middle Preclassic. (Drawing courtesy of Carolyn E. Tate.) (c) Circular Relief, stone, d. 75 cm; Gulf Coast, Mexico; Middle Preclassic. (Drawing courtesy of Carolyn E. Tate.)

may signify "beans" (Barrera Vásquez 1980: 69). A second meaning for *bul* is to play a game of dice or of fortune, possibly referring to beans used for divination. A third meaning is "complete," as in the completion of 18 uinals in the haab or with regard to the complete circle of the acrobat's body. A fourth meaning of *bul* is to dive or plunge, often into the water to drown—possibly a reference to the plunging contortions of the figure and to submersion in a shamanic state. At the top (east) edge of the circle, the human feet or footprints denote the uinal itself. "For the diviner, the context of divination begins with one's own body" (Edmonson 1997: 146).

Two smaller circular stone reliefs from the Gulf Coast region represent similarly contorted figures. The first (Figure 6.15b), with down-turned Olmecoid mouth, is in the acrobat position with his feet above his head, possibly originally

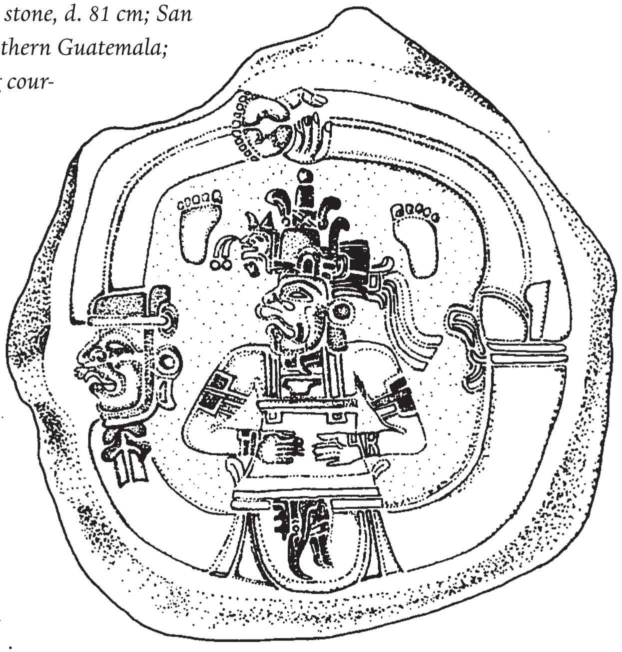


Figure 6.16. "Shook Panel," stone, d. 81 cm; San Antonio Suchitepequez, Southern Guatemala; Middle Preclassic. (Drawing courtesy of Carolyn E. Tate.)

displaying ten toes and ten fingers. The second figure (Figure 6.15c), with the usual eastern feet at the top, probably had twenty visible digits and eighteen small projections on its helmet—again symbolizing the cycle of uinals in the haab. The most striking and best preserved of these monuments is the Middle Preclassic "Shook Panel" from San Antonio Suchitepequez, in southwestern Guatemala (Figure 6.16).[16] Here the body of the elongated profile figure that represents the uinal forms the encircling border as a metaphor for this cycle of time. At the top, in east position, this figure's left hand, with five fingers, grasps his two feet, with ten toes, to complete the circle. The head, chest, and waist of the attenuated border figure mark the other three directions around the periphery. Within this frame the same individual is also shown axially, rising from the back of his own encircling form. His hands are held against his chest, with all ten fingers displayed, while his profile head, with Olmecoid down-turned mouth, duplicates his other head, to his right. However, unlike the others, the central figure has a tall headdress that displays emblems of Maya royalty. The headdress is flanked, within the circle, by two footprints with toes heading upward, or east. The axial frontal figure may personify the seating of the uinal, of the haab, and of this Maya lord, while his encircling form is the human incarnation of the perpetual cycle of twenty days that was born in the east—in a very literal expression of man as uinal.[17] He may have attained this acrobatic transformation by snuffing an hallucinogenic substance, since around his neck he wears a "spoon" of the type thought used for this purpose by the Olmec (Furst 1995: 77–79).

CONCLUSIONS

This paper has explored and illustrated some of the varied metaphors and great antiquity of the count of 20 days as found on monumental and portable objects in Mesoamerican cultures. Aveni has studied the prevalence of this count as a tool for the orientation of ceremonial architecture and of whole sites from the Preclassic period onward. In view of the identification, emphasized here, of this fundamental uinal count with the human body, it would be interesting to know how this union might be manifest in three-dimensional construction and in the spatial directions of an orientation. In describing his ethnographic work with the Mam Maya in southern Guatemala, John Watanabe emphasizes that Mam cosmology inextricably links space, time, and motion and that direction is implicit in any movement (Watanabe 1983: 716). The walking men on Preclassic stelae personified both time and space as they stepped along, embodying the uinal and its endless cycle. The static Las Limas figure, however, as chief and diviner, incorporated the center, the four directions, and its own seating while, as the uinal, it cradled the new year, in the form of the baby maize, at the seating of the renewed and forever turning haab. The symbolism and the significance of the calendar and its relationship to man was the operative metaphor at all phases of Mesoamerican cultural history.

ACKNOWLEDGMENTS

This paper has benefited immensely from the generous, enthusiastic, and knowledgeable suggestions of Susan Milbrath, to whom I am very grateful.

NOTES

1. Clark notes that La Venta's northern Complex A is one quarter the length of the total site center. It is not clear to me if he is describing the same harmonic proportion, or "golden section," described by Beatriz de la Fuente as governing the proportions of Olmec monumental sculpture (de la Fuente 1977: 344–356; 1981: 94).

2. Working from their own measurements of buildings at Uxmal, Kabah, and Chichén Itzá, O'Brien and Christiansen (1986) postulated a basic linear measure of 147 cm ± 5 cm, which would correspond to the Maya *sap*.

3. The word for "woman" is *(ix) ch'up* (Barrera Vásquez 1980: 144).

4. Others translate these relationships differently.

5. Brotherston (1979: 255) noted that "in the Maya screenfolds [manuscripts] the hieroglyph for Chuen was interchangeable with that of the uinal [glyph] itself."

6. In a commentary on the creation of the uinal, Victoria Bricker translated uinal as "week," even though it has twenty days (Bricker 2002: 2), whereas Mediz Bolio (1985: 115–120) used the commoner translation of "*mes*" (month, 28–31 days). Both seem unfortunate since the story clearly concerns the creation of the twenty named days. The "week" translation of uinal does, however, support Bricker's emphasis on the Christian elements in the story, also very important for Roys and discussed in a Biblical context by Brotherston (1979).

7. For some recent examples of work on the association of footprints with time, the uinal, and calendrical ritual, see Paxton (2001: 39–42) and Bricker (2002: 5–6).

8. Since the word for "flag" is homophonous with the count of twenty objects, the flag sign was used to signify 20 (Karttunen 1983: 186–187).

9. The large day at the top of the inscription is read 3 Chuen (Andrews 1981: figure 1); this day sign is interchangeable with the uinal glyph (see also Thompson 1960: figures 8.35–50, 26.41–48). The monkey (Chuen) may also be interchangeable with man; it has twenty digits, and a transformation occurs in the Popol Vuh where the brothers are turned into monkeys.

10. Michael Coe has noted that this superior position begins in the Early Classic, as seen at AD 292 on Tikal Stela 29 (Coe 1976: 119).

11. This point is not clear to me in the 1976 article.

12. At Chichén Itzá the enthroned figure is within the sun disk at the top center of the reliefs in the Lower Temple of the Jaguars. His speech scroll is a serpent, which may be *kan*—yet another relevant meaning for this homophonous word.

13. Milbrath notes the analogous circle of twenty days at the center of the Aztec Calendar Stone (personal communication).

14. I am especially indebted to Carolyn Tate who assembled these acrobat examples for her discussion of "shamanic contortions" (Tate 1995: 62–63).

15. East, where the sun rises, is the primary direction for the Maya. In the Madrid Codex's calendrical diagram of both time and space, east is at the top, where the count of the uinal begins (Figure 6.2b).

16. Lee Parsons placed this relief in the "Colonial Olmec Period" between 800 and 300 BC, probably contemporary with La Venta Monument 13—the walking man with the flag and associated footprint in Figure 6.9 (Parsons 1986: 261).

17. Karl Taube (1996: 74) saw this figure as the Maize God in "dynamic pose."

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CHAPTER SEVEN

GARY URTON

A Multi-Year Tukapu Calendar

INTRODUCTION

Students of what was once commonly termed “nuclear American” studies, by which was meant the complex Pre-Columbian societies of Mesoamerica and the Andes, have long recognized a number of profound and persistent similarities and differences in the cultures and material remains of these two regions of the ancient Americas. One of the most notable differences is the existence of writing systems in Mesoamerica and the apparent absence of any such system(s) in the Andes (but see Urton 1998 and Quilter and Urton 2002 on this point). One of the principal areas in which writing was employed among the Maya and Aztecs was in the recording of calendrical notations, such as monuments bearing Initial Series and other date indicators. These notations often took the form of extended, multi-year records with lunar series, eclipse cycle indications, and other such features, such as appear in the Dresden Codex and in the Borgia

Group codices (Vail and Aveni 2004). Calendars in the Maya world also often took the form of commemorative plaques or stelae placed in private settings, such as in tombs, as well as public ones, as in the many monuments that were erected in the plazas of sites such as Copan and Palenque (Aveni 2001; Fash 2001).

Given that we have not encountered any recognizable form of writing in the Andes, it becomes a matter of considerable interest to ask whether the practice of erecting, unfurling, or otherwise displaying public documents containing calendrical information commemorating notable events, such as battles, regnal succession, and eclipses, was a salient feature of cultural practice in Pre-Columbian Andean societies. The one example of such a display described to date is in my study of a *khipu*—a knotted-string record—from the site of Laguna de los Cóndores, in Chachapoyas, northern Peru (Urton 2001). What I referred to as the "tomb text" from Laguna de los Cóndores is a large khipu—known as UR6—that was found, along with thirty-one other examples, in association with some 220+ mummies in a set of burial chambers in a rock overhang high above the lake. The khipu in question, which contains a two-year count of pendant cords ($730 = 2 \times 365$), may have served as a census or tribute record of the population that lived around the burial site in Inka and early colonial times. Khipu UR6 may have been kept with the ancestral mummies, thereby providing a dramatic and highly sacred setting for local residents when they consulted what I argued was a foundational document pertaining to the history of the local population. There have been many other finds of khipus associated with burials; in fact, all khipus for which we have good information on their archaeological context of recovery have been found in burials. I also note that one other khipu containing calendrical information has been discovered: an example from Ica, on the south coast of Peru, which Zuidema has argued contains calendrical information connecting this south coastal region with the ceque calendar of Inkaic Cusco (Zuidema 1989).

Thus, the idea of producing khipus with calendrical content, or based on a calendrical organizational principle, was not unknown to pre-Hispanic Andean societies. The question arises, however, of whether calendrically based commemorative "documents" in the Andes were produced only in the medium of khipus, or if they may have been produced in other media as well. I am interested in particular in whether Andean peoples produced commemorative calendars in formats that were more ostentatious, readily accessible, and perhaps more easily interpretable by a wider public—for example, like a stela planted in the middle of a plaza—than a khipu tucked away in a burial chamber. In this paper, I present information pertaining to what I argue was just such

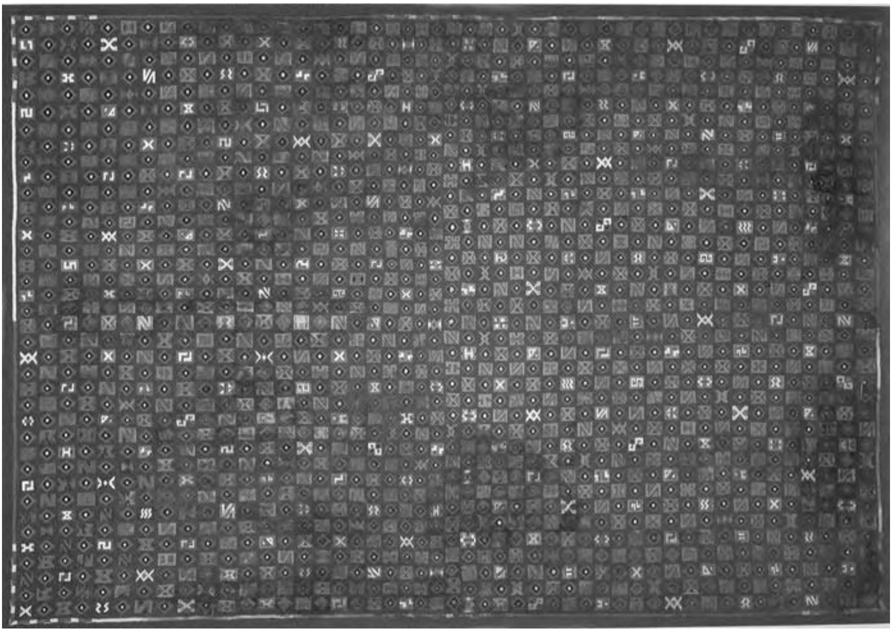

Figure 7.1. The cloth mantle MFA325. (From Stone-Miller 1992: 180, plate 67a.)

a monumental and perhaps at one time widely viewed commemorative calendar from the Andes that takes the form of a large tapestry mantle bearing hundreds of complex geometrical designs referred to as *tukapus* (squares filled with geometric designs; see following). I argue that this tapestry mantle was produced either to commemorate the times, places, and identities involved in some set of historical events that transpired over a particular five-year period, or that it commemorated and marked internal divisions within some cycle or sequence of ritual activities that recurred over five-year intervals. I shall return at the end of the paper to consider the possible nature of the events or periodicities that may have been commemorated in this tapestry calendar.

The specific piece of cloth, or weaving, that we will analyze here is a cotton- and camelid-fiber mantle in the collection of the Boston Museum of Fine Arts (MFA). The work in question, which bears the MFA catalog number 1988:325, will be referred to here by the admittedly inelegant label "MFA325" (see Figure 7.1).

AN INTRODUCTION TO MFA325

MFA325 is a rectangular piece of cloth that has been described as a "mantle." The piece measures 119 × 171 cm and was originally woven in two parts. The two pieces of cloth were joined in such a way that the warp threads run the length of the mantle (that is, along the horizontal axis in Figure 7.1; Sawyer n.d.: 1). The designs in the mantle, the tukapus, which will be at the focus of the analysis presented here, were produced by the interlocking tapestry technique. Mantle MFA325 has been characterized by various Andean scholars over the years as one of the finest works of Inka tapestry known. The cotton and camelid warp threads yield a thread count of 32 threads per square inch, and the camelid fiber weft threads attain an astonishing 195–200 threads per square inch (Stone-Miller 1992: 179; Sawyer n.d.: 1). As Stone-Miller observes, this thread count is "nearly the upper limit of handspun production in the medium."

We have no information on the provenance or archaeological context of discovery of MFA325. Although the piece is generally in a good state of preservation, there are several areas of staining across its surface. From his examination of the pattern of stains, Alan Sawyer concluded that MFA325 was probably used, at least at some point in its use-history, as a burial shroud. In fact, Sawyer surmised that the individual buried in this mantle/shroud was probably a young male of around 13–14 years of age.[1] In his (unpublished) report on MFA325, Sawyer further suggested that the mantle was produced during the early colonial period. As mentioned earlier, we do not, in fact, have any archaeological data concerning when or where the mantle was found; thus, Sawyer's suggestion for the production of this mantle in the colonial period is not supported by archaeological evidence or by documents testifying to its place and conditions of recovery.

The main rationale Sawyer used for assigning MFA325 to the colonial period was the likeness he saw between this piece—the only known sample of a mantle-sized textile that bears an all-over tukapu design layout—and another weaving bearing an all-over tukapu design: the well-known Dumbarton Oaks tunic (Sawyer n.d.: 2–3). Because the latter garment is in such an excellent state of preservation, Sawyer surmised that it was produced in colonial times. Thus, by comparing the Dumbarton Oaks tunic to MFA325, he was led to surmise the latter similarly dated to the colonial period. It is important to note, however, that the Dumbarton Oaks tunic itself lacks archaeological context and provenance information and has *not,* in fact, been dated with any certainty.

Susan Niles (1992) makes a somewhat more convincing argument on the possible colonial era production of MFA325 on the basis of what she argues is a similarity between several of the tukapu designs on this mantle and the forms of several tukapus in the drawings of Inka tunics by the colonial Andean author, Guaman Poma de Ayala (Stone-Miller 1992: 181–182). Still, I find Niles's stylistic argument ultimately unconvincing, and I therefore proceed from the position that we simply do not have enough information to assign MFA325 to either the pre-Hispanic or early colonial era with any degree of certainty.

Whether produced before or after the Spanish Conquest, it is in any case clear when one compares the designs woven into MFA325 with those carried by other Pre-Columbian and colonial textiles that the tukapu design elements, to which I turn my attention later, were quintessentially Inkaic iconographic elements, as we find such designs reproduced not only in textiles but also in other media such as wood and ceramics of more certain pre-Hispanic vintage (see Cummins 2002). In sum, I shall proceed in the following discussion from the general position that MFA325 was produced in keeping with design conventions and sensibilities that prevailed over the period from late pre-Hispanic (i.e., Inkaic) to early colonial times across a large area in the central Andes.

THE HYPOTHESIS FOR MFA325 AS A COMMEMORATIVE CALENDAR

The most obvious and striking feature of MFA325 is its all-over tukapu design layout. Tukapus, which may be defined as small squares containing geometric designs (see González Holguín 1952 [1608]: 344; Cummins 2002: 130–132), were relatively common design elements in Inka weavings. They are particularly common on Inka royal tunics (*unkus*) as these are preserved in museum collections (Rowe 1979) and as represented in the colonial era drawings in the chronicles of Guaman Poma de Ayala (1980 [1615]; see Cummins 1991; Zuidema 1991) and Martín de Murúa (1962–1964).

I shall go into the typology and layout of the different types of tukapus on MFA325 in a moment, but first I note that I became interested in studying this magnificent textile because it contains a total of 1,824 tukapus distributed across the fabric's surface. Rebecca Stone-Miller mentions the total count of tukapus in her description of this mantle in her excellent and highly informative book, *To Weave for the Sun: Ancient Andean Textiles in the Museum of Fine Arts, Boston* (1992). Stone-Miller says that "[t]he shroud's design features an *astronomical* 1,824 separate motifs" (1992: 179; my emphasis). As Stone-Miller does not return to discuss any possible astronomical or calendrical significance of the count of tukapus in her own analysis of MFA325, I take the adjective highlighted in the sentence cited above to be her quantitative, rather than qualitative, assessment of the number of tukapus contained in this piece. However, when we note that the number of tukapus adorning this textile—1,824—is very close to a calendrical count of five schematic solar years—5 × 365 = 1,825—we can begin to appreciate the perhaps felicitous choice of an adjective used in Stone-Miller's statement of the number of tukapus woven into this mantle.

In this paper, I will pursue the hypothesis that MFA325 was designed and produced as a commemorative five-year calendar. To anticipate the argument developed in what follows, I refer the reader to Figure 7.2, in which I show in schematic form a division of MFA325 into five parts that represents the way in which I think the maker(s) of this mantle incorporated calendrical information, in the form of a five-year period(-icity), into the organization and layout of tukapus in this textile. There are two principal questions that we need to address in order to support the advancement of the calendrical hypothesis. First, what evidence is there to support the hypothetical organization of a five-year tukapu calendar like that shown in Figure 7.2—that is, with pairs of equal-sized squares on either side of a narrow vertical strip aligned down the center? And, second, to what degree does the organization and distribution of tukapu design elements conform to, or even reinforce, the proposed five-year division and organization of the 1,824 units making up this mantle's design?

Although I have spoken of the concept of "commemorative calendars" in general terms up to this point, I should state more clearly what I intend by this phrase. In essence, a commemorative calendar is a record, built within a calendrical framework, of a particular set of historical events that occurred over some period of time or that are considered to recur within the regular cycling of a given temporal periodicity. I would distinguish such a commemorative record from a straightforward calendar on the grounds that the latter has as its basic structure and raison d'être the orderly representation of regularly repeating units of time (e.g., weeks, months, years), regardless of any particular set of events that transpire(-d) during their passage and/or repetition. A commemorative calendrical notation on a Maya stela would be, for instance, a date or set of interrelated dates (e.g., one in the Initial Series, another in the Long Count) that recorded something like the accession of a king to a throne or the transit of Venus. The difference that I am pointing to is like that between a calendar that hangs on my wall showing only the days, weeks, and months of the year as opposed to such a calendar that contains my notations of the particular things I did or the events that transpired on each day during the course of a given year. We are not restricted to thinking of such a calendar in personal terms, however, as such a construction could commemorate the events and activities of a royal household, for instance, or of an entire community.

I argue in what follows that MFA325 represents an Inka/colonial version of a commemorative-type calendar. In this reading of the tapestry mantle, I

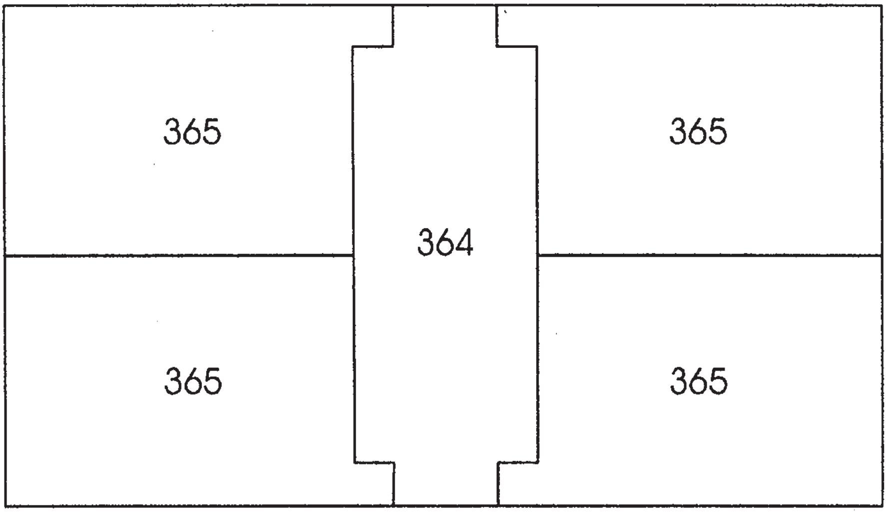

Figure 7.2. Schematic of the calendrical organization of MFA325.

propose that the tukapus represent signs or notations, posted by the weavers within the structure of this fabric, either of the historical events that occurred during some particular five-year period or of a recurring set of events that repeated not annually but every five years, such as an astronomical cycle or a set of ritual practices. As a commemorative calendar, I also suppose that at some time prior to its being used as a burial shroud and thereby becoming inaccessible for viewing in all its details, this magnificent mantle would have been displayed in a setting where it could be viewed by a specific group of people, as on the wall of a palace for the members of a royal household or within a temple precinct for a group of priests; alternatively, it may have been displayed publicly for all members of the wider community to appreciate.

THE CLASSIFICATION AND ORGANIZATION OF TUKAPUS IN MFA325

I begin to address the questions posed above by developing a typology of the tukapus in MFA325. The different elements that make up the 1,824 separate tukapu designs of MFA325 can be divided (as Sawyer also did) into three classes, or types, which I designate *A*, *B*, and *C* and define as follows.[2]

A	Concentric yellow, black, and red diamonds. These are the most numerous of the design elements, totaling 912 in all.[3]

B	Various forms of tukapus composed of red, brown, green, and indigo threads (without any white threads). There are 684 such designs.
C	Various forms of tukapus having design elements that contain significant areas of white threads within their designs. There are 228 such design elements in total.

Type *A* elements make up one-half of all the design units in MFA325; Types *B* and *C* combined (684 + 228 = 912) equal the total of Type *A* units.[4] It is also obvious that there are three times as many Type *B* as Type *C* tukapus (228 × 3 = 684).

The 1,824 tukapus are organized in 38 rows and 48 columns. Having noted earlier that MFA325 is composed of two pieces of cloth joined at a seam that runs the width of the mantle (forming a line oriented along the columnar axis), it is important to note that this structural division does not, in fact, divide the 48 columns into equal (24 × 2) sets; rather, there are 23 columns to the left of the seam and 25 to the right. This arrangement displaces the center line of the design layout of tukapus in the two panels to the left of the visual center of the mantle as a whole. This slight disjunction may be related to the fact, noted by Susan Niles in her comments on this textile, that the sizes of the tukapus near the end of the first piece of cloth (i.e., those in column 23) are slightly compressed, while those near the end of the second, right-hand piece of cloth in Figure 7.1 (i.e., columns 47 and 48) are slightly expanded (note that the average size of the tukapus is 3.18 × 2.54 cm—Sawyer n.d.: 1). These manipulations suggested to Niles that the two panels were woven from left to right (as we view the textile in Figure 7.1) and that the weaver(s) wanted to depict a particular total number of tukapus in the mantle; thus they manipulated their sizes to fit the available space (Niles 1992: 59).

In considering the patterning of different design elements in MFA325, I suggest that the dominant elements organizing the overall design of this mantle were the visually striking Type *C* tukapus that are arranged in a repetitive, diamond-shaped layout across the surface of the mantle. Each one of these "white tukapu diamonds" (as I call them) has at its center one or the other of two variants of the Type *B* tukapus. Following Niles (1992: 58), I refer to these alternative center elements as *X*-tukapu (which I shall term Type 1) and *N*- or reverse-*N*-tukapu; I take the latter two forms to be variants of one type (Type 2). In sum, the white tukapu diamonds take either of the two forms shown in Figure 7.3.

Now, an important factor to note with respect to the distribution of the white tukapu diamond centers of Types 1 and 2 across MFA325 is that they are not equal in number, nor are they laid out in a regular, alternating pattern across the full length and width of the mantle. There are 69 Type 1 centers as

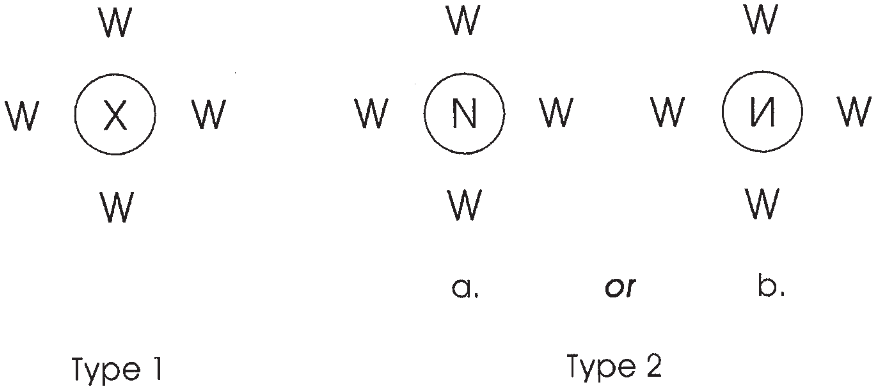

Figure 7.3. White tukapu diamond center types.

opposed to only 51 Type 2 centers. The two types of white tukapu diamonds are laid out across the mantle as shown in Figure 7.4.

As we see in Figure 7.4, although they are not equal in number nor regularly alternating in their layout, Type 1 and Type 2 white tukapu diamond centers nonetheless form what is, in fact, a regular symmetrical pattern over the surface of the mantle. This pattern has the following characteristics:

1. At the beginning and end (i.e., left and right sides) of the mantle, the point of division between regularly alternating and irregular (i.e., non-alternating) arrangements of Type 1 and 2 white tukapu diamond centers divides the end/terminal columns into two equal sets of five units each. Extending a line horizontally across the mantle at the division between these two groups or tukapu sets divides the entire mantle into two equal halves, with 19 rows above and 19 rows below the dividing line.
2. As we move from the two end columns toward the center of the mantle, each column inward contains one fewer irregular unit than the previous column.
3. The pair of white tukapu diamond columns that stand on either side of the center line of the overall columnar organization of white tukapu diamond centers (i.e., columns 23 and 27) each contains a regular alternation of Type 1 and Type 2 white tukapu diamond centers across the full width of the mantle.

When seen in terms of their overall layout, the above features combine to produce a first-level organization of columns and rows in MFA325 into a central grouping of columns set apart from the two sides and the two sides

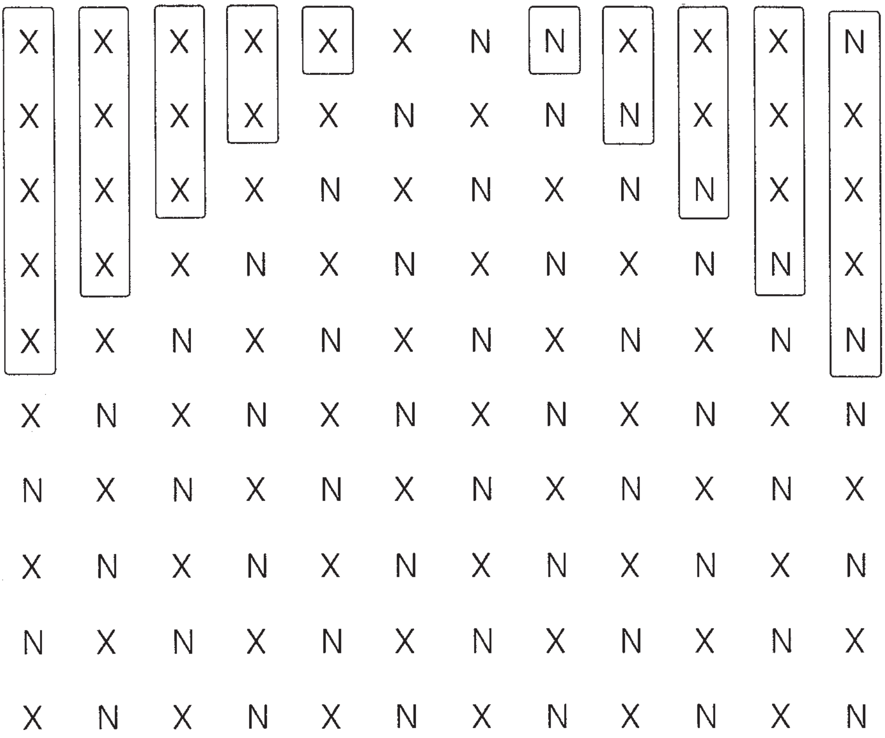

Figure 7.4. Layout of white tukapu centers.

themselves, each of which is divided into two equal parts, one above and one below the center of the mantle as divided along its long axis. Interestingly, in her own analysis of the layout of what I have termed here Type 1 and Type 2 white tukapu diamond centers, Susan Niles points out that these elements form a chevron-like arrangement that has column 27 as the center of its apex. Niles's figure illustrating this observation (reproduced here as Figure 7.5) also shows the seam of MFA325, which, as we learned earlier, falls between columns 23 and 24. Thus, the design and layout of tukapus derived earlier and depicted in Figure 7.4 from my own analysis of the distribution of regular and irregular occurrences of Type 1 and 2 white tukapu diamond centers, which resulted in our setting the narrow strip of columns from 23–27 off from the paired squares on either side, is reinforced by Niles's analysis of two different features of the mantle's organization, one of which is based on its construction (i.e., the seam) and the other on an altogether different design element (i.e., the chevron arrangement) from those elements used in my own analysis.

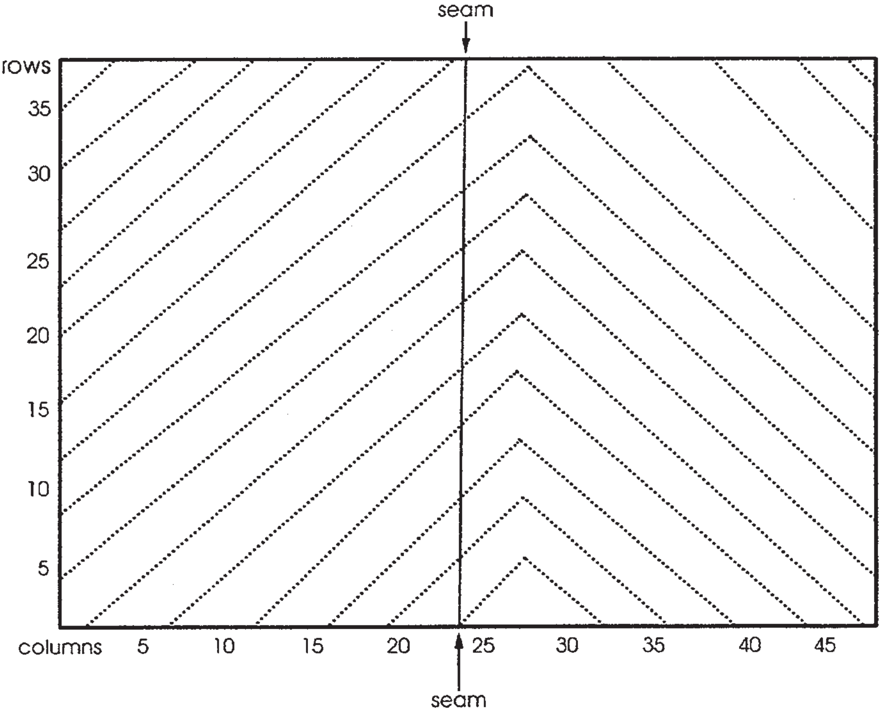

Figure 7.5. Structure of seam and chevron layouts (after Niles 1992: figure V.11).

THE COLOR DIVISIONS OF THE MANTLE BORDERS

Another construction feature of MFA325 that possibly points to the organization of annual segments in the five-year design layout is the division of the borders by means of color changes. These involve the alternation and asymmetrical layout of solid vs. segmented color zones around the edges of the mantle. Figure 7.6 is a schematic rendering of the color changes along the borders of MFA325.

First, as we see in Figure 7.6, the position of the center line that runs horizontally through the mantle's design field and which divides the left and right sides of the mantle into paired squares is marked by the juxtaposition of segments of red and yellow borders on the left and right sides (i.e., ends) of the mantle, thus dividing the rows of tukapus into 19 rows above and 19 rows below the center line. And, second, there are six areas around the edges of the mantle that are composed of multicolored segments. These segments are composed of patterned stretches of yellow/blue-green/red threads. Four of the six segmented color zones wrap around the corners. The other two

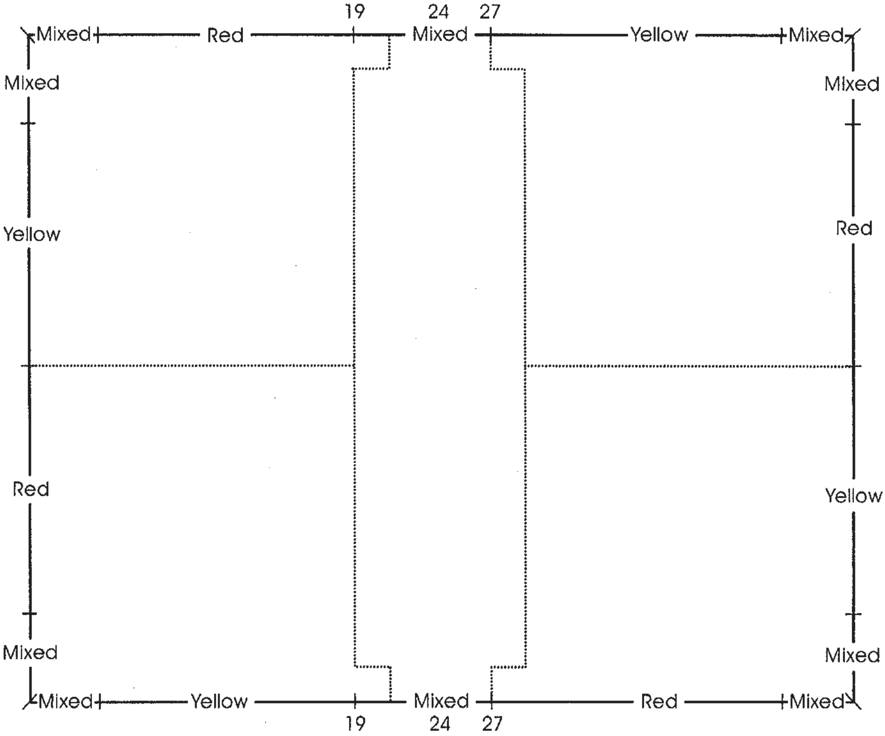

Figure 7.6. Color patterning on borders on MFA325.

segmented zones bracket the center of the mantle on the top and bottom edges. Notably, these latter two zones, which are eight tukapus wide, are not centered across from each other along the center line of the tukapu distribution (= column 24); rather, they are centered on the seam (= column 23). From this latter "center" line, the multicolored border segments cover a distance that is eight tukapus wide, stretching from columns 19 to 27 (see Figure 7.6). As we see, the left side of this border section (i.e., at column 19) defines the outside edge (on the left side) of the center strip of our hypothetical calendrical layout of MFA325, while the right side of the central strip (i.e., at column 27) defines the inside edge of the "notch" (see following) in the center strip. I suggest that this complex alignment of border segments at the top and bottom edges of the mantle represents the "guide" lines, or markers, for setting our hypothetical center strip apart from the paired squares on either side, thus forming the central year in our five-year tukapu calendar—that is, the year composed of 364 tukapus/"days."

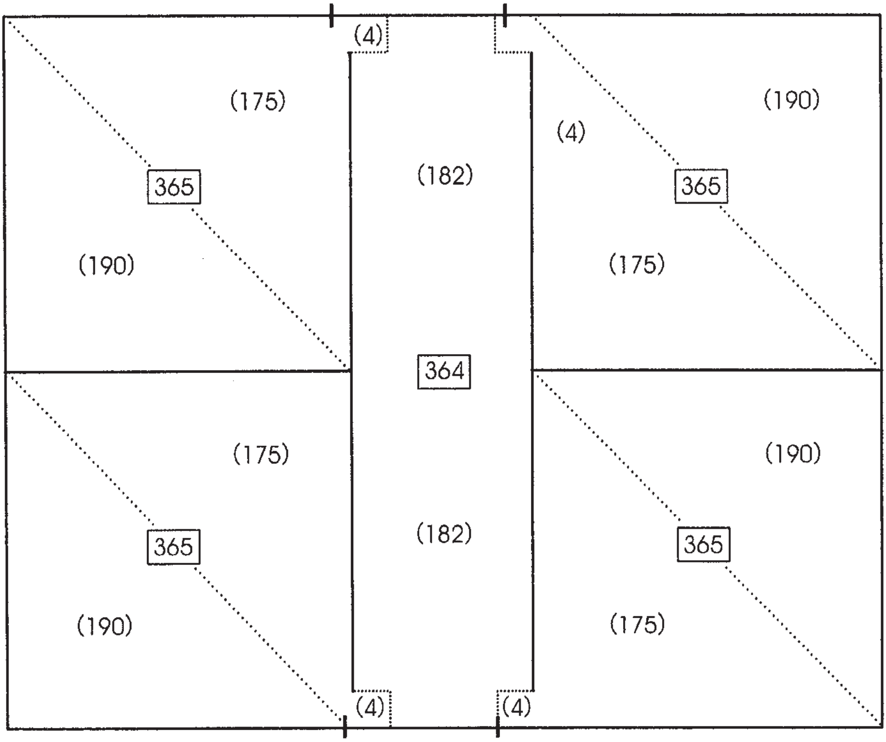

Figure 7.7. Calendrical organization of MFA325.

From the above analysis and arguments, I maintain that MFA325 was designed in such a way that there was a central, vertical strip flanked on either side by pairs of equal-sized squares. As I began this study with the general hypothesis that MFA325 represents a five-year calendar, I now refine that hypothesis by arguing for the division of this mantle into five parts to arrive at five different groupings of tukapus, each of which ideally represents an annual schematic calendrical period of 365 days. Figure 7.7 shows the organization and arrangement of groups of tukapus laid out in such a fashion as to accomplish what I believe was the principal objective of this mantle—the representation of a five-year calendar.

THE CONSTRUCTION OF ANNUAL PERIODS IN MFA325

Before moving on, a word should be said about a particular feature implicated in the manner of dividing up the tukapus into sections equivalent to five annual periods. I am referring to the unusual "notched" configuration of the central strip, the effect of which is to provide an additional four days/tukapus to the four years located at the four corners of the mantle. Without the additional tukapus provided by these notched segments, each of these four squares/years would contain only (19 × 19 =) 361 tukapus/days. The four tukapus added to each corner square bring these totals up to 365, and coincidentally, they reduce the number of tukapus/days included in the middle strip/year by (4 × 4 =) 16, which results in a total count of 364 tukapus/days for the central strip.

As for the counts of the number of days in the four years in the four corners of MFA325, the four notched tukapu/day units just mentioned represent a construction akin to the "epagomenal" (i.e., extra) days in Mesoamerican calendars. That is, as reckoned in Maya and Aztec calendars, solar year counts were based on 18 months of 20 days each, which totals 360 days. In these Mesoamerican calendars, what constituted an additional, nineteenth named month (commonly called Uayeb) composed of five days was tacked onto the 360 days to produce the complete solar year count of 365 days (Thompson 1960: 117–118). I suggest that four of the five years in the five-year calendar represented in MFA325 were composed of 361 + 4 = 365 days. In other words, in the Inka/Andean multi-year calendar in MFA325, the epigomenal-like period was composed of four rather than five days. I will have more to say later about the 364-tukapu/day total of the fifth year in the center of the construction.

If MFA325 concerned year counts, what about the lack of accommodation for the fact that the solar year is composed of 365.25, not an even 365, days? The concern here is with the fact that five solar years (5 × 365.25) equal 1,826.25 days. This is two and a quarter days more over five years than what is accounted for in the 1,824 tukapus in MFA325. I would suggest that what the Inka (or colonial) weavers were interested in when producing this five-year calendar was a close approximation of the appropriate number of days in question; one that was built on principles of symmetry, rectitude, and balance rather than absolute accuracy (for a discussion of the significance of these principles in Andean cosmology and arithmetic, see Urton 1997). In fact, this is precisely how the Maya calendar specialists represented their solar year counts. Mayanists from J. Eric Thompson (1960: 121–122) to Anthony Aveni (2001: 164) have noted that year counts in the Maya codices and commemorative stelae were premised on an annual period of 365 days. The additional days that accumulated at the rate of one-quarter day per year were recorded elsewhere and were brought into calendrical calculations only when absolute accuracy was required.

The appeal to a possible similarity between Mesoamerican and Andean calendrics in seeking an explanation for the use of annual counts of 365 days in the MFA325 calendar might be used as well in trying to explain the 364-tukapu/day segment that runs vertically through the center of this construction. In his analysis of the repetition of glyphs across several pages in the Paris Codex, Aveni points out that one sees there a sequence of 28 days repeated 13 times, producing a total calendrical count of 364 days, a value that is also found in the Mars table of the Dresden Codex (Aveni 2001: 201). Just as the makers of the Paris Codex could make use of a year count totaling 364 days since it allowed them to correlate several other cycles that were of interest to them, so too could the astronomers, calendrical specialists, and weavers who produced the MFA325 calendar have used such a period for their own purposes. In this case, the objective would have been to arrive at a calendrical organization of five years that respected certain structural principles and design canons that were also of interest to them.

Thus, MFA325 appears to represent a calendrical construction based on multiple solar, lunar, and perhaps stellar periodicities synthesized into a relatively standardized format in which four years contained 365 tukapus/days and the fifth contained 364. Our inability to read, or give even a general semantic interpretation for, the 26 tukapu elements (see following) and their numerous variants leaves us unable at the present time to interpret anything beyond the overall structural design and layout of this multi-year calendar. I return to address the general question of what this construction might have been used for in the discussion and conclusion section.

THE DISTRIBUTION OF TYPE C TUKAPUS

Another approach that presents itself for expanding and deepening our recognition and understanding of the commemorative nature of the calendar in MFA325 is analyzing the arrangement of specific tukapu designs across the full design field of this mantle, particularly when it is divided into its “annual” segments. In such an approach, the question would be whether there are repetitions and patterns of specific tukapus that might constitute internal markers for week- or month-like divisions within the hypothetical annual units. I lay out such an approach, with tentative interpretive commentary, in this section.

The most visually striking and iconographically complex tukapu design elements in MFA325 are what I defined earlier as the Type *C* tukapus; these are the elements I focus on in this discussion. Type *C* tukapus contain significant

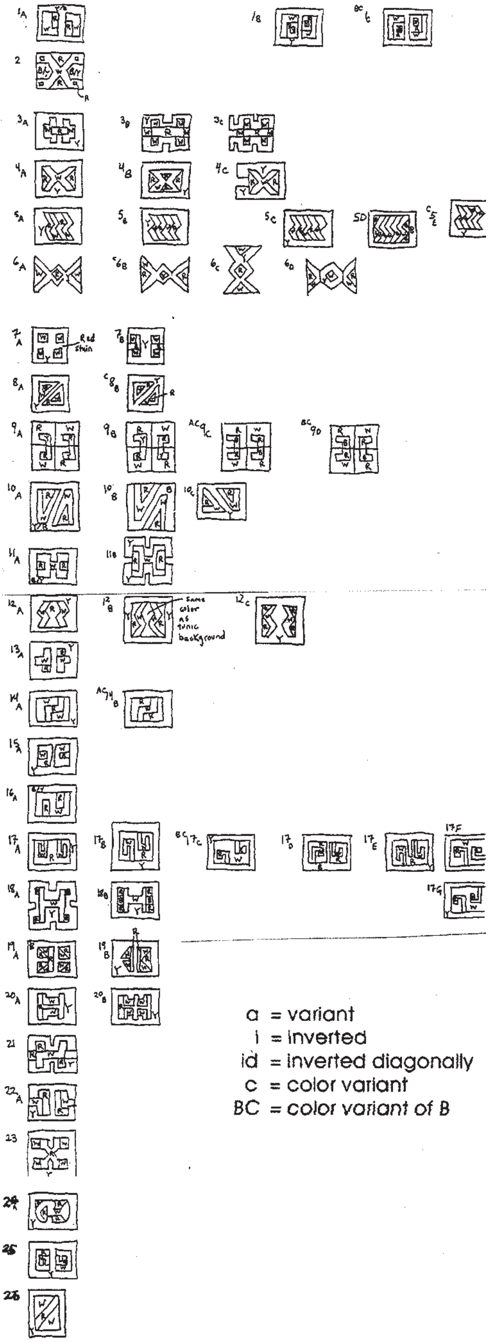

Figure 7.8. Classes and variants of Type C *tukapu.*

portions composed of white threads. From a close study of the actual designs of all the Type *C* tukapus, I suggest that these can be classified into 26 distinct types (see Figure 7.8). However, as will be seen in Figure 7.8, several Type *C* tukapus exhibit variants. Counting all of the variants shown in the figure, we arrive at a total of 57 distinct Type *C* tukapus.[5]

The central question in regard to the tukapus defined in Figure 7.8 is the following: are all these tukapu types (with their variants) represented equally and regularly across the full expanse of mantle MFA325? The answer to this question is, decidedly, no. There is not space here to develop a complete response to the question posed above. Speaking generally, I note that the 26 Type *C* tukapu types and their variants are distributed in what appear to be idiosyncratic, or at least irregular, patterns both in terms of their frequency and their distribution. That is, there are only a few of some Type *C* tukapus and a score (or more) of others. In general, each of the 26 main tukapu types has its particular, irregular arrangement on the mantle. In this respect, MFA325 is similar to one of the few other all-over tukapu textiles: the Dumbarton Oaks tunic. In this latter garment, the various tukapus carried on the front and back sides do not recur in any obvious nor, to date, well-understood pattern. The irregular distribution of tukapus in MFA325 can be appreciated by viewing a diagram of the distribution of all Type *C* types and their variants across the mantle (see Figure 7.9).

To quantify and characterize the variation of occurrence and irregularity of distribution of Type *C* tukapus somewhat more specifically, I give in Figures 7.10 and 7.11 the locations across the mantle of two different Type *C* tukapus; these are #4 and #5 (see Figure 7.8). I would note first that Type *C* tukapu #4 is represented by three variants, whereas Type *C* #5 is composed of five variants.

As for the frequency and distribution of the three variants of tukapu #4, we see in Figure 7.10 that there are 28 occurrences of this type, with at least four occurrences (irregularly placed) within each of the five annual segments of the mantle. As for tukapu #5 (Figure 7.11), there is a total of only seven occurrences of the five variants of this type across the entire mantle. There is no appearance of any variant of tukapu #5 within the central strip of the mantle.

The frequency and distribution of the other tukapu types and variants shown in Figure 7.8 fall somewhere between the extreme ranges illustrated for types #4 and #5 as shown in Figures 7.10 and 7.11. I conclude on the basis of the examples discussed here, which can be confirmed by examining the distribution of each of the other Type *C* tukapu distributions (Figure 7.9), that the tukapus in MFA325 are not organized according to regularly repeating

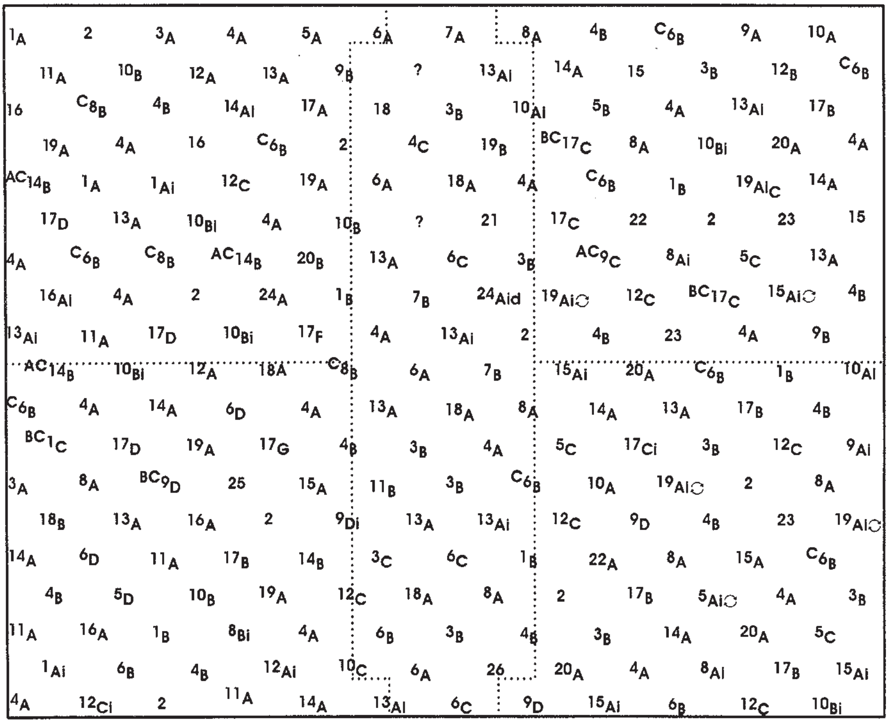

Figure 7.9. Distribution of all Type C *tukapu.*

periodicities that might have constituted weekly or monthly periods within each "annual" segment of our five-year calendar.

My interpretation of the complex, seemingly idiosyncratic organization of design elements in MFA325 is that these may represent an accounting, or situating, of what may have been some 26 (or 57, if we include all variants) distinct place names, event designations, or identities (e.g., personal names, titles, or *ayllu* names) within a five-year calendrical framework. Because of the apparent absence of a strong symmetrical principle guiding the placement and number of these identities as they are distributed over the five annual units, I suspect that what we are viewing in this mantle is an arrangement of place names or identities whose organization was determined by historical rather than structural, symmetrical, or purely design-based considerations. It is for this reason that I suggested that MFA325 may have represented a "commemorative" calendar. By this phrase, I mean to suggest that MFA325 could have been understood by its makers and users to have represented the peculiar manner in which some 26 or so distinct identities assumed unique roles or performed particular actions in

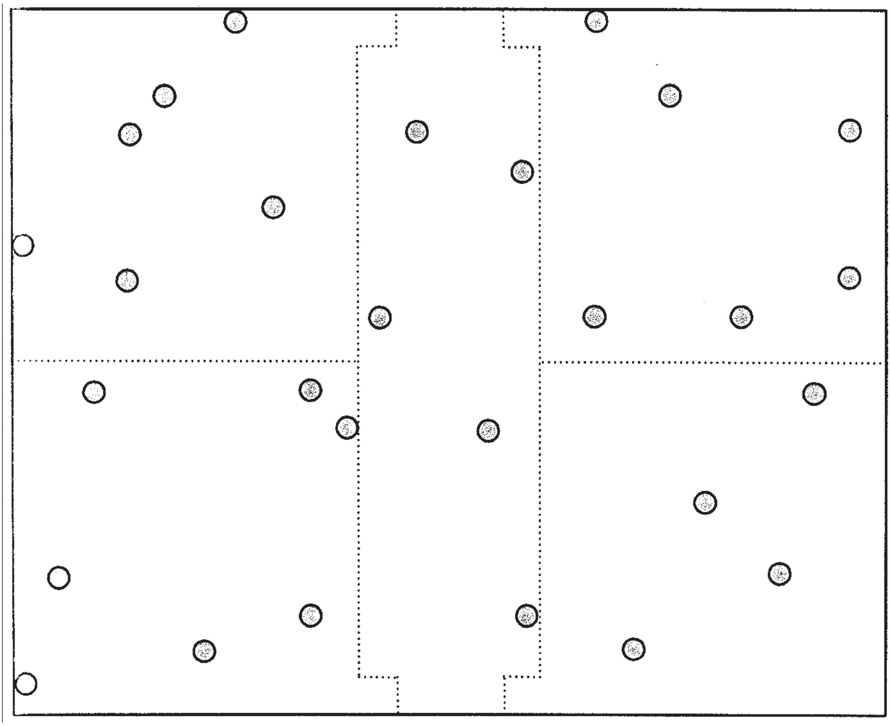

Figure 7.10. Distribution of Type C *#4 tukapu.*

the course of a five-year period. Perhaps in what I have termed its commemorative aspect, the mantle also carried the message of an endless repetition or cycling of these assorted, ordered roles or actions over time.

DISCUSSION AND CONCLUSIONS

I began this study of MFA325 by raising the question of whether we might have, in the material remains of Inka civilization, artistically and technologically complex manifestations of commemorative (i.e., historically rather than structurally based) calendrical "inscriptions," similar to those so commonly found in the material productions of the Maya and Aztecs. I submit that MFA325 does, indeed, represent such a production. As for whether this multi-year calendar was intended and used for private and/or public consumption, it is difficult to say. Although there has been no chemical analysis performed on the stains on this mantle, Sawyer (n.d.) argued that the piece was made and used as a burial shroud for an Inka noble adolescent. This may well have been

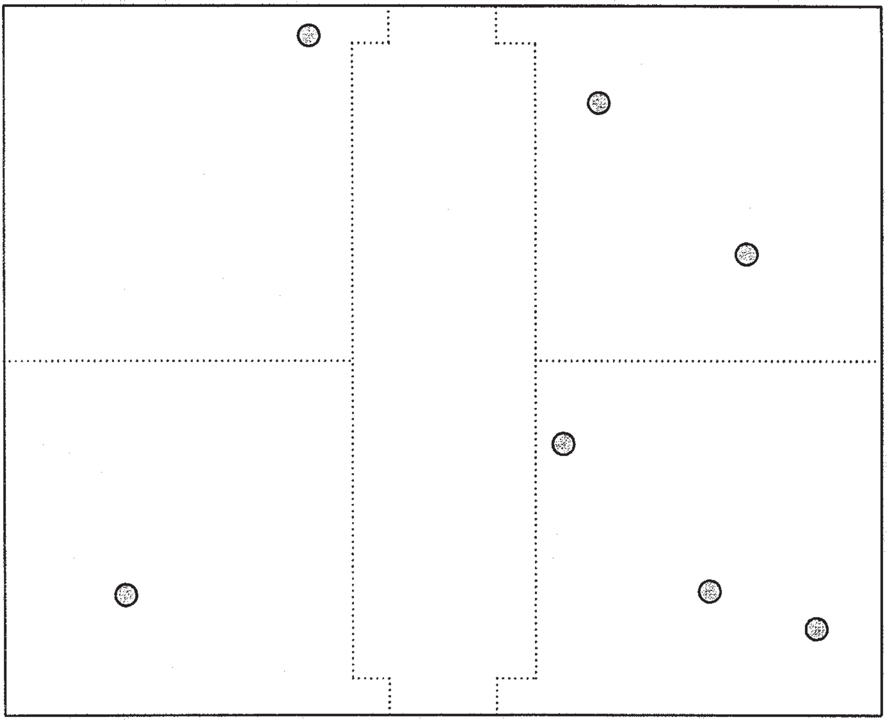

Figure 7.11. Distribution of Type C *#5 tukapu.*

the case, although there is no evidence that I am aware of that would compel us to accept this interpretation and certainly not for the sum total of the life (or use) history of the piece.

I cannot say with certainty what was the content or theme of either a historical construction or a cyclical periodicity that organized the calendar of this tapestry. There is a considerable amount of evidence pointing to the significance of groupings of five elements or units in Inka social, political, and ritual organizations. For instance, Zuidema identified quinquepartition as one of the principal structural patterns that gave shape to the ceque system of Cusco, as well as to the system of age-grades (Zuidema 1964: 213–227). Units organized by or into fives were central to local religious symbolism in the central Andes, as is evidenced in the Huarochirí manuscript (Mendizábal Losack 1989; Salomon and Urioste 1991; Urton 1997: 174–177). And what I have termed the model of fives—a group composed of a mother and her four age-graded children—represented the formative principle underlying and generating Quechua decimal numeration (Urton 1997: 13).

Concerning Inka administrative or ritual practices that repeated in five-year intervals, the most obvious example relates to Inka censuses, which were conducted every five years and recorded on khipus. We read of this practice, for instance, in the chronicle of Martín de Murúa:

> They sent every five years *quipucamayos* [khipu-keepers], who are accountants and overseers, whom they call *tucuyricuc*. These came to the provinces as governors and visitors, each one to the province for which he was responsible and, upon arriving at the town he had all the people brought together, from the decrepit old people to the newborn nursing babies, in a field outside town, or within the town, if there was a plaza large enough to accommodate all of them; the *tucuyricuc* organized them into ten rows ["streets"] for the men and another ten for the women. They were seated by ages, and in this way they proceeded [with the count] as has been said in preceding chapters. And this was commanded by the *Inga* every five years. (Murúa 2004 [1590]: 204; my translation)

It may be that the complex, five-year tapestry mantle we have analyzed here represented a type of commemorative construction pertaining to a particular group of people in which its internal organization, demographic make-up, and perhaps its own understanding of its history—over some actual five-year period or as viewed in ideal, cyclical terms—was woven in rows and columns of interlocking tapestry for public or private display.

In conclusion, I suggest that in its design, production, and perhaps for some portion of its use in pre-Hispanic and/or early colonial times, MFA325 represented a multi-year calendar that provided the framework for—or, better, was actually composed of—numerous design elements (tukapus) that were representative of important toponymic, social, or individual identities. I suggest that the actions and/or histories of (or at) these places over a five-year period—or within an eternally cycling five-year periodicity—were accounted for in the design and distribution of tukapus adorning this magnificent tapestry mantle.

ACKNOWLEDGMENTS

This paper is dedicated to Anthony F. Aveni with fond memories of the many years we spent together at Colgate University. I express my great appreciation to Pamela A. Parmal, curator, Department of Textile and Fashion Arts, Boston Museum of Fine Arts, for her help and cooperation in allowing me to view mantle MFA325 and to study Dr. Alan Sawyer's notes and unpublished

manuscript (Sawyer n.d.) on this textile. Thanks to my research assistant, Emma Burbank-Schmitt, for her help in studying MFA325 and for the preparation of materials for the illustrations. I acknowledge with thanks my wife, Julia Meyerson, who produced the drawings. Finally, thanks to Anthony Aveni and Ari Zigelbhoim, both of whom read and made valuable comments on an earlier version of this paper. I alone am responsible for any errors.

NOTES

1. Sawyer noted that the measurements of the shroud, or mantle, and its pattern of stains "indicate that the burial was a male child about four feet tall and around 13 years old" (n.d.: 2). It is not clear to me why Sawyer believed that the burial was that of a male rather than a female.

2. Sawyer's *A, B,* and *C* classes of tukapus differ from my own. His class *A,* like mine, totals 912 tukapus, but he classifies only 454 of the tukapus as Type *B* (those with designs he represents in the following shapes: X, \, and Z) and 458 as Type *C*. His Type *C* category contains the 228 elements composing my Type *C,* but he adds to this group 230 of the tukapus that I have classified as Type *B*. Sawyer does not explain clearly on what grounds he includes many of the red, green, and indigo tukapus (corresponding to my Type *B*) with the tukapus that have significant areas of white threads (corresponding to my Type *C*).

3. Sawyer notes (n.d.: 6), on the authority of John Rowe, that the Type *A* elements may not, in fact, represent tukapus; rather, they may be simple geometrical designs that were meant to fill the spaces between the true tukapus (i.e., Sawyer's and my own Types *B* and *C*). To the extent that the Type *A* tukapus are not, in fact, enclosed within squares (a common design convention of tukapus), I think one may be justified in eliminating Type *A* as a true tukapu type, although I have chosen not to do so in this paper. This decision does not affect my larger argument in any way, as the calendrical interpretation developed herein is based on the overall number of design elements on the mantle.

4. Sawyer arrives at the same total by adding his Type *B* (= 454) to his Type *C* (= 458).

5. Sawyer (n.d.: 10–12) identified only 36 variants of these tukapus (i.e., my Type *C*), although these represent in his classification only one of two different types of design elements that he combines into his Type *C* tukapus (see Note 2).

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CHAPTER EIGHT

R. TOM ZUIDEMA

Solar and Lunar Observations in the Inca Calendar

INTRODUCTION

In this paper I shall discuss three of the dual divisions of the year that the Incas applied to their calendar in Cuzco: the first division of 258 and 107 days obtained by observing sunrise on the two days when the sun passes through the zenith; the second of 251 and 114 days defined by observing the days of antizenith sunset and thus derived from the first one; and the third of 220 and 145 days closely related to the second one. My interest is, of course, inspired by the repeated attention that Aveni paid to apparently similar problems in Tenochtitlan and Copan, suggesting comparisons to Cuzco. Here I want to concentrate, however, primarily on the role that the moon in Cuzco played in constructing a calendar with the use of those solar observations. Let me recall first the problem as it presents itself in Mesoamerica.[1]

The Templo Mayor in Tenochtitlan is aligned on a point on the horizon close to Mount Tlaloc, where the sun rises some twenty days before the March equinox and twenty days after the September equinox. Aveni, Calnek, and Hartung (1988) and Iwaniszewski (1994) have also suggested the importance of the dates twenty days after the March equinox and before the September one. In Copan, the view from Stela 12 to Stela 10 is toward sunset on April 12 and September 1 (Aveni 2001: 250–257), dividing the year into periods of 220 and 145 days. As those dates are twenty days from the equinox dates as well as from the dates in Copan of the solar passages through the zenith (May 2, August 11), the alignment seems to fulfill two purposes:

1. Measuring the sun's rises in units of twenty days; and
2. Correlating them with2 the traditional local dates of planting and harvest.

Although the local dates of zenith passage are different in Tenochtitlan, a similar argument would have been valid.

In Cuzco, the most important and precise observations of sunset were made from the *ushnu* on the central plaza of Haucaypata, using a system of four pillars on the nearby horizon. They stood on Mount Yahuira, today known as Mount Picchu and, because of its astronomical functions, formerly also called Mount Sucanca. Aveni and I suggested that the sun would have passed the central pillars on days including those of antizenith sunsets: August 18 and April 26 (Aveni 1981; Zuidema 1981). As one chronicler stated the distances between the pillars and from the pillars to the ushnu, we calculated that the sun passed through the whole pillar system in at least 27 days and possibly 29/30 days, equal to a month. Ritual evidence from Cuzco makes clear that the dates when the sun passed through the southern pillars were as important, or perhaps even more important, than the antizenith dates. As I shall conclude later, these dates of April 10 and September 2 divided the year into periods of 220 and 145 days.

In Cuzco, we have no information that the Incas observed sunrises and sunsets on the equinoxes. Our ethnohistoric data also suggest very little interest in, or knowledge of, the equinoxes, so the 220-145 division seems unrelated to these solar events. Consequently, from my Andean point of view I could never rid myself of a simple question: why did people in Mesoamerica find it necessary to observe the 220-145 division if they, in fact, could have counted it so easily from the old and fundamental 260-105 one? Of course, I will not venture an answer for Copan other than the one Aveni gave, but at least I can argue that how and why Cuzco came to the 220-145 division by way of the southern outer pillars was different.

We can approach the Cuzco problem by combining precise archaeological and historical information and taking into account the lunar involvement. Let me first mention briefly, by way of introduction, two more general topics.

Pre-Conquest Calendars

We now have precise information on some five calendars of different societies from Inca and Huari-Tiahuanaco times. Apparently, two distinct types of calendrical calculation existed simultaneously:

1. The first comprised twelve solar months, either of 30/31 days or of $12 \times 30 + 5$ days, for which solstice observations would have been sufficient.
2. The second, primarily based on zenith observations, gave rise to quite different kinds of monthly units.

The Cuzco calendar that I shall discuss here belongs to the second type. A *quipu* from Inca times but found in the coastal valley of Ica gives information on both types of calendar (Zuidema 1989). In its first section, the quipu demonstrates how both types are used simultaneously throughout the year. In the second section, it gives more detailed information on the second type. It is likely that Cuzco society also knew the first type but we cannot yet reconstruct its exact configuration.

The Type of Information on the Cuzco Calendar

In what follows, I shall select from our combined archaeological and ethnohistoric information on astronomical observations those examples that, taken together, are supported by a tightly integrated system of ritual movements well located in the landscape (Zuidema 2005).

The system of ritual movements is closely related to the exclusive observation of five moons in the year: four moons in the 220-day period and one moon in the 145-day period. In particular years, any two of the four moons might have been observed successively but not the others; in other years the situation would have been different.

One important source of information that I will not use for the moment is a long myth that explains in sequence the actions of four "culture heroes," each action being related to the beginning and the social use of one of the four seasons as defined in the calendar.

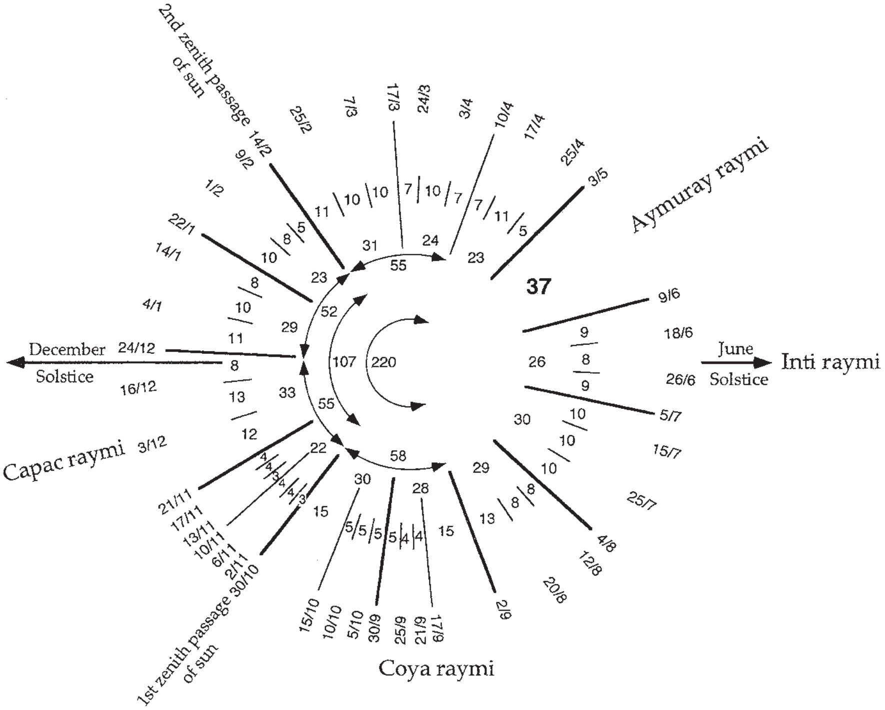

Figure 8.1. The ceque calendar. Each huaca represents a day; each ceque, a "week" of variable length; and each group of three ceques, a "month" of variable length.

There were thirteen social groups (ten *panacas,* two groups known as "uncles" of the first, and one group of foreign lords), each group responsible for the rituals in one month. The fact that such a system existed is clear enough; the main difficulty is making a discerning reading of the sound historical information in order to determine which group was in charge of which month, what was the group's exact function, and what were the exact temporal limits of its month. All groups except the one of foreign lords were registered in the *ceque* system, consisting of 41 directions (ceques) as seen from the central Temple of the Sun, organizing the ritual use of 328 locations (*huacas*). This system not only defined space in the Cuzco valley, but also the relative ranks of all groups, and the calendar (using the sequence of huacas for counting 328 days of the solar year). Information from what I call the "ceque calendar" (Figure 8.1) is indispensable for research on time in the Andes. It confirms results obtained independently by ground-based astronomical observations; it also gives precise dates and suggests further calendrical practices.

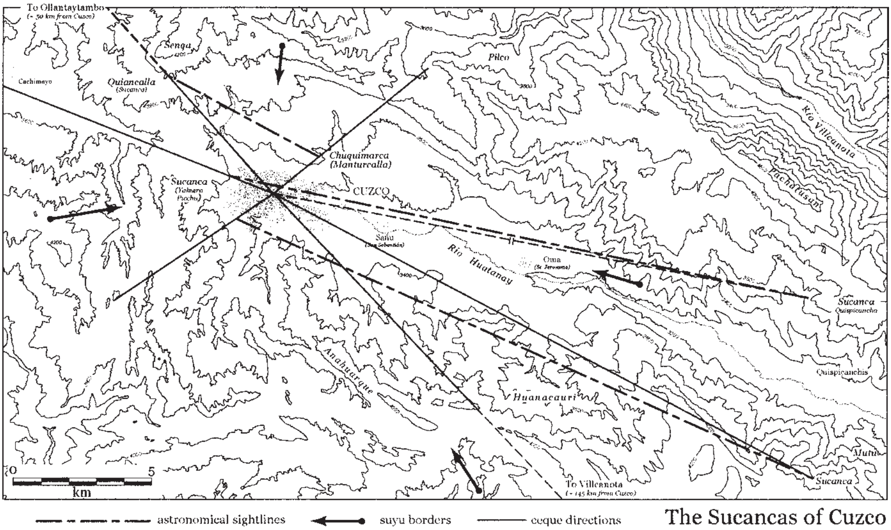

Figure 8.2. The sucancas and ritual movements.

THE SUN AND RITUAL MOVEMENTS IN THE CUZCO VALLEY

Observations to four horizon features, the *sucancas,* and two observations from the central Temple of the Sun defined the solar framework of the Cuzco calendar (Figure 8.2). One sucanca was observed from a temple south of Cuzco to determine sunrise at the December solstice and another from a temple north of it to determine sunset at the June solstice. The respective sucancas were too far south of east and north of west to allow for any solar observation between them.

The view between the two other sucancas defined, from the first (Mount Sucanca near Cuzco) to the second, the observation of sunrise on the two days when the sun passes through the zenith, October 30 and February 13. From the second to the first, the view defined the observation of sunset on the two dates of antizenith passage half a year later: April 26 and August 18. Abundant, albeit dispersed, information exists on the multiple ritual use of the axis between both sucancas. A legendary account describes the approach to Cuzco, along the whole axis, of a newly crowned king. A myth describes the Incaic conquest of Cuzco along the last part of the axis. In April, a procession was repeated during the eight days that ended on the day of antizenith sunset. It took place along the axis in the valley east of Cuzco in the direction of the town and toward sunset on the mountain called Sucanca by antonomasia. In August, observations were made from the ushnu in the plaza following the monthlong sequence of sunsets through the four pillars erected on Mount Sucanca. The multiple uses of this axis to observe antizenith sunsets—from the far-off other sucanca, from the valley, and from the ushnu—formed the core of the Inca calendar, as they defined the months used for planting (around August) and harvesting (around April/May).

These were the observations toward and from the periphery. The two kinds of observation using the central Temple of the Sun, Coricancha, were carried out without any need of a sucanca. Most important were the two rooms west of the courtyard aligned to sunrise on May 24/25 (Zuidema 1982). From here the king himself made this precise observation, best confirmed by ethnohistoric evidence as I will detail in a moment. We can assume that this observation, 29 days before the June solstice, was repeated 29 days after this solstice. The second kind of observation was made primarily in the back part of the temple compound, now for the December solstice itself (and not for any nearby date). The straight outside walls of the compound were either facing the solstice (the eastern wall) or aligned toward it (the northern and southern walls). Moreover, an extra, fifth room was aligned to this solstice. Here, the image of the sun god "slept" at night with *acllas,* called "virgins of the sun," although in this case associated with the moon (Zuidema n.d.).

We are dealing with two systems of observation quite unlike each other:

1. One using the sucancas, undertaken both from and toward the periphery and organized around the December solstice; and
2. The other, carried out in the center and more tightly organized around the June solstice.

The pillar system held an intermediate place both in terms of space, being carried out between center and periphery, and in terms of time, forming the transitions between the two periods of the year as measured by the respective systems.

LUNAR RITUAL MOVEMENTS

Various ritual movements within periods from one solar observation to the next were scheduled by using the moon. However, only five of the possible twelve or thirteen lunations in a year were selected for more elaborate attention in this way. One full moon was observed around the June solstice. In four other cases, the moon was followed from new moon until some eight days after full moon, according to a system of four double months around the December solstice. Let me first document the second system.

The 107-day period between the first and second zenith passage of the sun was divided into two Incaic double months of 53/54 days each. Before and after these double months two other double months were organized. One chronicler (Anonymous 1906) recognized that each of these four double months was shorter than two synodic months: "the moon of one month always reaching the other." The lunar rituals and the fact that we have such information exclusively for these four double months allow us to describe in detail how the system worked out in practice and to realize how, in fact, it could be applied in a rather simple and straightforward way.

Let me take as an example the third double month, starting with the December solstice. First, the next new moon was observed; this was when the recently initiated noble boys engaged in a ritual battle between their two moieties. During the night of the next full moon all noble men and women danced through the streets and at sunrise joined together, encircling the king in the plaza. Four (Molina 1989) or six (Cobo 1956) days later, the most important concluding rituals occurred. At night, runners would follow the rushing waters of the river down to Ollantaytambo, stay there for two days, and then return during daytime in a competitive race. Just before reaching Cuzco they passed the sucanca where the June solstice had been observed. With a late moon after the December solstice, the race would finish just before the sun passed the zenith for the second time. It was a single moon that within a two-month period "carried on time" between two "seats" (in Guaman Poma's words) of the sun.

We have similar lunar information for the first and second double months. I will just recall two important details here. In the second double month a pilgrimage was repeated, in lunar time, that was first held around the June solstice. I shall consider this repetition in a moment. The lunar rituals in the first double month started with the new moon after the sun passed the last (southern) pillar of the four on Mount Sucanca. Thus, we can already suggest that the date was around the beginning of September. We have no lunar information on the last double month except for the statement that the two months were taken together because of the moon. In fact, a repeat—and, to some extent, a reversal—was held of the lunar rituals in September, when evil and illnesses were driven out from Cuzco. Now, in February/March, the encroachment of these same dark forces was warded off. The ritual was probably lunar but we do not yet have any explicit statement about the particular days used for that purpose. This double month ended around April 10 when the sun returned to the southern pillar.

One general observation with respect to the other three double months is of interest. All month names had seasonal meanings except for three months, each of which was the principal month of a double month. Here a different lunar name existed next to the month name. In the first double month, the solar month was called Coya raymi, "feast of the queen," and the lunar feast Situa. In the second double month, the solar month was called Capac raymi, "royal feast," and was celebrated by the king, ending with the December solstice, while the synodic month was called Quilla raymi, "lunar feast," and celebrated by the queen. In the third double month, the principal month could again be called Capac raymi, but its proper name Camay quilla, "the moon that animates," probably derived from the lunar feast then held. Remarkably enough, an optional name for the lunar ritual of following the rushing waters was given by one chronicler to the first, principal month (Cabello Valboa 1951). Two other chroniclers gave this name to the second month when, in fact, the ritual would occur more often (Fernández 1963; Gutiérrez de Santa Clara 1963). The paired names could reflect the fact that solar and lunar calculations were distinguished from each other and combined. Possibly, men and women applied separate calendars making their respective solar and lunar calculations (Zuidema 1978; Urton 1981). Marriage partners would be in a position to correlate and contest those calculations with each other.

A somewhat different argument has to be made for the combination of solar and lunar observations in the five months around the June solstice. Molina refers to the lunation that started with the new moon after May 25; he enables us to understand why on this date the king observed the rising sun. The full moon, celebrated next, was the one on or around that solstice. The month was called Haucay cuzqui and its "feast for the sun," Inti raymi. We have an excellent description of its many layers of celebration but just here it is not clear if the rituals, extending for at least twenty but probably close to thirty days, were organized around the full moon or around the solstice itself. The ritual movements included a pilgrimage of priests to a far-off temple southeast of Cuzco. Although it was said to be dedicated to the December solstice, it was visited for the June solstice. The pilgrimage started at the sucanca of the December solstice sunrise. It ended at the sucanca of the zenith sunrise. We remember, however, that from here the antizenith sunset was observed. Thus, it also becomes understandable why the other sucanca and the temple, both related to the December solstice, were visited. Both eastern sucancas were included, but not to make any observations now; rather, to be commemorated. Thus the most logical hypothesis is that the pilgrimage was a solar ritual completing the Incaic month around the solstice and that it commemorated the longer period from first to second antizenith sunset, April 26 to August 18. Even if the pilgrimage had been lunar it would not have made much difference, as that moon would still have fallen between May 25 and July 19, and thus between the antizenith sunsets.

We realize that the technique and purpose of making solar observations around the June solstice was different from that around the December solstice. Now they were spaced more closely together; in fact, they were the length of one synodic month apart from each other (April 24, May 24, June 22, July 21, and August 20). Each observation served a double purpose: announcing the next new moon and indicating the date in the middle of the fixed month around which the following full moon was going to be celebrated.

I can return now to the repeat of the pilgrimage in the double month from the sun's first zenith passage to the December solstice. I suspect that the direction of the pilgrimage was reversed, starting from the zenith sucanca and ending at the December solstice sucanca. Now the pilgrimage was regulated by the moon. An early departure of the repeat pilgrimage would have been from the sucanca that then was observed and a late return at the sucanca also then observed. These were the same sucancas as in June but their commemorative function now not only reversed their sequential use but also switched to the other half-year, not around but before, and concluding with, the December solstice.

SIDEREAL AND SYNODIC LUNAR PERIODS

I can now contrast the period of the four double months around the December solstice with the period around the June solstice—the rest of the year. The solar observations from Coricancha on May 24 and July 21 are spaced 29/30 days from the June solstice date. The full moons were observed not between, but around, the respective solar events.

Thus it remains for us to try to understand the reason for the existence of the four pillars on Mount Sucanca. We can approach the issue, being aware of the potential consequences if one tries to accommodate a system of lunar observations into a year divided primarily by the zenith and antizenith observations. The zenith period is 107 days long and the antizenith period about 114 days. The remaining intermediate periods have 72 days each ($107+72+114+72=365$). These periods are difficult to combine with a full number of lunar observations as could be done for the other two periods. The inner pillars represented the combination of two calculations: of the observed period between the two antizenith sunsets (114 days) and of the average period between the full moon two months before and the one two months after the June solstice full moon (118 days). The elapsed time of the solar observations, one from the central pillars to the southern outer pillar and the other from the last to the first, helped to split the 72-day periods each into two periods of ~15 and ~57 days.

We can already predict the direction in which the solution of the Incaic monthly calendar was likely to go. Organizing five full moons around the June solstice needed a fixed period of 147½ days. This leaves almost 218 days for four double months of 54½ days each. Not only might this last number have been intended by the chronicler who said that the double months were each shorter than the period of two synodic months but it is also almost the exact length of two sidereal months (54⅔ days). Apparently, the Incas intended to measure the solar year in terms of two periods: one of 8 sidereal months [8 × 27⅓ = 218⅔] and the other of 5 synodic months [5 × 29½ = 147½]. The sum of 218⅔ and 147½, 366⅙ days, is less than a day longer than the tropical year.

THE CONTRIBUTIONS OF THE CEQUE CALENDAR

I can now introduce the ceque calendar and discuss how it confirms and refines this reconstruction of the Inca calendar (see Figure 8.1).[2] Each ceque group of three ceques represents an Incaic month with its huacas counting the days in clockwise order.[3] The place of that month in the year is stated by the ritual obligations of the panaca in charge. Thus we can conclude that the ceque calendar started counting with the month around the June solstice and finished counting just after the antizenith sunset in April. In fact, the month names around that date also attest that the agricultural year came to be "at rest." Perhaps the best confirmation of this calendrical use of the ceque system is that it specifies the end of Capac raymi month as two days after the December solstice. This is exactly what Molina (1989) said, and he is also the chronicler who gave us the precise information on the use of May 25 for announcing the first full moon around the June solstice. Let me concentrate on those remarks that for the comparative argument of this paper are most relevant.

The ceque calendar defines well the zenith period of 107 days as from October 30 to February 14. The four double months have an average length of 55 days, but in order to accommodate the zenith period three days are taken from the third double month (52 days, from December 24 to February 14) and added to the first (58 days, from September 2 to October 30). Thus the two extra days after the December solstice could also be represented. The passage of the sun through the pillars around August and April/May could well be represented by the division of the corresponding Incaic months into their respective "weekly" periods. Apparently, the antizenith sunsets were indicated by the dates of April 28 and August 20, in each case two days after the actual event.[4] If the middle period of eight days represented the solar passage through the central pillars, in agreement with the description of our chronicler, then these pillars would not have stood in the middle of the outer ones. They would have accommodated primarily the antizenith sunset and secondarily the nearby full moon. (Another advantage of this arrangement could have been that the half year from August antizenith sunset to February zenith sunrise was only one day longer than the period of six synodic months [178 days].) The ceque calendar does not seem to represent the second passage of the sun through the pillars in exactly the same way as the first passage. Nonetheless, the sun passed the first, southern pillar exactly on the expected day: April 10.

The two days of passage through the southern pillar divided the year into the periods of 220 and 145 days, thus rounding off the exact periods of, respectively, eight sidereal months [218⅔ days] and five synodic months [147½ days]. These last five months are represented in the ceque calendar by the periods of 60 days (23 + 37: from April 10 to June 9), 26 days (from June 9 to July 5), and 59 days (30 + 29: from July 5 to September 2). Apparently the reduction from 147½ to 145 days was taken from the central month.

Other numbers are also of considerable interest but I will not comment on those now as I wanted to demonstrate first of all that the ceque system does account well for the Cuzco calendar as reconstructed from the solar and lunar data and corroborated by the information on ritual movements. Much new ethnohistoric information now reveals its relevance. Let me highlight one enigmatic detail from Guaman Poma's description of the Incaic astronomical and calendrical system, as it seems to reflect in a precise and intriguing way the transitional function of the pillars. It leads me to finish with a comparison with the 260-105 and 220-145 problem in Mesoamerica.

THE MEETING OF SUN AND MOON

Guaman Poma de Ayala (1987: 235[237], 884[898]) claimed that the Inca year was divided into two half-years. But when he mentioned the months of these half-years, he first enumerated the seven months of January–July and then the five months of August–December. Even more curiously, when he began the second half-year, he specified the day of St. John not as that of his birth, June 24, but that of his death, August 29. Thus, in fact, Guaman Poma divided the year into two periods of eight and four months respectively. One remote possibility motivating him to do so may have been the fact that the old Alexandrinian calendar and even the Coptic one today begin the year on August 29. Guaman Poma's own elaboration on that beginning may illustrate, however, an Incaic incentive not derived from any Old World source. His intention is clear but he expressed himself in such an entangled way that I have had to cut through his words to try and determine precisely what he was saying.

During the December solstice, according to Guaman Poma, the sun is high but the moon—that is, the full moon—is low. To that I would add that during the June solstice the sun is low and the full moon is high. Halfway between the June solstice and the December solstice the sun and the moon change their respective high and low courses. Guaman Poma did not associate this moment with the September equinox but with the month of August and more specifically with the day of August 29. Then the sun and the moon meet each other; "the moon is one degree below the sun, they are like man and wife," and it is the time of planting. From that date on, "the moon follows the sun as his wife and as Queen of the Stars."

In conclusion, Guaman Poma identified the equinox with the date of August 29, which is very close to that of September 2, when, according to the ceque calendar, the sun passes the southern pillar. He did not mention the pillars but was very much aware that in August the passage of the sun along the horizon—I would say any horizon around Cuzco—was followed most closely. Guaman Poma even repeated the words of the anonymous chronicler, who gave us the only precise, useful, and practical information on the pillars, which was that then "people see which time(s) they have to do the early and late sowings." The system of pillars was probably the local expression of a more widely followed practice at the time of planting. In the Cuzco area, September 2 would have been the generally accepted date for the end of that practice.

There are probably good reasons why around June, in the dry season, the phases of the moon were followed more closely during night and day, and why around the December solstice, in the rainy season, the position of the moon against the stars was followed, now only at night. It led to the curious consequence that more attention was paid to both the sun and the moon in their respective periods of 145 and 220 days when they were low and not high.

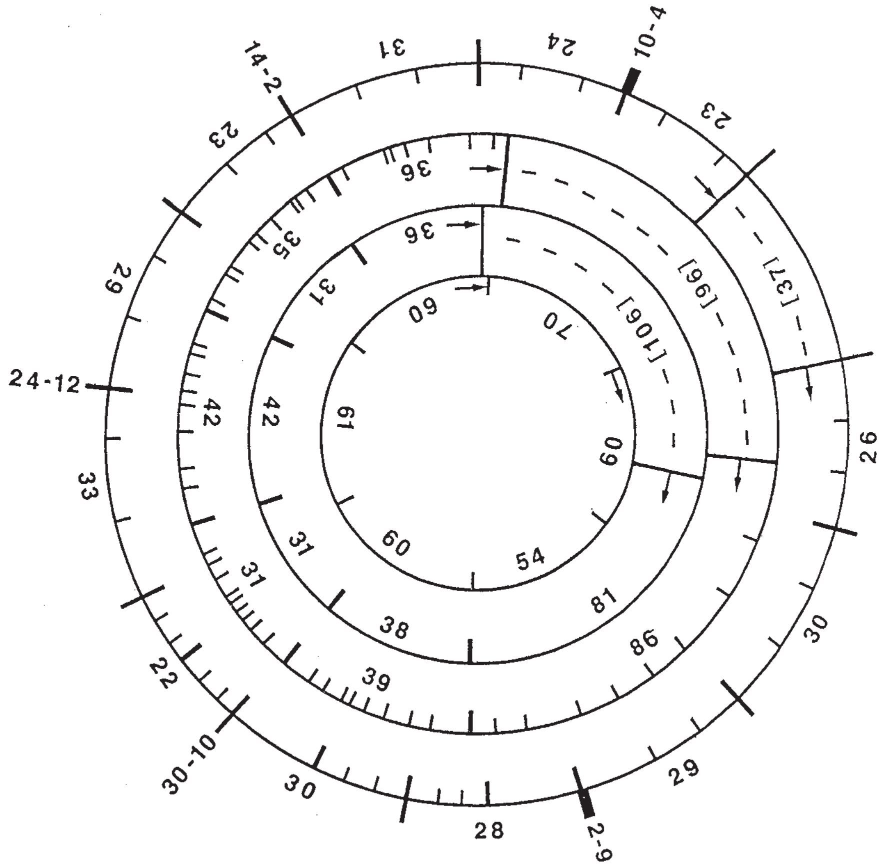

Figure 8.3. The ceque calendar and the Ica calendars compared. Reading from the inside out: the first Ica calendar, of solar double months; the second Ica calendar, taking into account the solar zenith passages; the third Ica calendar (not discussed here); the ceque calendar.

CONCLUSIONS

I can now reach further conclusions about the ceque calendar by integrating some results about the Ica quipu calendar, given that the latter correlates its first calendar of twelve solar months with its second, shorter calendar taking into account the dates of zenith passage (Zuidema 1989).

Owing to the zenith and antizenith observations, the ceque calendar recognized thirteen months in the year, six and a half in each half-year as divided by the solstices. Thus the antizenith observations themselves could not serve the beginning or end of a month; that function was assumed by the outer pillars.

One month in Cuzco, around May, was removed from any specific connection with agricultural activity; it was not counted and not represented by any local panaca or ayllu. In Ica (Figure 8.3), this period was much longer, 106 days, but it also occurred around the same time of the year. (Although this period did not run from one antizenith passage to the other, I suspect the antizenith passages had something to do with it.) Assuming that in Ica one organization of ayllus was in charge of both calendars, this would suggest that one and the same ayllu would have been in charge of a long month in the year calendar and of a corresponding short month in the smaller 259-day calendar. We lack this crucial type of information for Cuzco although it is clear that here too both calendar systems coexisted.

I can now finish with a preliminary comparison and contrast with the Mesoamerican systems. It is, of course, pure coincidence that our information from both areas happens to come from similar latitudes. There is good reason why the Mesoamerican calendars were more interested in the zenith passages and the Andean ones in the antizenith sunsets, given the respective times of planting and harvest. Copan and Cuzco came to the same interest of dividing the year into 220 and 145 days, although they arrived at these numbers in different ways: in Copan by counting in units of twenty days and in Cuzco by following four sidereal double months (4 × 55) and five synodic single months (5 × 29). This calendrical system in Cuzco was not, of course, dependent on the zenith and antizenith observations, although it was combined with them. In Ica, at a slightly lower latitude, a somewhat different kind of combination was applied. Some information exists on the earlier calendar in Tiahuanaco, with a suggestion there that the solar zenith and antizenith observations were also used for dates different from Cuzco. If so, the combination with monthly divisions would also be different. In Mesoamerica, the calculation with months of twenty days and a cycle of 260 days became so fixed that, I suppose, it is difficult to imagine that there, at some point in the past, a looser connection also existed between months and zenith observations according to different latitudes. Anyhow, I wonder if in Copan, and in Tenochtitlan too, the interest in the number 220 was derived solely from the practice of counting in twenty-day units and not perhaps also from additional motives.

In Peru we can also follow how a sociopolitical system of twelve groups translated its interest in twelve solar months (365 days) into a system of twelve shorter months (328 days) related to the agricultural activities in the year, leaving a thirteenth month for rest. Let me recall some similar practices in Mesoamerica. At one time I was much interested in a type of kinship system, existing in North America and in Mesoamerica, recognizing thirteen kin-lines that led to the formation of social systems consisting of thirteen groups (Zuidema 1965). In accordance with such a social system, the Mesoamerican calendar of thirteen sidereal months of 28 days each could have played a role. I wonder, therefore, if a second interest in the shorter agricultural cycle could not have helped in establishing the 260-day (i.e., 13 × 20–day) cycle. Correlating cycles of different lengths to each other was, of course, well-known; I am thinking now in the first place of the clear example that Barbara Tedlock (1992: 45) gave of Momostenango, where the 328- and 260-day cycles interact. Returning to Cuzco, an evident relationship existed between the 220-day (i.e., 4 × 55–day) cycle around the December solstice and the whole cycle of the ceque calendar of 328 days, divided into four seasons with an average of 82 (85, 80, 85, 78) days. Both sequences were built on an alternation of monthly periods with either about 30 or 25 days.

Whatever the importance of the 220-day period in the Andes and in Mesoamerica, I think that the Incas, in addition to dividing the year into twelve solar months of 30/31 days, came to a beautiful solution by also dividing the year into a combination of eight sidereal and five synodic months. As an example, it belongs to the unitary discipline of tropical calendars in the Americas, an avenue of research where Tony Aveni has led the way.

NOTES

1. The information on Cuzco used here is documented at greater length in a forthcoming book on the Inca calendar (Zuidema n.d.).

2. The 41 ceques were divided over the four quarters (*suyus*) of town. In three suyus there were nine ceques each—three groups of three. In the fourth suyu there were fourteen ceques (one ceque being divided over two directions), giving a total of five ceque groups.

3. The numbers of huacas were comparable in all four suyus (85, 78, 85, 80). The counting of the days in the fourth suyu by way of three months followed a pattern independent from its division into five groups of ceques.

4. The way in which the ceque calendar accounts for the days of antizenith sunset invites some further discussion. We observe that although this calendar correctly defines one set of dates (October 30, February 14, and June 22, this last date being in the middle of the "week" of June 18–26), it consistently defines the other set of dates two days later than when the actual events occurred (December 24, April 28, and August 20). Apparently, the antizenith sunset dates were not observed within the "weekly" period when the sun was within the inner pillars but when it passed through

the southern inner pillar in August and through the northern inner one in April. The nearby average full moons occurred when the sun was within the inner pillars, although not centrally. I estimated the correlation of the ceque calendar with the Gregorian calendar departing from the dates of the June solstice and of the first passage of the sun through the zenith (October 30). The date of the second passage through the zenith (February 14) is accounted for one day after the actual event (February 13). Of course, it is also possible that the ceque calendar should be moved, for instance, one day back in its correlation to the Gregorian year. Then all six dates would be one day off from the actual events. I should, however, also make two caveats. Although I can account for the general correctness of my observations of zenith sunrises and antizenith sunsets, more precise observations might slightly change their dates. Furthermore, we do not know the exact techniques that the Incas used in making these observations.

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CHAPTER NINE

CLIVE RUGGLES

Cosmology, Calendar, and Temple Orientations in Ancient Hawai‘i

> *The idea that there can be an interplay between a monument and its setting is by no means new . . . it was a common theme in the first half of the twentieth century, interest dwindling in later decades. Recent work has put the issue firmly back on the agenda.*
>
> JOHN BARNATT AND MARK EDMONDS[1]

> *Hawaiians see themselves as an integral part of the cosmos and the ‘aina, the land. We belong to this and everything in it is living and everything is conscious and everything intercommunicates.*
>
> KEKUNI BLAISDELL[2]

INTRODUCTION

The basic archaeological evidence available to the archaeoastronomer consists of material expressions of perceived relationships with objects and events in the night sky. Addressing issues in cultural astronomy, however, typically involves considering a wider range of evidence wherever it is available and relevant, including data obtained from history and ethnography. In the past two decades we have moved beyond Aveni’s green/brown characterization (Aveni 1989) in two important ways. On the one hand, serious archaeoastronomers studying prehistory and hence dealing wholly with archaeological evidence—the nominally “green” camp—can no longer be accused of choosing to ignore, let alone remaining blissfully unaware of, the broader interpretive context. The rise of interpretive archaeologies has provided a suitable broader framework of theory and practice for deriving cognitive inferences from material data

(Ruggles 2005a) and efforts have been made to establish theoretical frameworks for dealing particularly with questions relating to perceptions of the sky (e.g., Ruggles and Saunders 1993; Iwaniszewski 1998). At the same time, those archaeoastronomers working in "brown" contexts, such as Mesoamerica, where conclusions are strongly informed by written documents and ethnohistory (Aveni 2001), have nonetheless had to find well-founded rather than arbitrary ways of dealing with (what for the sake of simplicity we may characterize as) alignment evidence[3] and of integrating their conclusions into the broader interpretive picture. A good example is provided by recent efforts to reexamine the horizon calendars of central Mexico and to reinterpret them in terms of cultural perceptions of the landscape (Šprajc 2001; Iwaniszewski 2003). These developments open up a set of more subtle and challenging methodological issues concerning (1) the retrieval and analysis of alignment/spatial patterning data, and (2) the integration of these data with evidence of other types—both archaeological and non-archaeological—in order most effectively to address cultural questions, given varying degrees of quantifiability, reliability, and relevance (see Ruggles 2000a).

The problem of interpreting temple orientations in ancient Hawaiʻi brings a number of these issues into sharp focus. The alignment data must be considered not only in the light of a range of other archaeological evidence relevant to the meaning and function of the temples in question—including the date and methods of construction, the materials used, the form and spatial layout, the nature of offerings and other artifacts, and the location within the natural and cultural landscape—but also in the light of strands of evidence from oral history and ethnography. Hawaiian ethnohistory presents us with a body of evidence that—although mostly of uncertain provenance owing to the lack of a written language prior to European contact—cannot simply be ignored (Ruggles 1999a: 40–43). Nor can we ignore surviving indigenous practices and beliefs, even though they need to be approached with caution, particularly in the light of modern political agendas and their various influences on perceptions of the past (e.g., Spriggs 1990). Linguistic evidence also informs the broader picture (Kirch and Green 2001). In a very real sense, the Hawaiian Islands provide, for investigations focusing on cultural astronomy, an important methodological "halfway-house" between prehistoric Europe, where there is no relevant ethnohistory at all and "formal" as opposed to "informed" approaches necessarily hold sway (cf. Taçon and Chippindale 1998 on rock art), and other parts of the New World such as pre-Columbian Mesoamerica, where the historical evidence dominates.

I underwent a transformation from astronomer to archaeologist in the late 1970s and early 1980s that in many ways paralleled the path that Tony Aveni had trodden somewhat earlier. In my own case, while studying European later prehistory, I had to recognize the need to move beyond the mere formal analysis of astronomical alignments in architecture if I wanted to start seriously addressing culturally relevant questions of significance and meaning. The need to reconcile theoretically or culturally "informed" interpretive approaches with suitable methodologies for dealing both with both quantifiable data and more subjective contextual evidence raises fundamental issues that still lie at the heart of archaeoastronomy as well as being of considerable importance within archaeology as a whole. For me, the Hawaiian project described in this paper has been an opportunity not only to examine temple alignments in a cultural setting where the prominent place of astronomy within religious, navigational, and calendrical traditions is pre-evident, but also to explore a range of issues relating to field method and practice in a context where spatially patterned archaeological data and ethnohistoric evidence exist in relatively fine balance.

Polynesia (Figure 9.1) represents by far the largest geographical area populated in premodern times by peoples sharing a common ethnic identity (Kirch 1985, 2000; Bellwood 1987). This extensive but highly dispersed "nation" presents the anthropologist with a number of challenging questions (Terrell 1986; Kirch 2000: 302–325). Why and how, for example, did people who retained an instantly recognizable common ethnicity come to inhabit such widely scattered island environments? (Despite earlier claims to the contrary, few can now have the slightest doubt that the Polynesian exploration across the Pacific was achieved in a planned manner by highly skilled navigators [Finney 1994].) How did ecological factors affect and determine the subsequent development of Polynesian society in each diverse island environment? (On small and isolated Rapa Nui [Easter Island], for instance, the overexploitation of resources clearly caused environmental and social catastrophe [Bahn and Flenley 1992].) And to what extent were people's actions, and social developments, in different parts of Polynesia influenced by their particular perceptions of the world?

Cultural astronomy has a key role to play in addressing big questions such as these, especially those that raise ideological and cognitive issues rather than purely economic and environmental ones. The extraordinary circumstances encountered in some of the Polynesian island environments certainly gave rise to equally extraordinary beliefs and practices. An obvious example is the (to

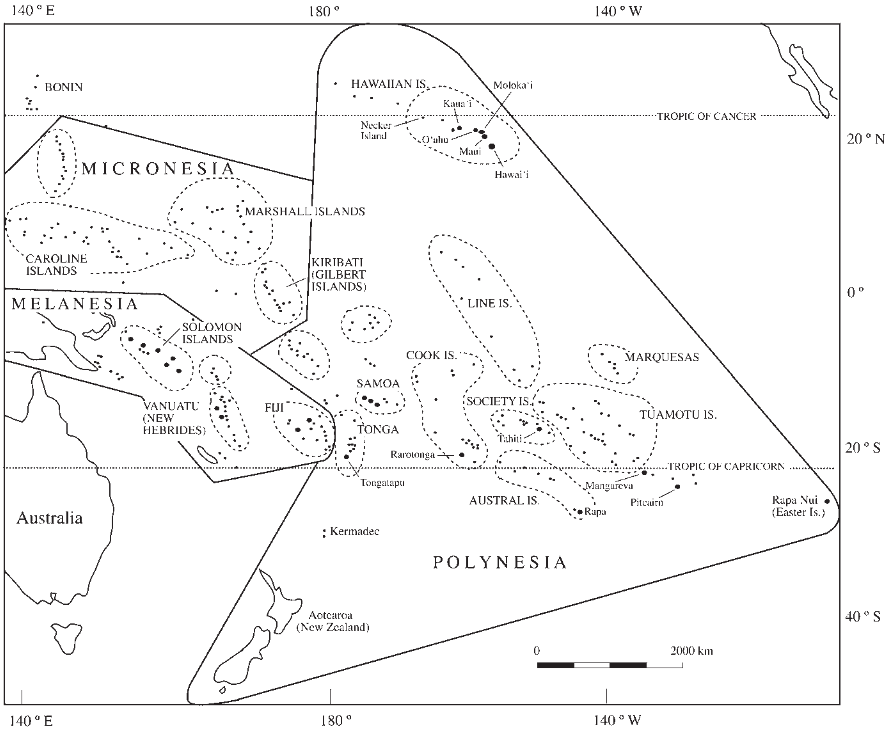

Figure 9.1. The main island groups of Polynesia. (Figure drawn by Deborah Miles-Williams; modified after Bellwood 1987: 8–9.)

us) supererogatory production and erection of scores of *moai* (stone statues) on Rapa Nui, bearing witness to powerful ideologies that developed there in response to an extreme situation (but prior to social collapse) (Van Tilburg 1994). Another phenomenon that makes no rational sense in our terms is the concentration of over thirty temple platforms built on the tiny, remote, and uninhabitable Necker Island, well beyond the last of the inhabitable islands in the Hawaiian chain (Emory 1928: 51–122; Kirch 1985: 94–98; Cleghorn 1987: 39–53).

On the other hand, marked similarities between customs that prevailed in different parts of Polynesia just prior to European contact clearly indicate the existence, many centuries earlier, of common ancestral religious traditions from which the later variations derived. The temple structures (enclosures and platforms) found all over Polynesia testify clearly to this shared background (see Kirch and Green 2001: 249–256). Although reflecting a variety of forms and functions, these sacred temples and shrines—known variously as *heiau* in the Hawaiian Islands (Valeri 1985; Kirch and Babineau 1996), *marae* in central Polynesia and Aotearoa (New Zealand), and *ahu* in remote Rapa Nui—formed an integral part of cultural landscapes throughout Polynesia. They are valuable to the archaeologist not only as an indicator of specific religious practices but also (e.g., in their spatial disposition) as a material reflection of broader cosmological principles (cf. Parker Pearson and Richards 1993; Rapoport 1994; Bradley 1998: 108–109; Ashmore and Knapp 1999; Ingold 2000: 209–218).

Astronomy was a vital component of cosmology. In Polynesia, and throughout the world, the sky formed an integral part of the environment perceived by ancient peoples. It is also a part that is directly accessible to us, for we can use modern astronomy to reconstruct ancient skies (Ruggles 2000b). Elements of cosmology can be reflected in a variety of ways in the cultural landscape, with astronomical relationships (along with many others) being encapsulated and symbolized in, for example, the location of sacred places within the natural topography and the design of temple sites, including their orientation (Ruggles 2005a). The fact that many topographic features have the names of stars or other celestial objects seems to reinforce this expectation in the Hawaiian Islands, although the complexities of thought that underlie the particular relationships that are found have yet to be unraveled (see Ruggles 2001: 49, 75–76). Intentional alignments of sacred structures upon astronomical targets most likely encapsulated only one small aspect of a complex web of relationships perceived as significant by their builders. Nonetheless, where they do occur, such alignments can reflect elements of past cosmologies exceptionally clearly, because we can calculate and visualize the appearance, position, and cycles of movement of regular objects in past skies.

It is natural, then, for the archaeoastronomer who becomes interested in Polynesia to ask about the location, design, and orientation of the ubiquitous heiau. On the other hand, there has been little interest in this issue until recently among archaeologists. In the Hawaiian Islands, for example, the general assumption since the early twentieth century was that temple orientations were simply constrained by the topography (see Kirch 2004: 103–4). Ironically, broad surveys of heiau orientations undertaken by serious archaeoastronomers have tended, on the face of it, to strengthen this conclusion: this is equally true of an early systematic analysis of orientations of 227 ahu orientations on Rapa Nui (Liller 1989) and surveys of 20 extant heiau on the Hawaiian island of Kaua‘i forming part of the early stages of the project described in what follows (Ruggles 2001). In both cases the predominant trend was for orientations perpendicular to the shoreline.

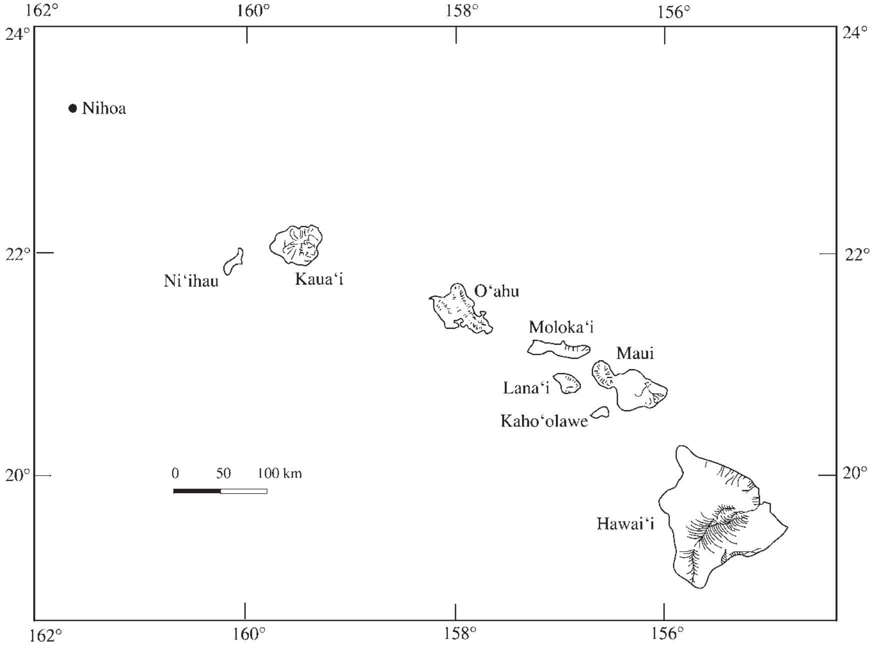

Figure 9.2. The principal islands of the Hawaiian chain. (Figure drawn by Deborah Miles-Williams.)

Yet to conclude that temple locations and orientations were determined by no more than topographic convenience would be to argue in the face of the evidence that exists alongside the alignment data and other aspects of the archaeological record: the evidence from ethnohistory.

The Hawaiian Islands (Figure 9.2) represent a resource-rich corner of ancient Polynesia, where powerful social hierarchies developed in the centuries immediately preceding European contact (Kirch 1984). Here, alongside the archaeological evidence, there is an abundance of ethnohistory. A few seminal accounts of traditional practices, as related by native informants and recorded in the nineteenth and early twentieth centuries, have been translated into English (see Malo 1951; Ii 1959; Kamakau 1964, 1976, 1991). So too have various creation myths and formal chants that had been passed down from one generation to another by oral tradition prior to European contact (e.g., Beckwith 1970, 1972; Emerson 1997). There also exists a wealth of further material, much of it published in early Hawaiian-language newspapers, that remains untranslated and is available only from library archives in manuscript form. The ethnohistory contains a good deal of information relating to calendrics and star knowledge, and it has also been claimed that many items of "oral literature" contain further encoded astronomical information, although such assertions remain controversial. For overviews, see Johnson and Mahelona (1975), Ruggles (1999a: 39–43), and Chauvin (2000).

In the Hawaiian Islands prior to European contact, as elsewhere in Polynesia, people's awareness and use of the skies took place within a cognitive framework that combined an extensive practical knowledge used in long-distance navigation with strongly developed elements of ritual and ceremonial (Grimble 1931; Makemson 1941; Gladwin 1970; Lewis 1972, 1974; Valeri 1985). Many aspects of sky knowledge were considered sacred in nature and were the preserve of high-ranking individuals, such as chiefs and/or priests (cf. Kirch and Green 2001: 246–249), who controlled how such knowledge was put to use socially and politically. Traditional names of stars and other celestial objects, together with calendrical practices, including season and month names, have been recorded from all over Polynesia (Johnson and Mahelona 1975; Johnson et al. n.d.). There are many common terms and other similarities, which bear witness (e.g., through "phylogenetic" analysis [Kirch and Green 2001: 237–276]) to the spread and gradual adaptation to local circumstances of widespread perceptions of the skies dating back at least to the time of the earliest expansion of Polynesian peoples across the Pacific in the early centuries AD (Kirch 2000: 207–301).

There still exist living informants who possess sacred knowledge, and some may be willing to divulge aspects of this knowledge to non-Hawaiians, although there is clearly limited potential to obtain through modern ethnography meaningful information about perceptions and practices that preceded (in the Hawaiian case) nearly two centuries of attrition and acculturation. Yet such testimony, in combination with related evidence of other types, may still have the potential to provide valuable insights into the past.

The ethnohistoric evidence makes it clear that strict protocols governed the location and orientation of temple sites (Valeri 1985: 253–256). For instance, a description of the construction of war (*luakini*) heiau by the informant David Malo in 1903 shows that cardinal directions were important in their construction, and in particular that they were oriented to the north or east, with the audience to the south or west (Malo 1951: 162; see also Kirch 2004: 103). Similar but different principles are described by Samuel Kamakau (1976: 135–136). However, even a cursory examination of the disposition of the remains of luakini heiau on the Kona (west) coast of the Big Island of Hawai'i suggests a more complex picture. Valeri (1985: 255–256) was forced to suggest two other possible motivations for a given temple orientation: alignment in the direction of the enemy at a time of war and alignment upon a mountain supposed to be the abode of a god.

In order to progress, we need to achieve a suitable balance between two extreme approaches. One of these amounts, if we are not careful, to little more than using arbitrarily selected orientation data (or, more generally, spatial patterning in the material record) merely to support or refute conjectures based on informants' accounts. At the other extreme is the sort of abstract statistical analysis (as epitomized in Aveni's "green" archaeoastronomy) that is likely to ride roughshod over critical differences in function and local context and thereby to demonstrate nothing. Where does the optimal balance lie and how might it best be achieved? The principles determining location and orientation are likely to have depended substantially on the principal purpose and function of a given heiau, to have varied from place to place and time to time, and to have derived their cultural significance from largely unfathomable complexities of symbolism and meaning.

The broad approach adopted in the project described here is essentially Bayesian, in the sense that quantifiable material evidence (such as alignment data) is used, in effect, to "test" (in the sense of being seen to strengthen or weaken) theories based on preexisting knowledge obtained from evidence (historical, archaeological, or of other type) that may be essentially qualitative but for which a "prior degree of belief" could, at least in principle, be specified (cf. Ruggles 1999b: 159–162). It is taken as axiomatic in what follows that (whatever the interpretive agenda) it is essential to obtain evidence on the spatial disposition of heiau, including orientations and alignments, *in a demonstrably systematic manner,* as well as to find suitable paradigms for integrating this evidence with a wider range of cultural data within the Bayesian framework just described.

HEIAU AND THEIR ORIENTATIONS: THE BROAD PICTURE

In 1993, a paper offered at the "Oxford IV" symposium on archaeoastronomy in Bulgaria by architect Francis Warther, working with astronomer Karen Meech, presented intriguing new evidence implying that certain alignments were encapsulated—in *kaona* (hidden) form—in sacred chants (Meech and Warther 1996). Although a combined assessment of the alignment and literary evidence (Ruggles 1999a) has cast doubts on the particular interpretations offered in their original paper, Warther's work, including much that remains unpublished, has opened up several new avenues of enquiry that can be addressed by combining archaeoastronomical and historical research. In particular, it has suggested (Ruggles 1999a: 44) that:

1. Astronomical alignments involving distant topographic foresights, viewed from heiau, formed an important component of Hawaiian sacred geography;
2. Certain sacred ceremonies, performed at particular heiau, were scheduled in relation to observable astronomical events; and
3. Observations of the zenith sun, and estimates of the time of nadir (anti-zenith) passage, were of importance for calendrical regulation.

In order to address these and other questions the present author commenced, in 1999, a long-term project aiming to investigate the nature and development of astronomical knowledge in ancient Hawai‘i by seeking to integrate:

- Systematic data on the form, spatial layout, location (within the natural and cultural landscape), and astronomical potential of temples and shrines obtained by systematic surveys;
- Historical evidence obtained through archival research; and
- Oral data obtained from indigenous Hawaiian informants.

As regards field survey data (the first strand above), the general strategy adopted was to undertake a preliminary reconnaissance on certain islands or in certain areas, as informed by local sites and monuments records (SMRs), published gazetteers, and other existing historical and archaeological data. This research involved locating suitable heiau (some of which were remote), assessing their condition, and conducting preliminary compass-clinometer and GPS measurements in a systematic way. The island of Kaua‘i was studied in this manner between 1999 and 2001, Maui in 2002, and Moloka‘i in 2003. Exploratory surveys were also undertaken on O‘ahu and the Big Island of Hawai‘i. The intention was that if the initial fieldwork indicated particular issues of potential interest and importance, they could be followed up by more intensive and accurate theodolite surveys. This happened most productively in the region of Kahikinui on Maui, as described later in this paper.

Many of the heiau surviving on Kaua‘i are irregular in design with badly dilapidated walls. The work on this island (Ruggles 2001) succeeded in locating only twenty accessible temples with wall sections well-enough preserved to provide a reliable estimate of the original orientation. The Kauaʻi heiau examined were largely distributed around the coast, although others had been built inland in a variety of topographic situations, including extreme locations such as the summits of the mountains Haupu and Waiʻaleʻale (see following). There is a concentration of large and relatively well-preserved temples in the Wailua valley in the east—the abode of high-ranking chiefs and their retinue (Kirch and Babineau 1996: 16–19)—and a cluster of generally more modest but documented temples around the modern resort of Poʻipū in the south, but otherwise the extant heiau are widely scattered.

As already mentioned, the overall tendency among the twenty measured temples on Kauaʻi was for them to be oriented perpendicular to the shoreline (Ruggles 2001: 65–68). But to what extent does this undoubtedly superficial conclusion, very much at the "green" end of things, mask genuine practices that were more specific to place? Could some heiau, for example, intentionally have referenced (e.g., been oriented upon) significant places in the visible landscape (as opposed to their orientation merely being constrained by the local topography)? It is possible to approach the location and orientation data in much the same way as one might tackle prehistoric monuments in their landscape, trying to identify specific relationships between the heiau and their visual setting through what is essentially a phenomenological approach (cf. Tilley 1994; Thomas 2001). One might, for example, take note of the cliffs of Mauna Kapu "standing sentinel" over the heiau at Poliʻahu (Kirch and Babineau 1996: 16–17) or the alignment of structures at Hikina a ka Lā upon the jagged peaks of the Kalalea range (Ruggles 2001: 68–69). However, such an approach is inherently subjective (cf. Fleming 1999) and in the absence of corroborating evidence, either contextual or statistical, we would have little to reassure us that such relationships might have had meaning. This is a very insecure basis indeed for speculating on their possible cultural significance.

Attempts to identify any more systematic relationships, either topographic or astronomical, among the extant temples on Kauaʻi have so far proved unsuccessful (Ruggles 2001). Even where there are heiau aligned on prominent peaks—likely affirming or enhancing a natural "power of place" (cf. Bradley 2000: 97–113)—the results are no more compelling. The peak of Haupu (^{4}585 ^{24}246),[4] at an elevation of 700 m, forms a prominent landmark from several coastal heiau in the vicinity of Poʻipū and is reported to have been the site of a heiau (Bennett 1931: 121n90); however, there is no evidence of preferential orientation of other heiau upon it or that it marked the rising position of any prominent asterisms as viewed from them (Ruggles 2001: 70–73). A similar conclusion holds for Waiʻaleʻale, which is in the form of a ridge running from north to south with sharp cliffs on the eastern side, conspicuous on the skyline from the south although rarely visible. The shrine here (^{4}484 ^{24}412) is at an elevation of 1560 m, wedged between a treacherous swamp to the west and a steep drop to the east, at a location reputed to have the highest annual rainfall in the world. The general assumption is that it was reached on pilgrimages from Wailua valley to the east (Joesting 1984: 1–5), but there is no evidence of preferential orientation upon Waiʻaleʻale among the Wailua (or any other) heiau.

Can ethnohistory help? One example where one might invoke indirect support for a one-off subjective "discovery" is in the case of Kukui (^{4}6597 ^{24}3853; Bennett 1931: 127n108; Davis and Bordner 1977; Kirch and Babineau 1996: 18–19). From this coastal heiau to the north of the Wailua River, the western horizon is dominated by two prominent peaks, Mauna Kapu (^{4}6335 ^{24}3715, 208 m; az. 242.1°, alt. 4.0°) and Nonou (^{4}6337 ^{24}3963; 378 m; az. 292.8°, alt. 7.6°). The author's program GETDEC (Ruggles 1999b: 169; http: //www.le.ac.uk/ar/rug/aa/) yields declinations of –24.1° and +23.9°, respectively. These two peaks, then, lie just outside the solstitial sunset extremes and would literally have framed the annual setting arc of the sun (see Ruggles 2001: 73–75). But since no similar phenomenon is evident at any other of the island's temple sites, do we have any reasonable grounds for postulating that it might have been a deliberate factor in the location and the function and significance of this particular temple? The idea receives no support from the orientation, since (as far as can be judged from its current state, given likely modifications in the nineteenth century together with modern landscaping) this long, narrow, roughly rectangular enclosure seems simply to have aligned with its long axis parallel to the shore (az. 54°–234° [Ruggles 2001: 67]). However, across the Wailua River lies another coastal heiau, Hikina a ka Lā, whose very name means "sunrise" and where "the rays of the morning sun rising from the eastern sea came full against the stone structure" (Joesting 1984: 6). And there is certainly documented evidence of an awareness of the annual excursion of the sun, particularly at Kumukahi, the easternmost cape on the Big Island of Hawaiʻi, where the annual motions of the rising sun were followed using lava pillars as markers (Beckwith 1970: 119; Emerson 1997: 197). It is questionable nonetheless how confidently, in the absence of any other evidence, we should extrapolate from a prepossession with the sun rising over the eastern sea to postulate a simultaneous prepossession with sunset over inland mountains.

The ethnohistory can help more directly by indicating aspects of the purpose and meaning of a particular heiau. Thus, in some cases oral traditions associate a particular temple with a particular god: the one on Haupu, for example, is said to have been dedicated to the *hula* goddess Laka (Thrum 1906: 36), and the Waiʻaleʻale shrine to one of the principal gods, Kāne (Joesting 1984: 1–2). Two of the great Wailua valley temples—Poliʻahu (^{4}6333 ^{24}3798) and Mālaʻe (or Mana) (^{4}6505 ^{24}3770)—were luakini heiau dedicated to the war god Kū (Kirch and Babineau 1996: 16–19). The orientations of the last two—respectively, 73°–163°–253°–343° and 12°–96°–192°–276° (with errors up to ±5°) (Ruggles 2001: 66–67, table 3)—are approximately cardinal and so broadly consistent with Malo's description on the Big Island but deviate sufficiently from cardinality to invite further investigation and discussion.

The work on Maui and Molokaʻi in 2002 and 2003 will be described more fully elsewhere, but some points particularly pertinent to the overall methodology will be emphasized here. Maui was first visited in 2002. As regards site selection on this island, it soon emerged that systematic investigation of sites included in published gazetteers would be impracticable. Some 240 heiau had been included in a list compiled by Elspeth Sterling in the 1970s (Sterling 1998) incorporating previously unpublished field notes compiled in the 1930s by Winslow Walker. Many were listed as destroyed, however, and in the great majority of remaining cases the descriptions of their locations were so vague as to suggest that, even if not ruined beyond recognition or completely obliterated, it would be difficult to locate them without an extensive search. Beyond a handful of prominent examples, it was clearly necessary to rely on more recent publications and local knowledge. Two publications (Kolb and Radewagen 1997; Dixon et al. 2000) related to the Kahikinui district, on the southern slopes of the volcano Haleakalā. This area soon became the main focus of attention, and I shall consider it in more detail later.

As regards the remainder of the island, eleven sites were surveyed by compass-clinometer and, in seven cases, subsequently by theodolite. These included Halekiʻi (^{7}6040 ^{23}1364) and Pihana (^{7}6080 ^{23}1344), two large rectangular platforms, both some 100 m in length, in adjacent locations. Pihana is reputedly a luakini heiau (Sterling 1998: 77) and is popularly supposed to have been oriented (or reoriented) in the eighteenth century toward enemy chiefdoms on the Big Island (e.g., Ward 2001: 306). Unfortunately, having been built atop a sand ridge, it is now too eroded for an orientation to be readily determined, but Walker's plan (Sterling 1998: 77) does indeed show it facing broadly southeastward. In fact, the north point on this plan yields an azimuth of about 152°, but the precise figure must be treated with considerable caution. There is a significant discrepancy between a similar estimate (of about 156°) obtained from Walker's plan of Halekiʻi and the value as determined from the theodolite survey in 2002, which is 132°.

One thing is immediately clear: these heiau were not oriented cardinally, so any extrapolation of the practices described by Malo seems to fail in this case. Although one informant described Halekiʻi as facing eastward, toward sunrise, it misses the solar arc by more than 10° (az = 131.6; alt = +5.1; dec = –35.9). The orientation of both heiau is arguably constrained by the direction of the ridge along which they are situated, dominating the plains to the southeast, once covered in taro plantations, which they overlook. Directly behind these plains is the mountain of Haleakalā, and in fact Halekiʻi directly faces its summit (^{7}8535 ^{22}9254, 3050 m). For an explanation of the orientation we may need to look no further, although one can well imagine the sun rising over the northern slopes of Haleakalā and dawn celebrants facing the first sunlight as it stretched across the heiau.

Other notable "one-off" cases can be identified on Maui just as they can on Kauaʻi. One example is the orientation of Loʻaloʻa (^{7}9997 ^{22}8500; Sterling 1998: 173–174), a large heiau in the Kaupo district in the southeast of the island. At 155 m in length it is the longest platform on the island, overlooking a gulch to the northeast and with views of the slopes of Haleakalā beyond. Its long axis is oriented northeast-southwest, and its orientation, as far as can be judged without a full EDM survey,[5] is around 67°. Given a horizon altitude of about 3°, this orientation yields a declination of around +22.5°, close enough to the rising solstitial sun as to warrant further investigation.

To what extent, though, might we be inclined to accept the topographic orientation of Halekiʻi, or the solstitial orientation of Loʻaloʻa, as deliberate, given that neither type of alignment receives any direct corroboration from the published oral history? To dismiss them out of hand for this reason would certainly be premature, but we do need other forms of supporting evidence. Three possible ways forward are being actively pursued. The first is to attempt a more intensive "formal" analysis of particular temples in their landscape, moving beyond simply looking at their orientations. This approach involves a fuller consideration of visible topographic and horizon features, as well as astronomical events of possible significance, and necessitates considering why particular locations were selected over apparently equally viable alternatives. This work, being carried out in collaboration with Andrew Smith of the University of Adelaide, follows an approach that has been pioneered in research on Neolithic and Bronze Age monuments and landscapes in Scotland,

and particularly in the North Mull Project (Ruggles 1999b: 112–124 and references therein).

The second way forward is to seek to gain firmer insights into the principles that might have governed the siting and layout of temples by consulting a range of indigenous informants.[6] This aspect of the work will be the subject of a separate article but can be summarized as follows. One approach is to ask direct questions about heiau orientations. Initial responses can seem superficial and contradictory: for example, one informant stated categorically that heiau faced east but then qualified this statement by saying that burials faced the sea and were placed on the seaward side of the heiau. However, if the sea could not be seen from the heiau, then the bodies were placed on the westward side facing sunset. On another occasion, the same informant talked of heiau facing the mountains. It is questionable, of course, to what extent such testimonies reflect traditions "independent" of the "classic" recorded accounts, such as that of Malo. Nonetheless, this and other accounts strongly attested to a broad concern with orientation in relation to the seaward/mountainward (*makai*/*mauka*) directions and in relation to cardinal directions as broadly defined in relation to the rising or setting sun. On the other hand, they failed to affirm more precise topographic or astronomical orientations.

A complementary approach, which has the potential to achieve greater depth, is to try to locate the keepers of particular heiau, who are responsible both for the protection of the temples in their charge and for the perpetuation of the sacred traditions relating to them. It is in an effort to prevent these traditions being lost altogether that some keepers may now be prepared to discuss aspects of their knowledge relating to the function and purpose of specific heiau. Again, certain recurring themes emerge: stone is considered a living substance, and identifying the appropriate rock to be placed in a heiau is an interactive process; in some cases stones were brought from a considerable distance by different people; stones must never be removed from a heiau, and anyone who does so is cursed. Cornerstones were of particular importance and were the first stones to be put in place.

In one instance, the keeper (with whom the subject of orientation had not been broached previously) identified a corner-to-corner orientation, diagonally across the heiau, as significant in relation to passages used by navigators heading for, or arriving from, the distant islands of central Polynesia. One particular alignment related to a hill named after a prominent star, the (heliacal) rising of which served to indicate the time of year for preparing to sail to Tahiti. Accounts such as this one have the potential to be confirmed and elaborated by archaeoastronomical field survey, so that surviving oral traditions and archaeoastronomical evidence would reinforce each other in a pleasingly direct way.

The last of the three ways forward is to return to seeking repeated instances of certain types of alignment but relaxing the need for formal statistical justification by finding better ways of taking account of the archaeological and historical context. Generally speaking, the problems with any type of "broad brush" approach are clear. There were many different types of heiau, constructed for different purposes, and for the use of different people in the social hierarchy; there is every reason to suppose that different principles applied in each case. In general, we are faced with a random set of temples and shrines that happen not to have been damaged beyond recognition or utterly destroyed, that are largely if not completely stripped of their chronological or cultural context, and for which specific knowledge of their particular function or significance has long since been lost. The optimal situation would be to find a particular locality where more than just a handful of heiau survive within a secure context about which archaeology can provide a range of complementary information, and such that a consistent set of principles is likely to have guided their construction and use. During the second period of fieldwork in Maui during 2002, one such locality emerged: Kahikinui.

A LOCAL FOCUS: KAHIKINUI

Kahikinui is a remote district in southern Maui, where the slopes of Haleakalā stretch down unremittingly from an elevation of 3000 m all the way to the shore. Here, over thirty temple enclosures exist in a relatively confined area, integrated within an exceptionally well-preserved cultural landscape including households and cultivation areas. The construction of the temples in this area is known, through Uranium-Thorium (^{238}U-^{234}U-^{230}Th) dating of branch coral offerings, to have taken place within a period of no longer than a few decades around AD 1600 (Kirch and Sharp 2005), suggesting that they were all built within one or, at most, two generations under the control of a new and powerful ruler (see Stokstad 2005). This implies that their construction and use was controlled by a single dominant ideology.

Recent archaeological surveys within Kahikinui (Kolb and Radewagen 1997; Dixon et al. 2000; Kirch 2004) have identified over thirty heiau, more than two-thirds of which were not included in earlier reconnaissances (Sterling 1998: 192–213). In common with Hawaiian temples in general, they vary in

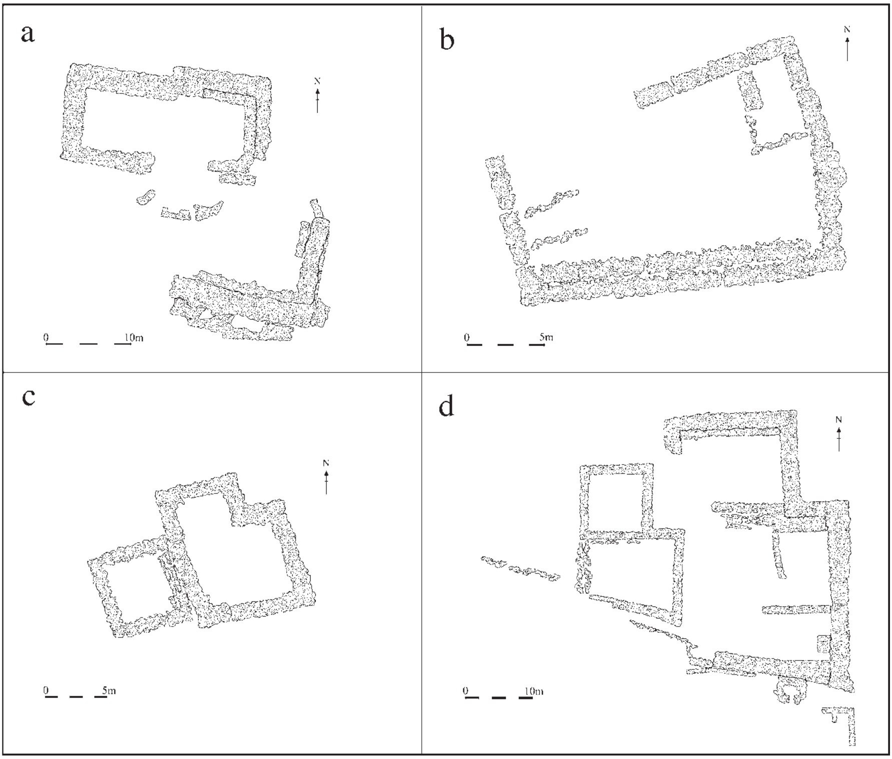

Figure 9.3. Plans of four Kahikinui heiau (based on Kolb and Radewagen 1997: figures 5.4, 5.6, 5.7, and 5.9). These examples illustrate some of the variations in design and show that it is not always an easy matter to assign a definitive orientation: problems include uneven preservation, nonparallel walls and multiphase construction. Even the primary direction of orientation may not be immediately clear. (Figure drawn by Deborah Miles-Williams.) (a) Site 19 (see Table 9.1), a rectangular enclosure with a small notch in the northern wall and with the remains of adjacent structures to the southeast. (b) Site 14, a distorted rectangle with terraces on the southern side and walls on the other three sides. (c) Site 9, a notched enclosure with an adjacent structure to the west. (d) Sites 15 and 16: the smaller and apparently later temple (16), built immediately to the west of the existing one (15), replicated its general form and orientation, including the curving southern wall distinctly skewed with respect to the rest of the structure.

shape from simple rectangular enclosures and platforms to complex structures (Figure 9.3). In fact, many Kahikinui temples are of a distinctive "notched enclosure" design (Kirch 1997: 21–25; see Figures 9.3c, 9.3d), in other words an L-shape, although the notch often amounts to little more than a slight double-bend—a sideways shift of 1 m or so—in one of the walls of what would otherwise be a simple rectangle (e.g., Figure 9.3a). There is a broad consistency in the orientation of the notches, with the great majority being found in the northeast or northwest corners.

An initial reconnaissance was undertaken in April 2002, using the site list, map, and plans provided by Kolb and Radewagen (1997) together with further information from Dixon et al. (1997: 38–39) and Kirch (1997: 21–25). A number of systematic compass-clinometer surveys were carried out; however, the difficult nature of the terrain (at its worst consisting of large and uneven lava blocks covered in almost impenetrable lantana thicket) and inaccuracies in the locational sketch map (Kolb and Radewagen 1997: 64, figure 5.1) caused considerable difficulty in locating and identifying several heiau. Various confusions could only be resolved when revisiting the area in March 2003 in the company of Patrick V. Kirch. During this period, fourteen temples were surveyed using a Leica Total Station. These surveys were generally undertaken during the periods immediately after dawn and before dusk, these being optimal times both because horizon profiles are at their clearest and because the high altitude of the sun during the middle of the day makes sun-azimuth determinations difficult and unreliable. The use of an EDM permitted the true orientations of relatively undamaged or uncollapsed wall segments to be determined by measuring the relative positions of each end from a theodolite station for which true north had been established by sun-azimuth observations.

An overview of the some of the key data is presented in Table 9.1. It is immediately evident that, contrary to what is found in some of the other areas I have already mentioned, none of the Kahikinui temples deviates from cardinality by more than 31°. Among a sample of twenty this trend is highly significant, and the rule extends to thirteen further heiau included in Kirch’s table (2004: 105). This result in itself rules out the orientations being strongly influenced by the dominant lie of the land, since the coastline and topographic contours run roughly ENE-WSW (~65–245°) through all but the westernmost of the eight *ahupua‘a* (historical land divisions, typically strips running from the high hills down to the shore) that make up the district: only two sites (nos. 11 and 19) are situated where the contours run east-west. It also permits us to speak without ambiguity of “N/E/S/W” in relation to the side of a heiau, or its direction of orientation.

Although total station measurements are much more accurate than ones obtained with a compass-clinometer, many of the azimuth values listed in the table have mean errors of several degrees. This is because there are often considerable inconsistencies between the orientations of different walls or wall

TABLE 9.1. Orientation data for a sample of heiau in the Kahikinui district of Maui, presented in order of the

1	*2*		*3*	*4*	*5*	*6*	*7*	*8*
1	${}^{7}8373$	${}^{22}8324$	Inland	Rectangular	230	2003.03.26	TS	E
2	${}^{7}8383$	${}^{22}8315$	Inland	Notched (at SE corner)	250	2003.03.26	TS	E
3	$\sim{}^{7}840$	${}^{22}825$	Inland	Rectangular	130	2003.03.27	TS	E
4	${}^{7}8915$	${}^{22}8324$	Mid-elev	Notched (at NW corner)	120	2003.03.27	TS	u
5	${}^{7}8174$	${}^{22}7844$	Coastal	Notched (at NW corner)	60	2003.03.22	TS	N (E)
6	${}^{7}8158$	${}^{22}7842$	Coastal	Rectangular	110	2002.04.13	CC	u
7	${}^{7}8428$	${}^{22}8406$	Inland	Notched (at NW corner)	100	2002.04.17	CC	u
8	${}^{7}8135$	${}^{22}7922$	Mid-elev	Rectangular	210	2003.03.23	TS	N (E)
9	${}^{7}8499$	${}^{22}8415$	Inland	Notched (at NE corner)	70	2002.04.17	CC	u
10	${}^{7}8156$	${}^{22}7943$	Mid-elev	Elongated N-S, notch NW, abutting on a natural outcrop on the E side	~500	2003.03.23	TS	N
11	${}^{7}7805$	${}^{22}7850$	Coastal	Rectangular	180	2003.03.24	TS	S
12	${}^{7}8355$	${}^{22}8326$	Inland	Double-notched (at NE corner)	240	2003.03.26	TS	E
13	${}^{7}8280$	${}^{22}8319$	Inland	Notched (at SE corner)	560	2003.03.25	TS	E
14	${}^{7}8449$	${}^{22}8212$	Inland	Distorted rectangle	190	2003.03.27	TS	N
15	${}^{7}8456$	${}^{22}8392$	Inland	Notched (at NE corner)	770	2003.03.25	TS	N
16	${}^{7}8453$	${}^{22}8392$	Inland	Notched (at NE corner)	370	2003.03.25	TS	N
17	${}^{7}8383$	${}^{22}8395$	Inland	Notched (at NW corner)	100	2002.04.17	CC	u
18	${}^{7}8321$	${}^{22}8303$	Inland	Notched (at NE corner)	140	2002.04.12	CC	u
19	${}^{7}7976$	${}^{22}8244$	Inland	Notched (at NW corner)	270	2003.03.24	TS	E
20	${}^{7}8112$	${}^{22}7833$	Coastal	Notched (at NW corner)	Small	2003.03.23	C	W (S)

Column headings:

1. Site number used in this paper
2. UTM position determined by handheld GPS (zone 4, WGS84/NAD83 datum) quoted to the nearest 10 m
3. Situation (Coastal [within 500 m of the shore and under 50 m in elevation], Mid-elevation [between 500 m and 2 km from the shore and between 50 m and 300 m in elevation], or Inland [over 2 km from the shore and over 300 m in elevation])
4. Shape (Morphological category, such as Rectangular or Notched)
5. Size (Total area in m^2, estimated to the nearest 10 m^2)
6. Date of survey
7. Type of survey (TS = total station survey; CC = systematic compass-clinometer survey; C = unchecked compass measurements)
8. Probable direction(s) of orientation (using "N/E/S/W" to refer to any direction within ~30° of the given cardinal direction). Where there are considered to be two possibilities, the secondary possibility is indicated in parentheses. u = undetermined
9. Determinant of probable direction(s) of orientation

10–17. For the N/E/S/W directions in turn:

- Azimuth (true): best estimate quoted to the nearest degree eastern azimuth.

9	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*
Platform in SE corner facing E	330	1	**59**	**1**	150	1	239	1	4362?	75	69	
Platform with E-facing "sighting stones"	330	3	**60**	**1**	150	3	240	1		77	71	
Highest wall on east side; coral found	331	1	**61**	**1**	151	1	241	1		567	64	a
	331	3	61	3	151	3	241	3		(MAW–1)		
Raised platform projects to N, on eastern side	**337**	**3**	**65**	**3**	157	3	245	3	184		340	
	344	3	81	4	164	3	261	4	180	1164?		
	348	5	81	3	168	5	261	3		1156?	73	b
Raised paved platform in NE corner	**351**	**1**	**81**	**3**	171	1	261	3	183		351	
	350	2	82	2	170	2	262	2	4269			
Raised platform at N end	**352**	**1**	86	4	172	1	246	4	1157		350	
Raised platform at S end	356	2	86	2	**176**	**2**	266	2	187			
Altar containing branch coral on E side	356	6	**87**	**7**	176	6	267	7	4364?	405	88	
Raised platform on E side; altar against E wall	3	1	**87**	**1**	183	1	267	1	181	1	89	
Raised platform in NE corner; walled on W, N, and E sides	**351**	**3**	89	11	171	3	269	11	394	175		
Offerings located on N side	**353**	**3**	92	7	173	3	272	7	4279 (E)	1010 (E)	0	c
Offerings located on N side	**354**	**6**	94	7	174	6	274	7	4279 (W)	1010 (W)		d
	2	4	94	3	182	4	274	3	3847?			
	6	5	96	2	186	5	276	2	3858?			
High wall on E side, W side side open	6	2	**97**	**1**	186	2	277	1	186	1386		
Raised platform projects to W, on southern side	29	2	119	2	**209**	**2**	**299**	**2**	unidentified			

•Estimate of mean error (±) in the azimuth quoted to the nearest degree. For compass measurements, a minimum of ±1° is applied. Errors in the case of total station surveys, and larger errors in the case of compass surveys, reflect the irregularity of the structures and/or their state of preservation.

Data relating to the probable direction of orientation are shown in bold against a shaded background; those relating to the secondary direction in bold. Data relating to other directions are shown in normal typeface.

18. State of Hawaiʻi Inventory of Historic Places number (50-50-15-. . .)

19. Bishop Museum inventory number (MA-A35-. . .)

20. Azimuth in the direction of orientation quoted by Kirch (2004:105, table 1)

21. Notes:

a = An accurate location determined by GPS is not available.

b = If this site has been misidentified, the Kirch azimuth will refer to another site.

c = The orientations of the two extant north-south-facing walls (from east to west) are 356° and 351°; the west wall is destroyed. The orientations of the northernmost east-west-facing walls (from north to south) are 85° and 87°. The southern wall, which bends round, has a mean orientation of roughly 99°.

d = The orientations of the north-south-facing walls (from E to W) are 0°, 354°, and 349°. The orientations of the east-west-facing walls (from north to south) are 87°, 94°, and 100°.

segments. Many heiau are in fact rather irregular, with nonparallel walls and corners deviating significantly from right angles (cf. Ruggles 2001: 65 on Kauaʻi). This irregularity could, of course, be taken to suggest that the overall orientation was neither defined nor implemented with any great precision. However, the possibility remains that certain walls or other structures at a given heiau were aligned with particular care. Temple no. 16, for example, was built on the western side of an existing temple, no. 15 (see Figure 9.3d). The new heiau was smaller but replicated many features of its predecessor, including a southern wall decidedly skewed with respect to the rest of the structure and with essentially the same orientation (close to 100°). The implication is that the alignment of the southern wall was so significant that it had to be carefully reproduced. Kirch and Ruggles are examining such possibilities in more detail as part of work in progress.

Returning here to the overall trends manifested in the mean orientations, the first obvious question is whether we can determine the direction that any given temple "faces" and hence single out one of the four possible directions of orientation as being of particular significance. The choice can be made in many cases by identifying, for example, the side where there is a raised platform or altar or evidence of offerings. A good indicator is the presence of pieces of branch coral and rounded, sea-worn pebbles as opposed to the jagged chunks of *ʻaʻā* that make up the main construction. The probable direction of orientation, where one could be determined, is indicated in the table, with primary and secondary possibilities being identified in one or two cases.

On the basis of his own compass determinations of the orientations of the Kahikinui temples, Kirch (2004) has noted that these seem to be concentrated into three clusters: one broadly around due north, one around due east, and a third around NNE. He hypothesizes that each temple in this area was dedicated to one of the four principal gods in the Hawaiian pantheon—Kū, Kāne, Kanaloa, and Lono—and that this patronage was reflected in their design, landscape situation, and particularly their orientation. Kū was associated with war, canoe building, and high mountains; Kāne with male powers of procreation, taro cultivation, and the rising sun; Kanaloa with the sea and fishing; and Lono with dryland agriculture. Thus, suggests Kirch, the Kāne temples faced eastward toward the rising sun, whereas the Kū temples faced broadly north, toward the high mountain. Those in the ENE-facing group, he suggests, were dedicated to Lono, implying strong associations with agriculture and the calendar. Thus, although the orientation would fit with summer solstice sunrise, a more likely determinant was the rising position of the Pleiades, whose heliacal and acronical (acronychal) rising are known to have marked the onset of the two different halves of the Hawaiian year.

In column 3 of Table 9.1, I have followed Kirch (2004: 104) in categorizing situations as "coastal," "mid-elevation," or "inland," which I have defined quantitatively in terms of elevation and distance from the shore. Although the criteria are couched in abstract terms, they reflect a very real division of the heiau into those associated with coastal villages, those associated with the main settlements well inland and uphill where cultivation was possible, and those constructed in the "barren zone" in between. Each ahupuaʻa in the area stretched across all these zones. It is commonly supposed, based on strong indications from the ethnohistory, that many if not all coastal heiau were fishing shrines (*koʻa*) dedicated to Kanaloa (e.g., Kolb and Radewagen 1997: 75). The four coastal temples included in Table 9.1 (nos. 5, 6, 11, and 20) show no consistency in their supposed direction of orientation, which could mean either that our interpretation of the primary direction is at fault or that orientation was of little importance, beyond facing broadly out to sea.[7]

If we remove the coastal heiau from the sample, we are left with some remarkable concentrations in orientation. The five northerly-facing sites (nos. 8, 10, 14, 15, and 16) all have mean azimuths between 351° and 354°. The easterly-facing ones split very clearly into Kirch's two groups, the three ENE-facing temples (nos. 1, 2, and 3) being tightly concentrated with azimuths between 59° and 61°. It is a reasonable assumption that the remaining temples for which a likely direction of orientation has not been determined (nos. 4, 7, 9, 17, and 18) either faced northward or eastward. If they all faced northward, this would broaden the spread of northerly orientations to more than 30° (between 331° and 6°). However, if they all faced eastward, then this would reinforce the separation into a tightly concentrated NNE-facing group (four temples facing between 59° and 61°) plus a group more broadly oriented around due east (between 81° and 97°). These results are illustrated in Figure 9.4, with Kirch's data included for comparison.

If the northerly orientations relate, as Kirch has proposed, to the god Kū, then we might expect them to be predominantly topographic, reflecting a broad association with the mountain ridge of Haleakalā to the north. The tight concentration of several azimuths around 352° suggests that more specific topographic referents might be involved, but the concentration itself may be misleading. The azimuths of the individual north-south walls of adjacent temples 15 and 16 vary from 349° to 0°, although the mean orientations come out at 353° and 354°, respectively. Nonetheless, as becomes immediately

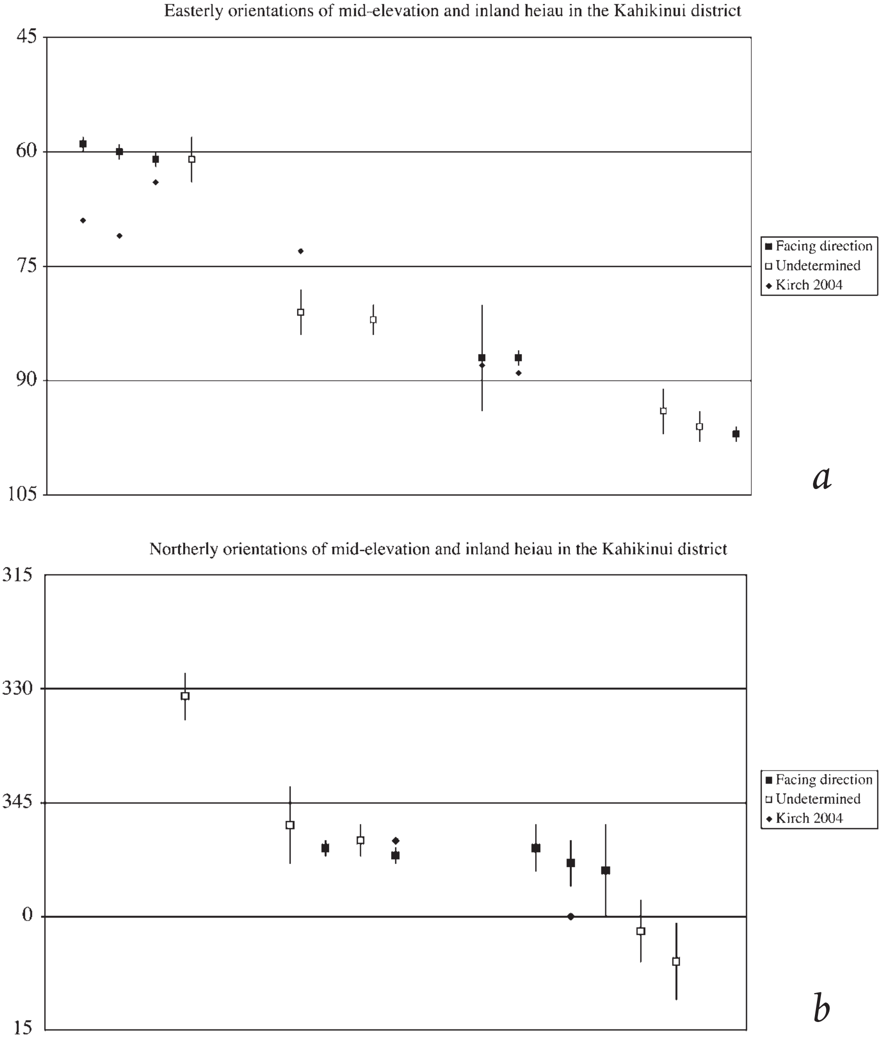

Figure 9.4. Easterly (a) and northerly (b) orientations of mid-elevation and inland heiau in the Kahikinui district. Azimuths are indicated on the left; in (b), the northerly direction is marked as 360° and 15° east of north as 375°.

clear upon visiting the site, their orientations seem directly related to a prominent red cinder cone that extends between azimuths 350° and 357°: this is a particularly prominent feature of the mountain profile to the north as viewed from this location. I conclude that, although ideological significance may have attached to the mountain ridge as a whole, specific topographic referents

TABLE 9.2. Easterly orientations at the Kahikinui heiau listed in Table 9.1 where this direction has been identified as the most probable direction in which the temple faces, or where the orientation is undetermined and might be either east or north. Coastal heiau have been excluded. Data relating to the probable direction of orientation are shown in bold against a shaded background. Azimuths and declinations are quoted to the nearest degree; horizon altitudes to the nearest half degree.

Site #	*Az (°)*	±	*Alt (°)*	*Dec (°)*	±
1					
2					
3					
4	61	3	5	29	3
7	81	3	0	8	3
8	**81**	**3**	**0.5**	**9**	**3**
9	82	2	1	8	2
12					
13					
17	94	3	0	–4	3
18	96	2	1	–5	2
19					

(quite possibly varying from place to place) were used in setting up the north-facing temples.

In Table 9.2 I focus on the easterly orientations, giving values for the altitude and declination alongside the azimuth. Included in this table are the five sites where it is unclear in which direction the temple faces, eastward or northward. The group oriented between 81° and 97°, a spread more or less centered on due east, could have been built to face sunrise within a period of about a month in the spring or autumn, roughly midway between the solstices. The declination range –5° to +8° corresponds in the Gregorian calendar to a period in the spring from late February to late March, and in the late summer from the end of August to the end of September. In the case of site no. 19, high hills just 1 km away result in a horizon altitude greater than 10°. However, since the sun rises at a steep angle in the tropics, the hills have no great effect on the azimuth at which the sun rises on any particular date and simply delay until well after dawn the time when direct sunlight first falls across the temple.

The tight cluster of azimuths around 60° does not, as might first be suggested, correspond to the direction along the prevailing topographic contours but to one slightly skewed inland, resulting in horizon altitudes of around 4° or 5° in each case. The resulting declinations are around +29° or +30°. These values have no obvious non-astronomical explanation, this direction being a few degrees to the north of both summer solstice sunrise and the rising position of the Pleiades, for which, ironically, orientation directly along the contours would have been more or less ideal. In around AD 1600 the Pleiades had a declination of +22.6 to +23.0 and would have risen at an azimuth of about 65°. This direction, as it happens, corresponds to the orientation of temple no. 5, which was dismissed earlier because of being coastal. Could the cluster at 60° be accidental and will a wider sample reveal a slightly broader range of azimuths more centered upon 65°? On balance, this seems the most likely outcome given the cultural significance of the Pleiades in connection with the calendar, and measurements at the remaining Kahikinui temples may clarify the issue. Meanwhile, the idea that these temples were associated with Lono may be strengthened independently by consideration of other properties of their location in the cultural landscape. Site no. 2 (A35-77), for example, has visual links with dryland cultivation in that it looks out eastward over an agricultural area (see Kirch 2004: 105).

In the light of this new evidence, I suggest a slight modification of Kirch's hypothesis, as follows:

- Some (although perhaps not all) of the coastal heiau in Kahikinui were koʻa dedicated to Kanaloa, and their orientation was not consistently defined.
- North-facing temples were dedicated to Kū and their orientation was determined by the visual topography. Broadly, they faced the high ridge of Haleakalā, although individual Kū temples may have been aligned upon particular topographic features.
- East-facing temples were dedicated to Kāne and faced the rising sun, evidently within a period of about a month in the spring and autumn.
- ENE-facing temples were dedicated to Lono and their orientation was astronomically determined. Those temples accurately measured to date cluster tightly around a direction some 5° to the north of the rising position of the Pleiades. Nonetheless, this seems most likely to have been the defining asterism. Further evidence may clarify the issue.

An example of a temple in each category is shown in Figure 9.5.

If this broad framework holds up in the light of fresh evidence, then a combination of methods was used for fixing orientations, some involving topographic referents and some involving astronomical ones, depending on the nature of the heiau. The possibility remains that at some types of temples and shrines the orientation was unimportant beyond being a matter of immediate convenience. The fact that we seem to have such complexity, even within a local area and within a relatively short space of time, has strong implications for methodology where surviving heiau are much fewer and farther between and contextual evidence is far sparser.

Brief mention will be made of the work in Molokaʻi undertaken during June and July 2003, since it provides an example of ways in which hypotheses

Figure 9.5. Examples of Kahikinui temples in each of the four orientation groups. (Photographs by Clive Ruggles.) (a) Site 15 (Kū), facing northward. The photograph shows the northward alignment of the eastern wall upon a prominent red cinder cone in the mountain ridge of Haleakalā.

Figure 9.5. (b) Site 19 (Kāne), facing eastward. The photograph shows the view eastward from the western end of the heiau, with the nearby Luala'ilua hills forming a high horizon in this direction.

Figure 9.5. (c) Site 6 (Kanaloa): the photograph shows the heiau from the north with the sea beyond.

Figure 9.5. (d) Site 2 (Lono): the photograph shows the view to the NNE along the northern wall.

generated within relatively data-prolific areas, such as Kahikinui, can be tested and corroborated elsewhere. On Moloka‘i, local contacts helped identify four areas of particular interest, taking into account site preservation and access, and investigations were concentrated in these areas. Total station surveys were undertaken at a total of fifteen heiau in addition to sixteen preliminary visits and compass-clinometer surveys. The overall patterns of orientation broadly reflect those found in Kahikinui.

One of the areas identified was the Kalaupapa peninsula in the north of the island, where there exist several heiau. Three of those situated on the eastern (Kalawao) side of the peninsula were successfully surveyed with the total station, and their mean easterly orientations are shown in Table 9.3.

Although the orientation of the second site is very close to due east, the other two fall midway between the easterly and the ENE group identified in Kahikinui, which seems at first sight to weaken the Pleiades hypothesis. I shall remark here on the first site in the list, which is a probable heiau in the form of a rectangular enclosure, situated only about 10 m from the shoreline cliffs. As Kirch (2002: 85) has noted, the presence of large facing slabs along the eastern wall suggests that it was indeed oriented eastward, directly out toward the sea. The view in this direction (Figure 9.6) includes a prominent islet, Mokapu

TABLE 9.3. Easterly orientations at three Kalawao heiau. Azimuths, horizon altitudes, and declinations are quoted to the nearest degree.

Location	*Site ID*	*Other ref.*	*Az (°)*	±	*Alt (°)*	*Dec (°)*	±
^{7}1321 ^{23}4311		Kirch 2002: 82–86	78	4	0	11	4
^{7}1167 ^{23}4381	KLW-27	Summers 1971: 189	91	5	0	–1	5
^{7}1169 ^{23}4377	KLW-28		76	4	0	9	4

Island, the temple being aligned roughly upon its right-hand (southerly) edge. To the right is the eastern end of the exceptionally tall cliffs that run along the northern coast of Moloka'i and to the south of the Kalaupapa peninsula, dominating over it and isolating it from the rest of the island. Remarkably, the azimuth of this point, Cape Halawa, marked *c* in the figure, is almost exactly due east, with an azimuth of 90.1°. The right end of Mokapu Island (*b*) has azimuth 78.0°, whereas the left end (*a*) has azimuth 69.6°. In around AD 1600, the Pleiades rose some 5° to the left of this island, passing over it as they rose steeply in the sky.

Why should we seriously consider that ancient Hawaiians might have observed the Pleiades from this temple when the rising point is neither directly marked by the orientation nor by a natural foresight? There is a clear answer: the heiau is situated by a point of land that bears the name Makali'i (Kirch 2002: 85–86), the Hawaiian word for the Pleiades.

This temple, then, can be seen as elegantly corroborating both of the alignment "targets" tentatively assigned to the easterly-facing temples in Kahikinui: due east[8] and the Pleiades. But it does so in an indirect way and thereby introduces fresh complexities. Chief among these is that the temple alignment is neither due east (90°) nor toward the rising position of the Pleiades (65°) but midway between the two (78°). Should we, following Kirch (2002: 85), assign the temple to Kāne, or favor Lono? Or should we postulate a fresh category of temples "hedging their bets" in some way or incorporating elements of two different sets of practices or even conflicting ideologies? There is no immediate answer.

DISCUSSION

Archaeoastronomy must be used to frame explanations that accord with the broader archaeological and historical evidence and not simply be used to indulge in uncontextualized "alignment hunting" (cf. Kintigh 1992; Aveni 1992). The maturation of archaeoastronomy is well illustrated in relation to solstitial and equinoctial alignments. In countless contexts worldwide, the earliest

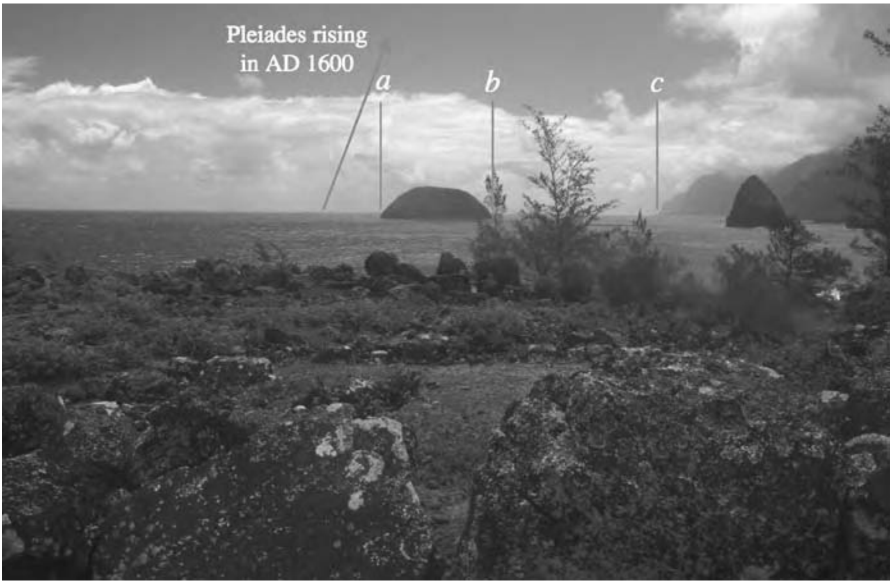

Figure 9.6. Eastward view from the heiau at Makali'i Point, Kalawao, Moloka'i. (Photograph by Clive Ruggles.) For the significance of a, b, *and* c, *see the text.*

archaeoastronomers, all too often operating in a cultural vacuum and applying preconceived ideas of which astronomical targets might have been significant (see Ruggles 1999b: 148–149; Aveni 2003: 444), have tended to seek—and duly find—solstitial and equinoctial alignments. Only later do more culturally embedded studies—where they do not dismiss astronomy altogether—begin to reveal greater subtleties and start to address meaningful questions.

Thus it was that early claims that Polynesian peoples determined the solstices and equinoxes to high precision using "sun sighting" devices (Ferdon 1961: 228–229) were later dismissed (Lee and Liller 1987a, 1987b), and similar claims by Liller and Duarte (1986) and Liller (1993a: 11–12) were criticized in their turn by Edwards and Belmonte (2004: 428). Even more modest claims for preferential temple alignment on sunrise or sunset at the solstices and equinoxes, over and above overriding trends that seem simply to reflect the topography (Liller 1989, 1993b: 130–132; 2000), seem difficult to sustain on the evidence presented (Ruggles 2001: 47–48). The obvious conclusion is that in Polynesia it may be unproductive, and indeed misleading, to apply this particular western "tool kit" of astronomical targets. Polynesians, apparently, had different astronomical predilections.

This view is supported by the archaeoastronomical reassessment of a sightline along the Nā Pāli coastline in northwestern Kauaʻi, apparently described in a sacred chant recorded in 1899, that was originally interpreted as solstitial (Meech and Warther 1996). The basic elements of the topographic alignment itself, together with ethnohistory relating to the place of performance of the chant and the hula goddess(es) (Laka / Kapo) associated both with the chant and with the place (Kēʻē) at the alignment's northeastern end, suggest that it may have been more closely related to solar zenith and antizenith passage (Ruggles 1999a: 45–64) and even possibly with Venus (ibid.: 78). The passage of the sun directly overhead was certainly of great significance to ancient Hawaiians. Not only was the summer season (Kau, lasting roughly from May until August) the time of year "when the sun was directly overhead" (Malo 1951: 30, 34). Noon was also the time of day when "the sun rests on the brains" (*Kau ka lā i ka lolo*). When the sun passed directly overhead at noon, this was a time of great spiritual power (*mana*), for a person's shadow was believed to have passed into their body through the top of their head (Pukui et al. 1972: 123–124; Pukui and Elbert 1986: 211). Although such accounts beg the question of how accurately it was conceived and measured, they argue plausibly for a prepossession with solar zenith passage within the Hawaiian Islands, and quite possibly elsewhere in Polynesia, that may come as little surprise to archaeoastronomers working within the Tropics in mainland America (cf. Aveni and Urton 1982).

The solstitial-equinoctial paradigm has also been vigorously questioned recently in Rapa Nui. Edwards and Belmonte (2004) have argued strongly that supposed solstitial and equinoctial alignments should be reconsidered as relating to stars named as significant by various local informants. In this context, they have also emphasized the Pleiades (*matariki*) as an asterism of particular importance.

The conclusions at Kahikinui provide yet further support for the contention that when it comes to heiau orientations, other astronomical targets were of more significance to ancient Polynesians than solar solstices and equinoxes. Indeed, this case study serves as an excellent warning against jumping too readily to "obvious" conclusions: the "Lono" group of temples might rather too hastily have been taken as oriented upon June solstice sunrise but, given the other cultural evidence, the Pleiades provide a much more plausible explanation.

There are, in fact, more fundamental reasons for being deeply suspicious about supposed equinoctial alignments. The concept of the equinox is a western one, ambiguous in the first place and tied to abstract conceptions of space and time that are generally inapplicable in other cultural contexts (Ruggles 1997). One can certainly recognize an orientation as being broadly to the east without presupposing that it was conceived as marking the halfway point (either in space or time) between the solstices. Surprisingly precise alignments upon due east, such as that at the Makali'i heiau on Moloka'i, unless put down to chance, present a severe interpretive challenge.

Yet it would be a mistake to jump too readily to the conclusion that the positions of sunrise or sunset at the solstices were simply of no significance in Hawai'i or elsewhere in Polynesia. I have already mentioned a set of natural lava pillars of Cape Kumukahi on the Big Island, two of which, according to legend, "manipulate the seasons by pushing the sun back and forth between them at the two solstices" (Beckwith 1970: 119; see also Ruggles 1999a: 72–74). Admittedly, this is not the site of a conspicuous temple platform or enclosure, there are no grounds for believing that the measurements were particularly precise, and the markers described are natural and not manmade. A rather different situation was recorded by the missionary Honoré Laval in the mid-nineteenth century on Mangareva, the largest of the Gambier Islands group in French Polynesia. Laval described observations that were made in several different places on the island of the course of the sun along the horizon, both rising and setting, with the northern and southern limits being marked by natural foresights or even a pair of stones specially placed on the horizon (Laval 1938: 213–214; Buck 1938: 414–415).

Given the momentum accumulated by the recent tide of opinion that careful observations of the solstices were of little or no importance in Polynesia, it might have seemed wise to treat Laval's account with great caution. A recent chance discovery has utterly changed this. It has resulted in the positive identification of a priest's observing place marked by a flat rock at the center of a platform (Kirch 2005). This timely discovery does not just represent the first secure identification of a historically documented location that might reasonably be termed a solar observatory. It also serves to illustrate the dangers of underestimating the complexities of indigenous astronomies, in Polynesia or elsewhere, and the importance of local practices, even in the context of broad common traditions. It would certainly appear that we should not, after all, dismiss too readily the possibility that the orientations of certain particular temple sites—such as Ahu Huri a Urenga on Rapa Nui, aligned upon a conspicuous peak (Mulloy 1975)—were intentionally solstitial. Nor, indeed, should we dismiss as necessarily fortuitous those solstitially aligned heiau that are encountered in the Hawaiian Islands, such as Lo'alo'a.

We might even go further. I asked at the outset to what extent developments in different parts of Polynesia might have been influenced by particular perceptions of the world developed in specific island environments. Later cosmologies retained recognizable elements of the ancestral worldview from which they derived, and studies of similarities between religious beliefs and ritual practices can certainly tell us something of the ancestral beliefs and practices that preceded them, as Kirch and Green (2001: 237–276) have demonstrated. The ways in which local circumstances forced the adaptation of ancestral practices are perhaps most evident where they form "rational" responses to readily discernible (by us) environmental factors. A good example is the effect of ecology and climate on the timing of agricultural activities and hence on preexisting lunar calendars (ibid.: 276). But an even trickier question remains: how was the evolving worldview of the settlers in any given island environment molded in the light of local perceptions of place?

To rephrase this question: can we identify any particular characteristics of the landscape setting in relation to the sky—in other words, the total perceived environment—in the Hawaiian Islands that could have influenced Hawaiian worldviews in a distinctive way? One candidate is the fact that remote Necker Island is located directly on the Tropic of Cancer and so stands not only at the physical limit of the Hawaiian chain (and, indeed, of Polynesia) but also at the limit of the zone (the Tropics) where the zenith passage of the sun can be observed (see Ruggles 2005b: 307–309). Another is the fact that the main peaks in the chain fall in approximately solstitial alignment. Both of these, to our way of thinking, are coincidences of nature, but either, if recognized, could have provided a stunning affirmation of cosmic harmony (Ruggles 1999a: 79). The solstitial alignment of the whole island chain could conceivably have engendered a specifically Hawaiian world view that laid particular emphasis on solstitial alignments in the landscape (cf. Meech and Warther 1996; but see also Ruggles 1999a). Could it even be—ironically, in view of the preceding discussion—that in the Hawaiian Islands there was an *enhanced* awareness of the solstices for this reason? In Kahikinui the same question arises in the small, for here the topographic contours run broadly along the other solstitial axis.

Such questions may seem impossibly far down Hawkes's "ladder of inference" (Hawkes 1954) but cannot be entirely brushed aside if we wish to move beyond the constraints of imposing a Western rationality. Archaeoastronomy may provide some modest tools to address some of them. But in order to make progress we need to pay careful attention to the sorts of methodological issue raised in this paper. In particular, there is a vital need, now recognized by most archaeologists attempting to understand aspects of past cosmologies, whether focusing on the sky or on other aspects of the perceived environment, to reconcile theoretically or culturally "informed" interpretive approaches with suitable methodologies for dealing with both quantifiable and more subjective contextual data.

Archaeoastronomical studies in Hawaiʻi have also acquired a role in helping to reconcile indigenous and non-indigenous perspectives, particularly in relation to issues surrounding the renewal (due in 2033) of the lease of the land for the Mauna Kea Science Reserve. The summit of Mauna Kea, the tallest volcano in the Big Island and on all the Hawaiian Islands, is sacred to Hawaiians but is also the site of one of the world's most important astronomical observatories.

It has been awhile since archaeoastronomy in Polynesia first acquired a relevance to broader issues of cultural identity. This dates back at least to the recognition in the 1960s by King Taufaʻahau Tupou IV of Tonga of the solstitial alignment of the Haʻamonga-a-Maui coral trilithon and the subsequent instigation of a modern solstitial celebration at the monument (Lewis 1974: 137; Liller 1993a: 48–49). In Hawaiʻi this arose in the 1970s, largely as a result of the work of Professor Rubellite Johnson, an archaeoastronomer who was also a native Hawaiian (e.g., Johnson and Mahelona 1975; Da Silva and Johnson 1982). One important effect of Johnson's work is that it has heightened awareness of cultural heritage relating to sky knowledge.

With regard to the Mauna Kea telescopes, cultural astronomy has an active part to play in any reconciliation between native Hawaiians and astronomers: a reconciliation that must involve, on the one hand, engendering a sympathetic attitude among native Hawaiians toward modern astronomy and, on the other, astronomers coming to appreciate the relevance of indigenous conceptions of the cosmos. A transfer of knowledge is needed in both directions. Cultural astronomy is directly relevant in the second of these, and archaeoastronomy programs currently exist within astronomy faculties at the University of Hawaiʻi. Transfer in the other direction can be achieved through astronomy programs in community colleges, but cultural astronomy can play a role here also. Having assimilated the basic concepts of positional astronomy and surveying, local investigators are in a better position to explore their own heritage by undertaking archaeoastronomical investigations firsthand. Initiatives along these lines have been encouraged by programs such as TOPS (http: //www.ifa.hawaii.edu/tops/), which was run between 1999 and 2003 by astronomers at the University of Hawaiʻi and included practical archaeoastronomy projects.

The archaeoastronomical investigation of the Kahikinui temples, in particular, provides an excellent opportunity to demonstrate principles of good practice in cultural astronomy in a protohistoric setting. It clearly illustrates the basic point that, if we are to make progress in understanding the meaning of temple orientations in their cultural context, astronomy must form *part* of the method and *part* of the interpretation: the sky must neither be ignored completely nor studied to the exclusion of everything else. The fact that we have a remarkably large sample of temples (sufficient for meaningful traits, such as consistent patterns of orientation, to be identified with some confidence), built in a restricted area within a short time span (and so, presumably, reflecting aspects of a common set of beliefs and practices) and contained within an unusually well-preserved archaeological landscape, also allows us to explore a range of more subtle methodological and interpretive issues. Work in progress by Kirch and Ruggles will explore some of these issues further.

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NOTES

1. Barnatt and Edmonds 2002: 113.

2. In *Honolulu Star-Bulletin* and *Honolulu Advertiser*, 1 Dec 1985: A15, as quoted by Spriggs 1990: 122.

3. From an anthropological standpoint, there is no reason why studies of spatial/astronomical relationships in the material record should be restricted to the visual embodiment of observed or observable phenomena, astronomical or otherwise, within and between buildings, or in relation to natural places and landmarks—in other words to "alignments." On the other hand, most archaeoastronomers prefer to avoid opening a tiresome door to a variety of theoretically improbable and methodologically unsustainable claims—for example, those claiming sets of monuments or buildings to be (literal) representations of prominent asterisms (cf. Ruggles 2005b: 113–115). A good example of the serious middle ground is Aveni's analyses of spatial/numerological relationships of arguable calendrical significance in pecked cross-circles (Aveni 2001: 329–334; 2005).

4. All grid references quoted in this paper are UTM coordinates within zone 4 and use the WGS84/NAD83 datum.

5. A survey with a basic theodolite undertaken in April 2002 had to be abandoned owing to rain. There being no opportunity to obtain timed observations of the sun, only magnetic compass readings were available to convert plate bearings into true azimuths.

6. It is inadvisable to restrict one's attention to temples, as is well illustrated by the following example. Standing by the shore in the Kahikinui district, at a point where the coastline reaches its southernmost extremity (^{7}8115 ^{22}7840), is a section of carefully constructed wall, 8.4 m long. Perplexingly, it stands in complete isolation. Referred to by two local informants as the sighting wall or navigational wall, its Hawaiian name, Pānānā, is used in modern Hawaiian to mean "compass" (Pukui and Elbert 1986: 313; Patrick V. Kirch, personal communication, 2002). The wall increases slightly in thickness from the ends to 1.35 m at its centre, where there is a carefully formed U-shaped notch that, according to one informant in the area, was used for watching stars. The wall is oriented 94-274°, so that looking straight out to sea through the notch frames a segment of horizon centered just a few degrees west of due south. The Southern Cross and Pointers appear here, just a few degrees above the horizon, at certain times in the year: they are prominent in the predawn sky in January, around midnight in April, and in the early evening sky in June.

7. One informant suggested that koʻa were aligned with stars so as to tell the time of year for sailing. If so, and different stars were used in different cases, then these alignments would have resulted in a set of orientations that, although individually meaningful and precise, would not reveal any systematic trends.

8. Interpreting this particular alignment as a precise one upon equinoctial sunrise raises other issues. One difficulty is that the "temporal" or "Thom" equinox (halfway in time between the solstices) would be slightly further north. In any case, there are inherent problems with extending the Western concept of the equinox into other cultures (Ruggles 1997).

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CHAPTER TEN

STEPHEN C. McCLUSKEY

Calendrical Cycles, the Eighth Day of the World, and the Orientation of English Churches

INTRODUCTION

Tony Aveni has frequently reminded us that in Mesoamerican astronomy, numbers and dates are not merely abstract measures of time. He has made us all familiar with the interlocking numerical cycles of days in Mesoamerican calendars. For example, the Venus table of the Dresden Codex embodies the relationship:

$$13 \times (5 \times 584) = 13 \times (8 \times 365) = 146 \times (13 \times 20)$$

The first two patterns reflect the well-known Venus relationship that five synodic periods of Venus equal eight calendar years; the third integrates this Venus period into the 260-day calendrical cycle of thirteen twenty-day "months," the *tzolkin*. As Tony has taught us, such recurring periods are central to Mesoamerican calendars. Some of these periods are arbitrary numbers related to the structure of the calendar, others are counts of the number of days between recurrences of periodic astronomical events, such as the appearance of Venus as the morning or evening star.

These astronomical events—and the numbers that represent them—can be reflected in physical structures: the orientations of buildings and the alignments between them. The orientation of the Palace of the Governor at Uxmal, its alignment toward the distant marker of the extreme rising point of Venus, and the repetition of Venus symbols and the number eight in the architecture of the building itself all remind us of the intertwining of astronomy and architecture, calendars, and numbers.

But these numbers are not just simple counts of calendrical and astronomical intervals; the numbers themselves are also symbols fraught with numerological and cosmic significance. For the Maya, the number eight was one such powerful number, representing the eight-year cycle of the planet Venus. When I was asked to prepare a paper for this volume, that same mystical number eight had just emerged from an investigation into the orientation of a group of medieval village churches in the English Midlands, although it had a totally different significance in this context and found an expression in the orientation of the churches themselves.

A recurring theme among Mesoamericanists is their regret at the loss of most of the written record that could give a fuller meaning to the astronomical calculations and orientations. Despite recent breakthroughs in Maya linguistics, our understanding of Maya astronomy and its relation to its broader cultural context still seems, to one with the pleasure of working with medieval European texts, strikingly limited. For centuries Medievalists have been cataloguing, editing, and commenting on a wide range of texts, many of which have implications for archaeoastronomical investigations. These medieval texts include the following:

1. Maps and diagrams of the cosmos;
2. Explicit statements of the proper way to orient churches;
3. Technical discussions of the astronomical concepts underlying the more complex parts of the Christian liturgical calendar, specifically focusing on Easter, which as a lunar feast presented difficulties in being integrated into the Roman solar calendar, which had become dominant in Europe since its inauguration by Julius Caesar;
4. Liturgical calendars themselves, which give the dates of festivals honoring particular saints as well as of major astronomical phenomena; and

5. Discussions of the numerological and theological symbolism of the calendar and of religious feast days, especially focusing on the days of creation, which traditional exegesis placed at the vernal equinox.

Heretofore, however, little has been done to connect the principles expressed in texts with their incorporation in physical structures—specifically with the orientation of churches. Since we know the structure of the Julian calendar, the principles of Easter reckoning, and the dates of the feast days, we have the opportunity to compare the astronomical phenomena on important days in the medieval liturgical calendar against measured orientations to determine how (or whether) these written principles influenced the orientation of churches. Medieval discussions of the theological symbolism of particular days can provide insights into what particular orientations were intended to symbolize.

Lying behind this project was evidence that medieval scholars related temporal concepts of the changes of the seasons with spatial concepts of the motion of the sun along the horizon. One example of this spatiotemporal reckoning is found in an early twelfth-century English computistical manuscript from Thorney Abbey (Figure 10.1). This diagram creatively combines three early medieval concepts: the changing course of the sun from summer solstice to the equinoxes to the winter solstice, the relationship of the annual motions of the sun to the liturgical cycle, and a conventional T-O map of the known world: Asia, Europe, and Africa (significantly oriented with the east, Asia, at the top). Reading clockwise from the northeast are the places of "Sunrise on the birth of John [the Baptist], Sunrise on the equinox, Sunrise on the Nativity of the Lord, Midday, Sunset on the Nativity of the Lord," and so on. By adding a T-O map, representing directions along the horizon, to traditional diagrams representing the changing arc of the sun through the sky and the corresponding changes of the hours of daylight, the author of this diagram focuses the reader's attention on the directions of sunrise and sunset (Wallis 1985; Obrist 2000). Thus we see that in the twelfth century, English clerics were relating space and ritual time by mapping the changing position of sunrise along the horizon (Figure 10.2).

This mapping of space and time can be considered in the light of what a wide range of experts, writing over a period of over a millennium, said about the proper way to orient churches and the reasons for that orientation.

Figure 10.1. A Medieval mapping of space and time (Thorney Abbey, ca. 1110). At the center is a T-O map of Asia, Europe, and Africa. The directions are marked by places of the sun, reading clockwise from the ten o'clock position: "Sunrise on the birth of St. John. Sunrise on the equinox. Sunrise on the birth of the Lord. Midday. Sunset on the birth of the Lord." etc. Oxford, St. John's College, ms 17, fol. 5v. Used by permission of the President and Scholars of St. John's College, Oxford.

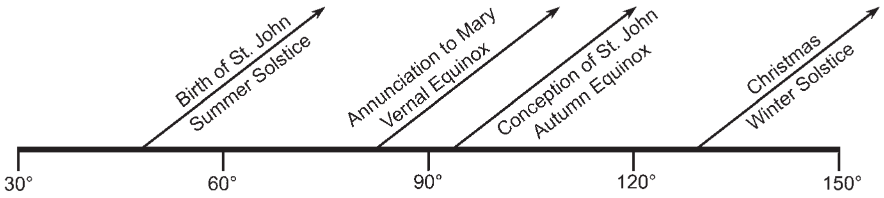


Figure 10.2. Changing sunrise azimuths in the course of the year.

THE PROPER WAY TO ORIENT A CHURCH

Authorities as diverse as Vitruvius (first century BC), in his *De architectura* (1931–1934: 4.5.1–2), Hyginus Gromaticus (early second century AD), in his *Constitutio limitum* (1971: 134), Isidore of Seville (early seventh century) in his *Etymologiae* (1962: 15.4.7), Walafrid Strabo (ninth century) in his *De ecclesiasticarum rerum* (1879: cols. 922–923), Honorius of Autun (early twelfth century) in his *Gemma animae* (1895: col. 575), William Durand (late thirteenth century) in his *Rationale divinorum officiorum* (Durantus 1998: 5.2.57), and the French court astronomer William of St. Cloud (also late thirteenth century) in his *Kalendarium regine* (Harper 1966: 108, 120) all maintained that churches or temples should be built facing east, using many of the same arguments.[1]

One repeated principle lying behind the insistence that churches face east was the concept that the worshiper should face eastward to pray. As Vitruvius put it in his discussion of temples, this way the rising heaven seems to look back on the worshiper (1931–1934: 4.5.1–2). Hyginus Gromaticus, in his treatise on surveying, justified the practice of orienting temples toward the east, as facing toward "that part of heaven from which the earth is illuminated" (1971: 134.15–21).

The direction east took on a whole range of additional symbolic meanings in Christian thought. Besides being the place from which heaven springs, as the rising place of the sun, east symbolized the resurrection of Christ, the Sun of Righteousness; by association it became the symbol of the resurrection of the dead; it was the place of the Christians' true home in paradise. To Christians in the west, it was the direction of Jerusalem (Dölger 1971).

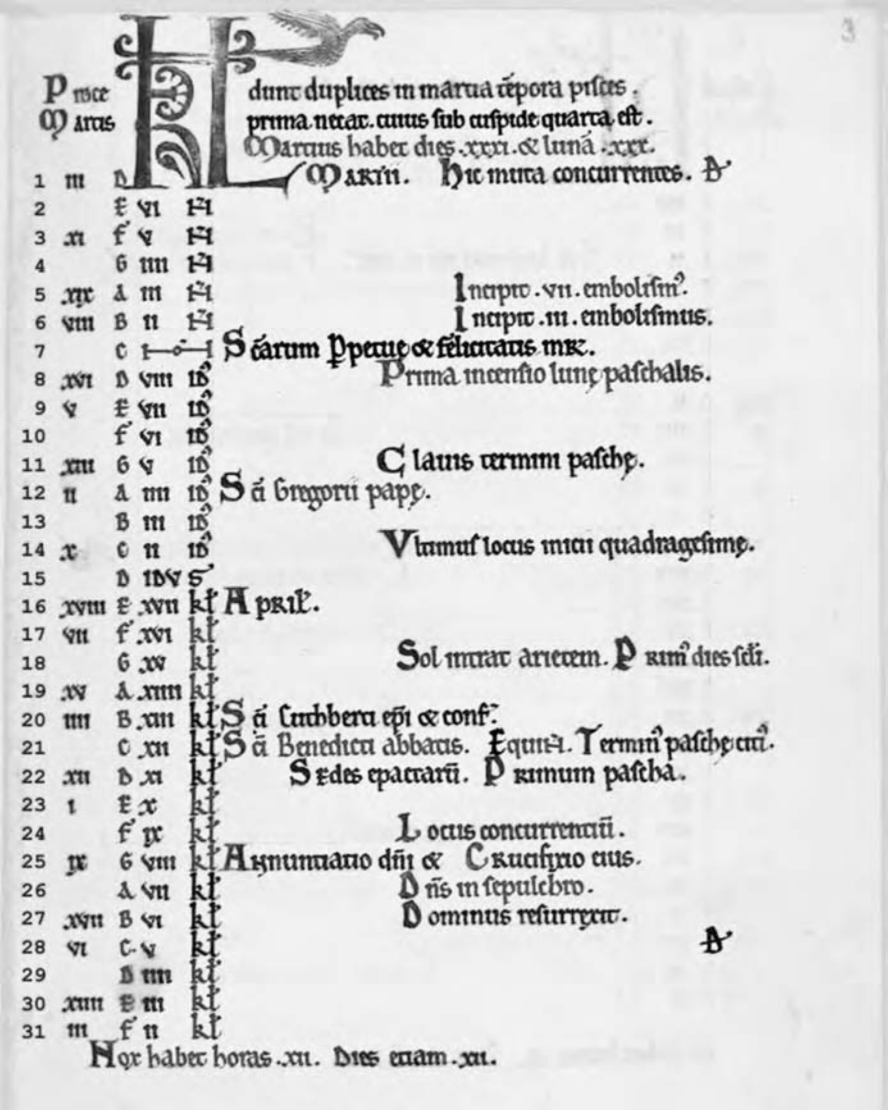
A frequently quoted passage from St. Augustine (1967: 5.17–18) maintained that the believer should always turn in prayer toward the east, whence heaven springs forth, but not because God is physically there since God is everywhere. Instead, by turning one's body toward heaven, the most perfect material thing, the worshiper symbolizes the turning of the immaterial soul toward God. Augustine's influence was widespread, and most significantly for our discussion of English churches, his ideas had a broad audience in England. In the 990s, abbot Ælfric of Eynsham wrote a sermon on the Lord's Prayer, in which he presented Augustine's arguments for turning east to pray (1999: 327). This sermon was in Old English, not Latin; it was not intended just for monks, clerics, and literate layfolk; it was also addressed to a broader range of the Christian population, whom Godden (2000: xxi–xxvii) calls "the laity and their ill-educated preachers."

The importance of the proper orientation of churches toward the east appears in other early British sources. In his life of St. Dunstan, written shortly after 1094, the monk Eadmer of Canterbury reports one purported event that reflects specifically on medieval British criteria (1874: 204–205). Eadmer tells us that when Dunstan was Archbishop of Canterbury (ca. 960–988), he arrived to dedicate a church that he had had built on one of his estates. As he walked around the church before the dedication, he noticed that it was not facing the equinoctial rising of the sun (*ad æquinoctialem solis ortum*). According to Eadmer, Dunstan then pushed against the church with his shoulder, and it was miraculously turned to the proper position facing due east (*in medium orientis*). This account indicates that the equinoctial orientation of churches was taken as the norm between the tenth and twelfth centuries, which was the period of the rebuilding of English parish churches in stone (Morris 1989: 140–167).

In the Middle Ages, however, even the term "equinoctial east" was ambiguous, for the date of the equinoxes—and hence the direction of equinoctial east—was not uniquely defined. English ecclesiastical calendars (Figure 10.3) give dates for the vernal equinox of March 25 (the equinox according to the Romans, which is also Mary's feast of the Annunciation), March 21 (the equinox according to the Greeks, a fundamental parameter in computing the date of Easter), and March 18 (the entry of the sun into the zodiacal sign of Aries). Some calendars even give all three alternative dates.[2] A similar range of dates is found for the autumnal equinox: September 24 for the Roman Equinox, September 21 or 20 for the Greek Equinox, and September 17 for the entry of the sun into the sign of Libra. Among these dates, medieval computists uniformly favored the date of March 21 for the vernal equinox.

The date of the equinox, like the direction east, had theological resonances in the Early Middle Ages. Near the end of the tenth century, Ælfric of Eynsham (1942, n.d.) maintained in his Old English paraphrase of Bede's *De temporum ratione* (1997: 291; 1999: 24–25) that the sun was created at dawn on the vernal equinox and that the newly created moon rose full opposite the sun that evening:

> Before that day there were three days without the sun and the moon and all the stars, and on the fourth day of the creation of this world the almighty Creator created the sun and in the early morning set it in the middle of the east where the equinoctial circle is reckoned to be, so that, in the course of the year, it would always adjust the day and the night there in an equal balance.
>
> On the same day in the evening he set the full moon in the east together with the shining stars in the course of the autumnal equinox, and



Pisce Martis

Habent duplices in marcia tempora pisces. prima necat. cuius sub cuspide quarta est. Martius habet dies .xxxi. & lunam .xxx.

1	iii	D			Martii. Hic muta concurrentes. A
2		E	vi	No	
3	xi	F	v	No	
4		G	iiii	No	
5	xix	A	iii	No	Incipit .vii. embolism.
6	viii	B	ii	No	Incipit .iii. embolismus.
7		C			Sanctarum Perpetue & felicitatis mr.
8	xvi	D	viii	Id	Prima incensio lune paschalis.
9	v	E	vii	Id	
10		F	vi	Id	
11	xiii	G	v	Id	Clavis termini pasche.
12	ii	A	iiii	Id	Sci Gregorii pape.
13		B	iii	Id	
14	x	C	ii	Id	Ultimus locus initii quadragesime.
15		D	Idus		
16	xviii	E	xvii	Kl	April.
17	vii	F	xvi	Kl	
18		G	xv	Kl	Sol intrat arietem. Primus dies sci.
19	xv	A	xiiii	Kl	
20	iiii	B	xiii	Kl	Sci Cuthberti epi & conf.
21		C	xii	Kl	Sci Benedicti abbatis. Equinoct. Termini pasche cicli.
22	xii	D	xi	Kl	Sedes epactarum. Primum pascha.
23	i	E	x	Kl	
24		F	ix	Kl	Locus concurrentium.
25	ix	G	viii	Kl	Annuntiatio dni & Crucifixio eius.
26		A	vii	Kl	Dns in sepulchro.
27	xvii	B	vi	Kl	Dominus resurrexit.
28	vi	C	v	Kl	A
29		D	iiii	Kl	
30	xiiii	E	iii	Kl	
31	iii	F	ii	Kl	

Nox habet horas .xii. Dies etiam .xii.

Figure 10.3. Liturgical calendar for the month of March. Note the entries at March 18 (The Sun Enters Aries, The First Day of the World), March 21 (Equinox, The Earliest Easter Limit), March 25 (The Annunciation of the Lord & His Crucifixion), March 26 (The Lord in the Tomb), and March 27 (The Lord Rises). Numerals for dates are added. MS Thott 143, 2° ("Folkungepsalteret"), fol. 3r, The Royal Library, Copenhagen (English, ca.1170). Used by permission; a complete facsimile is available at http://www.kb.dk/kb/dept/nbo/ha/manuskripter/.

> established the time of Easter through the origin of the moon. (Ælfric n.d.: II.2–3; original text Ælfric 1942: 16–18)

Ælfric went on to address the confusion about the date of the vernal equinox, insisting that Easter must follow after the equinox and that the Marian feast of the Annunciation, although commonly associated with the vernal equinox, did not fall on the true equinox:

> Many men say that the spring equinox (*lenctenlice emniht*) belongs rightly to the eighth kalends of April [March 25], that is on the festival of Saint Mary. But all the easterners and the Egyptians, who know most about computus (*gerimcræfte*), reckoned that the spring equinox is truly on the twelfth kalends of April [March 21], that is on the festival of Saint Benedict. Moreover, it is commanded in the rule that instructs us concerning the holy Easter festival that the holy Easter Day may never be celebrated before the spring equinox has gone and the length of the day exceeds that of the night. Know, therefore, that if it were really the equinox on the festival of Saint Mary, that day would never fall after Easter Day, as it often does. (Ælfric n.d.: VI.1–3; original text Ælfric 1942: 44–45)

Anyone who examines medieval discussions of time finds a world in which recurring patterns repeat themselves at different levels and every pattern can be equated with another and thus comes to reflect another higher reality.

The Medieval pattern of cyclical time is first revealed in the pattern of the seven days of creation: on the seventh day God rested and on the next day the world entered into a new pattern of time—the ordinary time in which we all live. Medieval theologians and writers on computus saw the subsequent ages as repeating this pattern through a cycle of seven ages: the First Age extending from Adam to Noah, the Second from Noah to Abraham, the Third from Abraham to David, the Fourth from David to the Babylonian exile, the Fifth from the Babylonian exile to the coming of Christ, and the Sixth Age lasting from Christ until the end of the world. The Seventh Age replicated the Seventh Day of Creation with an age of perennial sabbath; this would be followed by a new Eighth Age in which, as Bede of Jarrow puts it in his book *On the Reckoning of Times,* the blessed "will reign forever with the Lord" (1997: 464; 1999: 158).

These seven days and seven ages were further replicated in a whole range of other "weeks." First and simplest was the ordinary week, running from the first day, the Lord's day, to the seventh, the Sabbath, the day of rest after which the cycle began again with the eighth day, which was also the first. This strange identity of the first and the eighth day of the week was a recurring theme in scriptural commentaries, being applied to the days of creation, the eight-day interval between the birth and circumcision of Jesus, and the days leading up to the Passion and Resurrection of Jesus. In all of them, the eighth day was seen, in some way, as a completion and renewal of the first (Basil 1980: 27.66).

The concept of "the week" was extended to apply symbolically to the fifty days from Easter to Pentecost, seen as seven times seven plus one (Bede 1997: 303; 1999: 35). The same principle was seen in the Old Testament practice of letting the land lie fallow every seven years and having a Jubilee year, in which lands were returned to their original owner and debts were forgiven, every fifty years, again justified as seven times seven plus one (Leviticus 25: 3–17; Bede 1997: 304; 1999: 35–36).

The archetypal week was Creation itself. It was not just an event that had occurred in the timeless mythological past. Although Creation began before there were sun and stars by which time could be measured, the events of Creation allowed computists to place it firmly in the continuous sequence of ordinary time, which made certain days the anniversaries of these events. For computists, the crucial day of Creation was the fourth day, when God created the two great luminaries, the sun and the moon, "to be the measures of time, to mark out the day and the year" (Genesis 1:14). Since the sun was created to command the day and the moon to command the night, the moon must have been created in such a way that it rose full on the night of the fourth day and shone throughout the entire night.

Since the equinox conventionally fell on March 21 and the first day of the world on March 18, the seventh day when God rested fell on March 24, and the eighth day—the beginning of the second week—fell on March 25. Every year, March 25 is again the eighth day of Creation, as well as the day that the angel Gabriel announced the coming of Jesus to Mary, and also the day on which Jesus died and was buried (Bede 1997: 374, 432, 544; 1999: 87, 129, 248–249; Eliade 1961: 68–76). Intertwined is the weekly, as well as the annual, cycle, in which Sunday, the eighth day of Creation, is the same day as the first day of Creation: it is Pentecost Sunday, on which the Holy Spirit descended on the apostles, and, most importantly, it is Easter Sunday, the day on which Jesus rose from the dead (Lees 1985).

Despite this concern with integrating the intertwining periods of the week, the lunar month, and the Julian year, early medieval computistical reckoning seldom concerned itself with long and exact numerical periods. When computists occasionally discussed the longer periods of the planets, they reckoned them approximately in whole years, rather than in days. Their only attempts to compute recurrences of astronomical phenomena on the "same

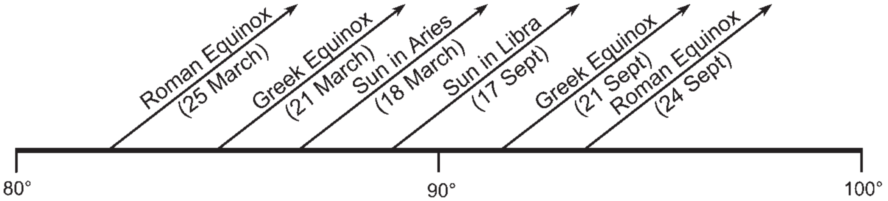


Figure 10.4. The ambiguous equinoxes: the azimuth of sunrise on various dates given for the equinoxes in medieval calendars.

day" in the distant past, such as we see among the Maya, were lunar and solar computations used to establish the historical eras of the Creation and of the Incarnation.

Although experts like Ælfric and Bede were sure of the proper dates of the equinoxes, their continued treatment of the matter and the calendars' listing of alternate equinox dates demonstrate that some of their contemporaries were less certain. The range of acceptable equinox dates found in the calendars has significance for the orientation of churches: a church oriented to "equinoctial east" can point anywhere along a range of azimuths extending some 12.5° from 81.5° to 94° (Figure 10.4). Since most computists followed Bede's opinion that the equinoxes do not occur when the sun first enters Aries or Libra but only when it has reached the fourth point of its sign, there should be a gap in the center of this expected range extending from about 86° to 89.5°.

However we define it, only measurements will tell us whether churches were actually oriented toward "equinoctial east." As early as the thirteenth century, William of St. Cloud had noted that some churches were not oriented along a true east-west line, a fact that he attributed either to the limits of the site or the lack of skill of the builders (Harper 1966: 147, 243). The evident skill of medieval master builders indicates that William's explanation clearly missed the builders' intent. Starting in the seventeenth century, English antiquaries began to explain the observed divergence from true east with the hypothesis that churches were oriented to face sunrise on the feast day of the church's patron saint (Aubrey 1813; Chauncy 1700: 43–44).

The orientation of each church toward sunrise on the feast of that church's patron would produce diverse orientations, thus contravening the principle strongly expressed by medieval authorities that churches, which signify Christ the true east by their orientation, must have that same orientation throughout the world (Harper 1966: 108, 210).

Furthermore, despite the medieval practice of discussing the changing places of sunrise during the year in terms of four major religious feasts—the birth of John the Baptist and the Nativity of the Lord marking the summer and winter solstices, and the feasts of the Annunciation (which commemorates the conception of Jesus) and of the Conception of St. John marking the vernal and autumnal equinoxes (Isidore of Seville 1962: 3.51; Wallis 1985: 218–219; Bede 1997: 87; 1999: 374)—the patronal orientation of churches is not mentioned in medieval texts.

AN ARCHAEOASTRONOMICAL INVESTIGATION OF CHURCH ORIENTATIONS

To disentangle the effect of sunrise on saints' feast days from equinoctial sunrise, I decided to survey several distinct subsets of churches, each dedicated to one particular saint. For this project I chose a contiguous set of early churches drawn from the database compiled by Jones (2002). The churches selected were all within that part of the medieval diocese of Lincoln in the counties of Leicestershire, Rutland, and Northamptonshire (plus a few from the neighboring parts of Lincolnshire and Huntingdonshire). To ensure that the churches, and their dedications, were early I required that the *vill* including the church was mentioned in the Domesday Book and that the dedication was recorded before 1531. From that group I selected four subsets of churches dedicated to Mary (with a major feast at the vernal equinox), John the Baptist (with a major feast on the summer solstice), All Saints (which falls midway between the autumnal equinox and winter solstice), and Andrew (whose feast on November 30 has no astronomical significance at all and thereby provided a control). By analyzing the results from these four subsets of churches, I have been able to separate the contribution of patronal dedications from the general distribution of church orientations.

In order to examine the data without losing any of the detail present in the measurements, the data were not constrained to predefined bins but were plotted as a cumulative frequency distribution, or "curvigram," a method used in other archaeoastronomical investigations (Thom 1967: 45–46, 102–103; Ruggles 1999: 50–52, 56, 59). For each church a normal curve of unit area was computed, centered on the orientation of the church and with a standard deviation reflecting the uncertainty of the measurements.

More importantly for this study, we can also compare how the distribution of orientations for churches dedicated to particular saints differs from the

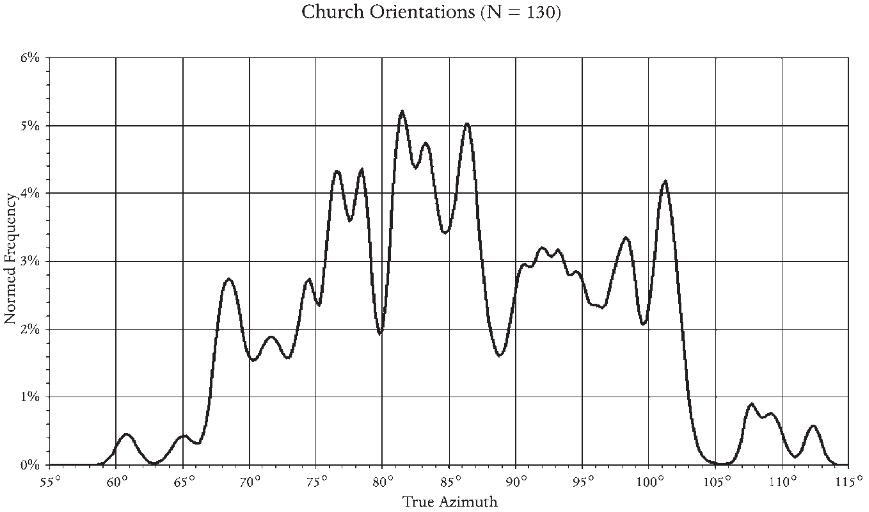


Figure 10.5. General pattern of church orientations: measured orientations of 130 village churches in the English Midlands.

typical pattern of orientations. Plotting the difference between the normalized frequencies for each of the four saints' dedications and the typical pattern of orientations yielded a graph in which deviations above the axis indicate where churches dedicated to a particular saint are concentrated more frequently than expected.

The analysis begins by comparing azimuths rather than declinations. I will later present some preliminary results in terms of declination, obtained by using horizon elevations derived from a digital terrain model.[3] Beginning with the broadest overview of the azimuths, we can see that the orientation of the churches, ignoring the many irregularities, forms something like a bell curve, centered a bit north of east (Figure 10.5). Ninety-five percent of the churches surveyed fall within a 38.2° range between 68.1° and 106.3°, with a median azimuth of 85.0° and a mean of 85.8°. In particular, there is a broad peak marking the range of dates for the vernal equinox, and a similar, if less distinct, peak marking the autumnal equinox. Almost 36 percent of the churches surveyed fall within the broad equinoctial band. This pattern clearly indicates that something like the equinoctial orientation principle described in the medieval texts was widely, but not universally, followed.

Conversely, no churches have been found to be oriented to sunrise on the Feast of St. John near the summer solstice (when the sun rises at about 48°),

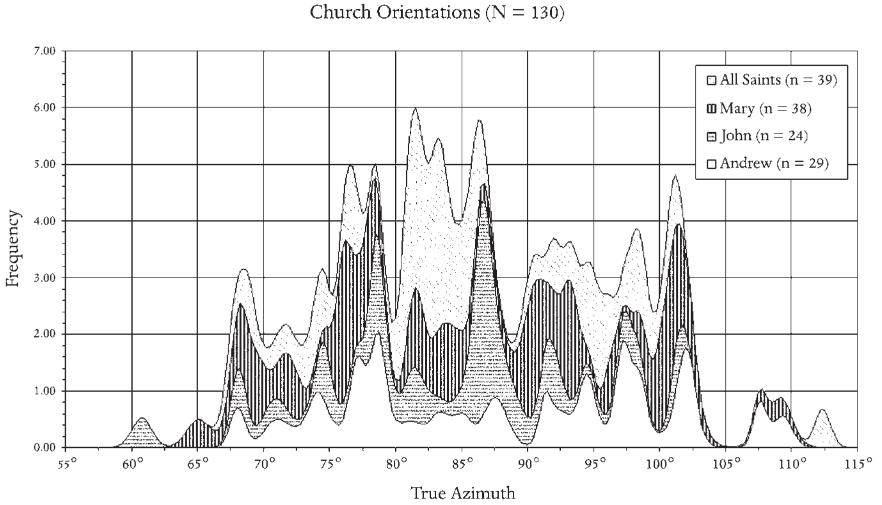

Church Orientations (N = 130)

Figure 10.6. Church orientations by dedication: measured orientations of churches dedicated to All Saints, Mary, John the Baptist, and St. Andrew.

the feast of All Saints on November 1 (when the sun rises at about 116°), or the feast of St. Andrew on November 30 (when the sun rises at about 128°). This in itself rules out the simplest version of the hypothesis of large-scale orientation toward sunrise on these saints' major festival days.

If we look more closely at the data by saints' dedications we find two significant peaks (Figure 10.6). Churches dedicated to All Saints make an overwhelmingly large contribution to the peak marking sunrise on the feasts of the Annunciation and the Birth of Mary, with churches dedicated to Mary only playing a marginal role. This peak appears to represent an equinoctial orientation rather than one due to a Marian feast. Furthermore, the right-hand edge of the peak between about 85° and 87° is due to churches dedicated to St. John the Baptist. This peak appears to represent churches oriented so that the nave points toward sunset on the feast of the Conception of John the Baptist on the Roman autumnal equinox of September 24. The special emphasis on All Saints and John in this equinoctial range and the comparative scarcity of churches dedicated to Mary and Andrew indicate that equinoctial orientations are not uniformly practiced in the four subsets of churches in our dataset.

The two peaks near the equinoxes associated with John and All Saints were found to be statistically significant. All remaining peaks failed to meet conventional statistical criteria. In sum, only the two peaks in the equinoctial azimuth

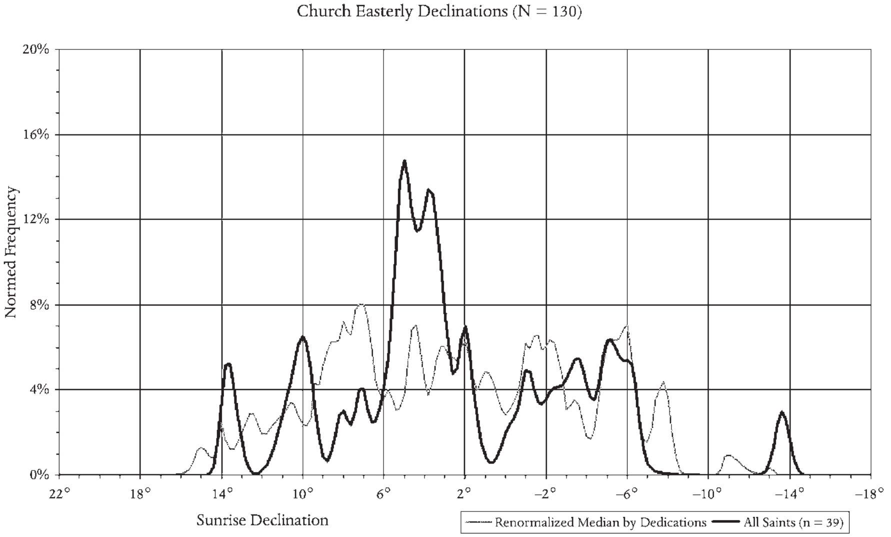


Figure 10.7. Indicated sunrise declinations of churches dedicated to All Saints. Declinations of the first gleam of the sun, corrected for atmospheric refraction and horizon elevation. Positive (northern) declinations are to the left, reflecting the appearance of the eastern horizon.

range of 80° to 88°, associated with churches dedicated to St. John and to All Saints, are supported by statistically significant evidence.

Here I shall concentrate on the thirty-nine churches dedicated to All Saints, which provide seventeen of the twenty-eight churches (χ^2 probability: 0.0014) in the range of 80.3° to 86.2°, a range that encompasses sunrise on the Roman and Greek dates for the vernal equinox. Looking at the declination data (Figure 10.7), we find a broad spike from +5.6° down to +3.0°, with one peak at a declination of +5.1° and another at a declination of +3.8°. The first peak corresponds to sunrise on March 28 or 27, the latter date being listed in the calendars as the date of the Resurrection; the second peak to sunrise on the March 24 or 25, the latter date being listed in medieval calendars as the date of the Roman Equinox.[4]

Having established, by measurements of churches, the existence of a statistically significant pattern of astronomical orientations, we now face the more significant question that touches on the meaning of such astronomical orientations in the Middle Ages. What, if anything, could lead the builders of churches dedicated to All Saints to take special care in following the formal mandate that churches face sunrise on these dates near the equinox?

RELIGIOUS SYMBOLISM

We have no texts providing an explicit link between the feast of All Saints and the equinoctial orientation of churches, yet a number of themes indicate the appropriateness of such an orientation. One of these is universality, which had been a major theme in the feast of All Saints since the eighth century, when the feast's date was fixed as November 1. As Hennig (1948) has pointed out, the feast was held to be universal both in its celebration and its object. It honored the saints in general (not only the martyrs), all the saints, and the saints from all the regions of the world. We might, then, expect churches associated with this feast to follow an analogous theme of universality in their orientation.

Both Bede (1997: 89; 1999: 376) in the eighth century and Ælfric (1942: 46–47; n.d.: VI.7–8) in the tenth had noted the special universality of the days of the equinoxes. Because of the sphericity of the Earth, all the other days are of different lengths throughout the world. On the equinoxes, however, the days and nights are of equal length everywhere in the world. Much later, William of St. Cloud (Harper 1966: 243, 147) would note that the equinoctial orientation of churches is the same everywhere in the world. By maintaining an orientation toward the vernal equinox, which is the same everywhere in the world and on which the days and nights are the same length everywhere in the world, these churches reflect the feast's theme of universality.

We also have a number of texts linking all the saints, or particular groups of the saints, to days that were commemorated at the time of the equinoxes. One group of saints comprises the holy men and women of the Old Testament. According to Early Medieval tradition, after Christ's death he descended into hell, defeated Satan, and liberated those holy people who had died before his redemptive sacrifice. They then rose with him at the Resurrection. The second group of saints comprises the apostles and other saints who had foresworn things of this world, who will sit on judgment seats with Christ at the end of time, joining him in judging all mankind. The third group of saints is not limited to such special holy people but includes all the saints—the judges and the judged—whose glorified bodies will rise on Judgment Day (Ælfric 1967: 434–435; Gatch 1977: 141, 143).

From this perspective, the equinoctial alignment of churches dedicated to All the Saints reflects the medieval integration of sacred space and sacred time. The sacred space of equinoctial east symbolizes the Resurrection and the place where Christ will rise as the Sun of Justice on the last day. This sacred space relates directly to the recurring cycles of sacred time, in which the judgment occurs on the eighth day of the world—which is also the eighth day of Creation, which took place on March 25; the day that the angel Gabriel announced the coming of Jesus to Mary; and the day on which Jesus died and was buried.

More significantly, we find an explicit theological connection of the equinoxes with All the Saints not, where we might expect it, in sermons and liturgical texts but in the computistical literature. The most unequivocal connection is in Byrhtferth of Ramsey's *Enchiridion* (1995), an introduction to computus and the ritual calendar written in Old English for young monastic oblates and novices, as well as for the less well-educated secular clergy. Discussing the events of March, Byrhtferth presented the sequence of Creation, including the creation of the sun and moon on the fourth day at the equinoxes. As he came to the seventh day, on which God rested, Byrhtferth elaborated on a widespread patristic theme that had placed an eternal eighth day or age of rest for the saints after the seven ages of the world. Byrhtferth specified the precise date of this eternal eighth day, on which eternal rest was granted to All the Saints, identifying it with the Eighth day of Creation, March 25, the Roman equinox, which was also Mary's feast:

> On the seventh day, 24 Mar., he ended his work, and the week was finished, and he blessed that day. The eighth day then came after the seventh, and it arrived on the day that fell on 25 Mar. That day was singled out especially in God's providence.
>
> On that day the angels were created; on that day the archangel Gabriel was sent to Mary; on that day Christ arose from death; on that day God's spirit came to mankind. It is holy Sunday; when all days fail, it will endure forever in its festiveness. It is the joy of angels and eternal benefit to *all the saints*. (Byrhtferth 1995: 72–73)

Although here Byrhtferth clearly associates the day of Judgment with the Resurrection, he goes on to note (1995: 292) that we read (apparently in calendars) that Christ rose from death on March 27. This inconsistency is also represented by the double peak in the indicated declinations of All Saints' churches.

Byrhtferth further developed his connection of the eternal eighth day, the Creation, the Incarnation, the Resurrection, the Last Judgment, and All the Saints in his discussion of the spiritual significance of the numbers seven and eight:

> God blessed the seventh day so that the eighth would be even more sacrosanct. *All the saints,* who through their faith overcome the kingdoms of this life, receive the seventh day of perpetual life and peace, released from their bodies, awaiting the coming of almighty God and our saviour.

> After the number seven, the number eight arises, sustained by the royal might. . . . It is celebrated by an angelic visitation, and it is sanctified by the saviour's advent, it is most sabbath through the saviour's resurrection; it is most renowned through the advent of the Holy Ghost; and, as we have said, it will be eternal following the day of judgement. It is, one might say, wondrous to the angels and archangels, to the just and to the saints, because through the everlasting divinity of Christ it is endless. (Byrhtferth 1995: 210–213)

Byrhtferth's connection of All the Saints with March 25 has no known liturgical precedent. In his extensive studies of the origins of the Feast of All Saints on November 1, Hennig (1946: 49–66; 1948: 147–161) has pointed out that many medieval liturgical texts included various local feasts honoring specific groups of saints, for example, All the Martyrs or All the Saints of Africa. None of these feasts fell on March 25.

Although identifying the eternal eighth day with March 25 seems to originate with Byrhtferth, the idea of an eternal eighth day had a long tradition. Augustine (1972: 22.30) discussed it at the close of his *City of God*; for Pope Gregory the Great (1985: 35.8.17) the number seven signified temporality, since there were seven days of Creation and seven ages of the world, whereas the number eight, reflecting the eighth day of eternal rest, signified eternity. The eighth day became a major theme in the writings of Bede of Jarrow, Byrhtferth's principal source for his *Enchiridion*. Bede addressed the eternal eighth day in his exposition on the building of the temple (1969: 153, 167, 196–197, 232–233; 1995: 12–13, 31, 72–73, 116), in his commentary on *Genesis* (1967: 39), in his sermon for the Feast of the Circumcision of Jesus (1955: 77), in the hymn "On the Works of the Six Primordial Days and the Six Ages of the World" (1955: 407–411), and in his *De temporum ratione* (1999: 246–249).

In his *De tabernaculo,* an allegorical exposition of that portion of the book of Exodus dealing with the construction of the tabernacle, Bede drew a connection among the eighth day, eastward orientation, and the saints. Here he juxtaposed the completion of the west wall of the tabernacle, its orientation, and the coming of Christ in the east on the seventh and eighth days in which the saints are granted rest and receive their incorruptible bodies:

> Aptly is the tabernacle completed on the western side, in which it is customary for the sun to end the day and the stars to set (*occidere*). . . . For just as the sun sets for anyone who migrates from this temporal light through the transitory shadows of death to the joys of eternal light and life, and just as the sun sets in the west for the whole Church so that it may

> surely rise in the east as the shadows pass away, so in the same way, when the Lord comes and the life of this present world is over, will the morning and the true day of eternity then appear for the righteous in the world to come.
>
> Now it is appropriate that the same western side of the tabernacle . . . was composed of six boards. This is . . . because there are six ages of this world, in which it behooves us to be perfected in good works so that in the future we may be able to enter into eternal rest and the glory of the resurrection.
>
> Another two boards again, besides the first six, are commanded to be erected . . . coming from the eastern side to meet the wall and join it to the wall of the western side. This pertains to the reward of the life to come . . . because it is divided into a twofold keeping of the sabbath, namely: the rest of the souls after release from their bodies, and the glory of the resurrection with the reception of incorruptible bodies. (Bede 1994: 73–74; original text Bede 1969: 65–66)

The eighth day was not an incidental matter for Bede; he closed his great work on computus, *De temporum ratione,* with a peroration on the eternal eighth day:

> [W]hen we read of the octave in Scripture, we know that it can be understood symbolically of both the day and the age. For the Lord rose from the dead on the eighth day, that is after the seventh day of the sabbath; and we shall rise again, not only after the seven fleeting days of this World-Age, but also after the aforementioned Seven Ages, at once in the Eighth Age and upon the eighth day. To be sure, the day of this life has always abided, abides, and will abide, eternal in itself. But for us, it will begin when we deserve to enter into it in order to see it, where *the saints,* renewed in the blessed immortality of flesh and spirit, . . . praise you, world without end. . . .
>
> And so our little book concerning the fleeting and wave-tossed course of time comes to a fitting end in eternal stability and stable eternity. (Bede 1999: 249; original text Bede 1997: 544)

Byrhtferth followed Bede's model in this regard; he concluded his *Enchiridion* (1995: 236–239) by emphasizing the importance of the eighth day and connecting it firmly to All the Saints. The eighth day, he notes, is "the judgement day; that is the eternal day, the long day after the judgement, the pleasurable day, the holiest Sunday, God's day and *the day of all the saints.*"

CONCLUSIONS

This study has shown that the Christian eschatology of the Last Judgment was memorialized in computistical texts, scriptural commentaries, sermons, and the orientation of a group of churches dedicated to All the Saints.

Figure 10.8. Domesday: Christ on a rainbow over the dead emerging from their graves. Painting located over chancel arch, Church of St. Mary, Lutterworth, Leicestershire. (Photograph by Stephen McCluskey.)

This same theme of the Judgment Day, joining as it does sacred time and sacred space, was a symbolic commonplace found in many surviving wall paintings of English Medieval churches (Figure 10.8). Typically, they were located over the chancel arch at the eastern end of the church, again associating the rising of the saints on the last day with the rising of the sun in the east. This painting is typical of the genre, conforming to Bede's hymn describing the events of the eighth age, which was also the eighth day of Creation, which fell on March 25, and which was also the Vernal Equinox:

> The eighth [age] remains,
> More sublime than the other ages,
> When the dead will rise again
> From the former heaped-up earth
>
> And the just will look perpetually
> Upon the pleasant face of Christ
> And they will become like the heavenly
> Angels upon the shining rainbow. (Bede 1955: 409)

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NOTES

1. For further discussion of ancient and medieval sources on church orientation, see Johnson (1912: 205–242), Vogel (1962: 175–211), and McCluskey (2004: 200–206).

2. Wormald (1934) notes the equinox on March 25 in his calendars 2, 4, 13, and 14; on March 24 in calendar 1; and on March 21 in calendars 5–14, 16, and 18–20. The entry of the sun into Aries on March 18 is given in calendars 1–2, 4–7, 9–11, 13, 14, 16, 19, and 20. None of these calendars distinguishes the vernal equinox according to the Romans from that according to the Greeks (or the Greeks and Egyptians); the distinction is usually made when two dates are given for the autumnal equinox or either of the solstices.

3. It was seldom possible to measure horizon elevations owing to the trees, hedges, and buildings surrounding most churchyards. Horizon computations were graciously performed by Dr. Andrew G.K. Smith of the Department of Physics and Mathematical Physics, University of Adelaide, using Land-Form Panorama Digital Data (Crown Copyright Ordnance Survey, an EDINA Digimap/JISC-supplied service). Cells in the OS Panorama digital terrain model are spaced every 50 meters, making horizon elevations unreliable for moderate slopes with horizons closer than 500 meters.

4. Between AD 1050 and 1200, the period when these churches were built, the declination of sunrise on March 25 ranged between 3.7° and 4.4°; on March 27 the sunrise declination ranged between 4.5° and 5.2°. These computations were made using Sky Map software (Marriot 2001).

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CHAPTER ELEVEN

EDWIN C. KRUPP

High Fashion

INTRODUCTION: MAGIC AND SCIENCE

Behind the Crystal Ball: Magic, Science, and the Occult from Antiquity Through the New Age, published by Times Books in 1996, appeared to depart from Anthony Aveni's well-established studies of ancient astronomy in its cultural context. Aveni instead turned his attention to occult magic and the belief systems that sustain it. The sky, however, commands ample territory in prehistoric, ancient, traditional, and contemporary belief. Aveni's contributions to our understanding of the role of the sky in systems of belief suggest his examination of magic was not really a leap into another realm of research but rather a lateral shift in his delineation of engagements with belief. Arguing that magical thinking continues to temper our interpretation of our experience, Aveni validated the systematic study of magic "as a way of understanding the diversity of human experience" (Aveni 1996: 8).

The word "magic" originates with *magi,* the Latinized form of an Old Persian word associated, by the fifth century BC, with Persian fire priests, Zoroastrian ritualists, and an elite tribe of Medes who specialized in divination, dream interpretation, and royal sacrifices (Graf 1997: 20; Dickie 2001: 28–29, 33–34; Gharib 2002: 2). For the Greeks, the Magi were priests. Rome, and especially the encyclopedist Pliny the Elder, regarded them as sorcerers. Magic is intended to access power from the spirit world, and through manipulation of forces of nature it attempts to control events, circumstances, and people with the supernatural leverage of ritual and symbol. It emerges from associative thought and relies on a theory of cause and effect articulated by analogy.

Through history, the content, character, technology, and vocabulary of magic have evolved. Distinctions between magic and science, between belief and rational analysis, are rooted in perceptions of reality and did not become particularly meaningful until the sixteenth century. The permeability of the membrane between magic and the prevailing understanding of reality, according to Aveni, reflects the influence of the cultural landscape. Identifying magic as "the means, the action that launches the power of spirits . . . the learned art that produces the marvelous effects of superhuman beings or departed spirits" (Aveni 1996: 8), Aveni remained unsatisfied with attempts to define it. "Magic is," he instead asserted, "culturally self-defining" (ibid.: 10–11), and he mentioned its ongoing absorption and transformation by postmodern mass culture.

Today, practitioners of magic are generally known as magicians, sorcerers, or wizards. Portrayed iconically, their canonical wardrobe usually includes a tall, conical hat and a long, loose robe. Both items of apparel are often, but not always, ornamented with celestial symbols. This image has been cultivated, propagated by, and domesticated through mass media.

Wizards: A Magical History Tour, by Tim Dedopulos (2001), documents the essentials of wizardry for young readers, and its numerous illustrations indicate wide variation in fashionable wizards' wear. Some hats and robes are plain. Others advertise the wizard's vocation with magical symbols, and sometimes the symbols are celestial. Probably the best known wizards today are those who appeared in the film trilogy *The Lord of the Rings* and in the Harry Potter movies, but astronomical emblems are absent from their outfits. Exploiting Harry Potter's popularity, however, an independent merchandiser packaged a wizard's hat and cape along with a book by "The Great Arcturus" (2001) as *A Starter Kit for Wizards,* and the costume was enriched with stars and moons (Figure 11.1).

The wizard's celestial accessories are so familiar, then, that they can be put to work on behalf of commercial enterprises. In fairy tales, elves work on

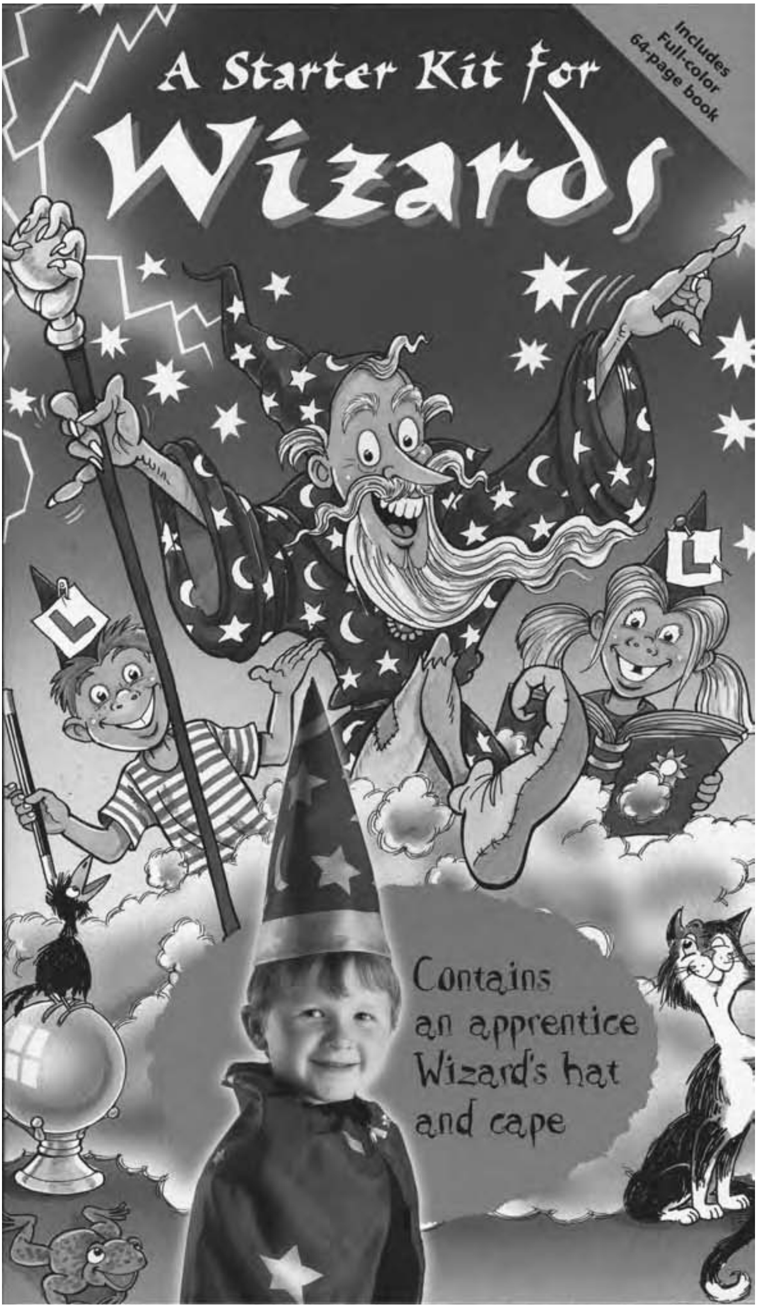

Figure 11.1. In the Harry Potter era, specialty outlets supply wizards-in-training with a star-studded cape and the canonical conical hat, emblazoned with moon and stars. (Parragon Publishing, Bath, UK, 2001; collection E. C. Krupp.)

shoes overnight, but in downtown Los Angeles, where a shoe repair business advertises its location with a neon sign of a star-studded wizard, the Shoe Wiz performs the magic that heels the soles. The wizard's celestial perspective also apparently allows him to light candles in the darkness, for a wizard dressed in stars casts his spell as the lid ornament for the Yankee Midsummer's Night Housewarmer scented candle, manufactured in Deerfield, Maine. Wizard imagery of this sort is so pervasive, it even appears in a story in a *Simpsons Treehouse of Horror* comic book (Groening 2003: 88–103).

Such popular recognition of the wizard's starry uniform owes something to the 1940 portrayal of the Sorcerer's Apprentice in *Fantasia,* one of Walt Disney's most famous animated feature films. The magic hat Mickey Mouse borrowed while the sorcerer slept was enhanced by a crescent moon and five-pointed stars. Its emblematic status has since been reconstituted into architecture on the Burbank, California, property of Disney studios, where a giant version of the hat announces the entrance to the Disney animation facilities (Figure 11.2).

SHAMANIC CHIC

For at least the last sixty years, popular culture has been comfortable with the astronomically attired magician, but the origin and meaning of this celestial fashion has not been examined.

Because powerful intellects and the command of occult knowledge have been attributed to them, wizards and magicians have been linked, especially in modern informal accounts, with primordial shamanic traditions. Shamans talk with the spirits and enjoy direct access to the supernatural realm. Shamans, however, are not identical to magicians. Magicians manipulate symbols according to ritual stipulations to modify circumstances and events. Although shamans also possess specialized technical knowledge of nature, their power originates in their charismatic ability to enter the spirit world and make contact with its residents.

Because wizards, shamans, and other ritual specialists share some of the same supernatural protocols, it would be natural to link the wizard's symbolic garb with archaic use of celestial insignia in encounters with the sacred. Although regalia worn by Siberian shamans are highly individualized, even within any ethnic group, the use of celestial symbols transcends tribal boundaries. Mircea Eliade asserted that "[t]he shaman's costume itself constitutes a religious hierophany and cosmography; it discloses not only sacred presence

Figure 11.2. Disney Animation Studios in Burbank, California, turns the celestially enriched sorcerer's hat from Fantasia *into vernacular architecture. (Photograph by E. C. Krupp.)*

but also cosmic symbols and metapsychic itineraries" (Eliade 1964: 145) and explained a disk on the back of the robe of Yakut shamans as being the sun (ibid.: 148). The caftan worn by an Altaic shaman in the nineteenth century and now in the collection of Peter the Great's Museum of Anthropology and Ethnology in St. Petersburg, Russia, is equipped with metal pendants that represent the sun, the moon, and the rainbow (Figure 11.3; Basilov 1989: 162). A dance coat attributed to a Koryak shaman is covered with white dots thought to symbolize stars (Figure 11.4; Fitzhugh and Crowell 1988: 32).

Ghost Dance shirts worn by the Sioux and other North American Indians in the nineteenth century "were fairly covered with representations of sun, moon, stars, the sacred things of their mythology, and the visions of the trance" (Mooney 1896: 790). Any participant in this messianic movement might own one of these celestially decorated garments, for the symbols were believed to provide protection from bullets. Use of the shirt was inspired by the vision a Sioux woman experienced while in a trance (ibid.: 916).

The Egyptian *sem*-priest, who presided over pharaonic jubilee and funeral rituals, wore a leopard pelt that symbolized the night sky, with the spots performing as the stars (Figure 11.5; Krupp 1983: 25; 1996: 61).

An Elamite figure found at Susa, in southern Iran, and fabricated in the eleventh century BC is believed to portray a king. His shirt, loaded with stars, appears to link royal power with the sky (Krupp 2003: 78–79).

Imperial Manchu (Qing dynasty, 1644–1912) robes from China included a symbol for each of the four cardinal directions in four different spots, emblems of the sun and the moon on the shoulders, and three stars of a constellation on the back (Vollmer 1980: 19, 22). Standing in as the cosmic polar axis, the emperor wore the robe as a demonstration of his supernatural relationship with world order and with the supreme celestial god that conferred his mandate to rule. The robe of a Taoist priest, collected at the beginning of the twentieth century, is embroidered with each of the animals of the Asian twelve-year calendar cycle (ibid.: 17). A traditional portrait of Confucius, "China's greatest sage," places the Big Dipper on one shoulder of his robe and what appears to be the Southern Dipper (in Sagittarius) on the other (Williams 1941: 84–86).

In eleventh-century Europe, Holy Roman Emperor Henry II of Bavaria donned a cosmic mantle that turned him into the world axis. Densely embroidered with medallions for the sun, the moon, numerous constellations, and astrological inscriptions, along with symbols for Christ, the Virgin Mary, St. John, and other elements of Christian doctrine, the robe bonded the emperor to celestial power (McCluskey 1998: 141–145). Historian Stephen C. McCluskey

Figure 11.3. Metallic pendants fortify the costume of a nineteenth-century Altaic shaman with celestial power. The half-disk on the left symbolizes the moon. The central disk stands for the sun, and the ring on the right represents the rainbow. (Collection Peter the Great's Museum of Anthropology and Ethnography, St. Petersburg; photograph by E. C. Krupp, "Nomads of the Eurasian Steppe" exhibit.)

Figure 11.4. The dots on this Koryak dance coat, probably owned by an Aliutor shaman from Siberia, are thought to represent stars. (Photograph by E. C. Krupp, "Crossroads of Continents" exhibit.)

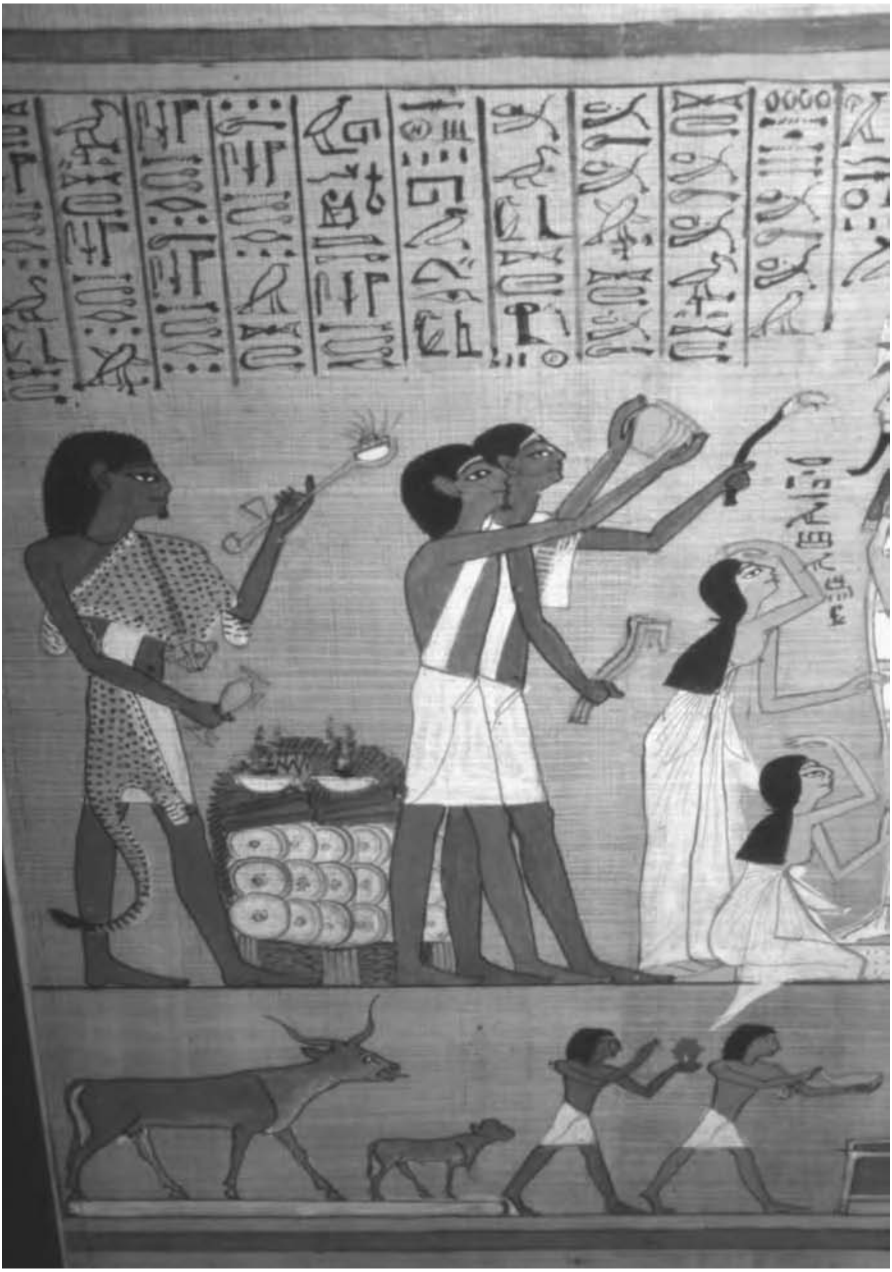

Figure 11.5. The Egyptian sem *priest on the left presides over the Opening of the Mouth ceremony for the deceased in a leopard skin (or possibly a cheetah skin) cloak. The spotted pelt symbolized the starry sky. (Papyrus of Hunefer, Dynasty XXII, 1285 BC; photograph by E. C. Krupp, "Treasures of the British Museum" exhibit.)*

links these astronomically charged royal cloaks with antiquity's image of Jupiter dressed in stars in his appearances at assemblies of Olympian gods (ibid.: 143).

THE ORIGINS OF MODERN WIZARDWARE

Notwithstanding these documented precedents for the celestial wardrobe, there is no evidence for any historic link between today's well-known wizard iconography and the archaic use of celestial symbols on ritual clothing that advertised cosmic connotations of divinity, royal sovereignty, priestly wisdom, and shamanic power. The true lineage of the familiar wizard's costume can be traced, however, through an iconographical review of the clothing historically attributed to figures who have been unambiguously identified as wizards.

Detailed modern surveys (Graf 1997; Dickie 2001) and compilations of ancient primary sources (Ogden 2002) offer no indication of any special costume worn by sorcerers. In a relatively rare exception, the Roman writer Marcus Annaeus Lucan (first century AD), in *Pharsalia,* described the "multicolored clothing" and the "crown of snakes" worn during a ritual performance by a Thessalian sorceress (Graf 1997: 191). To the extent that Chaldaean and Egyptian priests and Persian Magi were equated with magicians, their foreign clothing would have been associated with wizardry, but ancient commentaries that probably would have acknowledged such novelty are singularly silent on the appearance of magicians.

Medieval sources provide no endorsement for special wizard's attire. One of the earliest graphic depictions, the wizard in *Hortus Deliciarum,* an eleventh-century French manuscript, wears an ordinary frock and mantle and no hat (Figure 11.6). The wind-controlling sorcerers Olaus Magnus later included in *Historia de Gentibus Septentrionalibus,* published in 1555 (Olaus Magnus 1996–1999), also wear ordinary clothing (Figure 11.7).

In sixteenth-century portraits, famous and learned magicians like Theophrastus Bombast von Hohenheim, or Paracelsus (1493–1531), and Heinrich Cornelius Agrippa von Nettesheim (1486–1535) appeared in clothes of the time. The image of Paracelsus in *Astronomica et Astrologica Opuscula,* published in Cologne in 1567 (reprinted in de Givry 1931: 121), and the picture of Agrippa in his *The Occult Philosophy* of 1635 (reprinted in Wilson 1975: 64) both depict contemporary apparel. Apollonius of Tyana, Mohammed, Roger Bacon, Edward Kelly, John Dee, and Paracelsus were all classified as members of the occult Order of the Illuminati in a seventeenth-century book on Dee. Regarded as Major League magi, they were featured in a series of illustrations

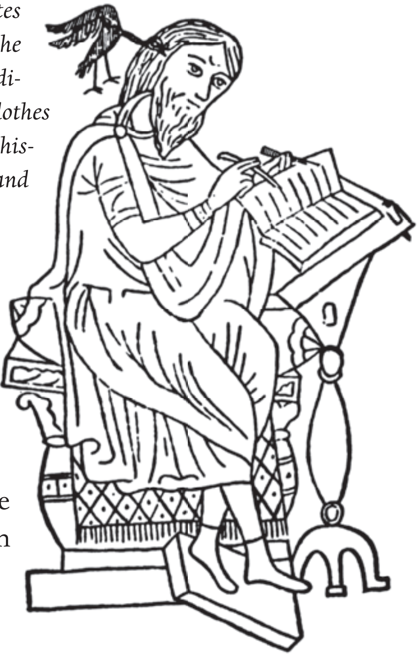

Figure 11.6. The Hortus Deliciarum *illustrates what the well-dressed wizard was wearing in the eleventh century AD. The magician in this medieval French manuscript is outfitted in ordinary clothes and shows no astral ornament. The black bird whispering into his ear is the Evil Spirit. (From Lehner and Lehner 1971: vii.)*

that resemble trading cards (reprinted in Cohen 1971: plate 5), but unlike baseball players, none of them is uniformed.

Numerous illustrations from the seventeenth, eighteenth, and nineteenth centuries cast the wizard in vaguely medieval robes. Although Hermes Trismegistus appears in Jacques Boissard's *De Divinatione et Magicis* in a more elaborate cassock and tall papal hat with a celestial globe (reprinted in Seligmann 1948: 127), astral and magical symbols are almost always absent. Edward Kelly is in plain robes in a well-known picture of his summoning at night a dead spirit in a churchyard (ibid.: 304). Formal wizard attire might be expected at meetings and banquets, but no special outfits betray the magi in *The Sorcerers' Feast,* a woodcut by Fr. M. Guaccius for *Compendium Maleficarum,* published in Milan in 1608 (reprinted in Seligmann 1948: 248). Rembrandt's 1652 engraving of Dr. Faust (reprinted in Lehner and Lehner 1971: 32)—engaged with an apparition of a magic Cabalistic disk—clothes him in typical robes. When Faust appeared in 1632 on the illustrated title page of Christopher Marlowe's *The Tragicall Historie of the Life and Death of Doctor Faustus,* he wore a fur-trimmed gown, fancy collar, and a flat doctoral hat (Figure 11.8). Celestial power is invoked, however, in symbols of the zodiac and planets incorporated into the magic circle that protects him in his encounter with the Devil.

Agrippa's *The Occult Philosophy* confirms the wizard's interest in astronomy, physics, and mathematics, but his mastery of these disciplines is not advertised in his clothes (Figure 11.9). According to Seligmann (1948: 317), a magus like Agrippa learns "the essence of the stars" through "the study of stones" and "from the planets his knowledge will lead to the sublime." He possesses "occult

Figure 11.7. No special uniform identifies the wind-merchandising sorcerer who is transferring a useful bag of wind, tied up in a rope with three knots, to sailors about to embark on a voyage. This illustration from Historia de Gentibus Septentrionalibus, *by Olaus Magnus, was published in Rome in 1555. (From Lehner and Lehner 1971: 69.)*

secrets" and is "master of esoteric wisdom." Through contemplation of Nature and the discovery of its "marvelous active forces," the sorcerer extracts power from detailed knowledge of the forces that drive the world. Spirits in the stars were one source of that power.

More familiar-looking wizards—in robes and conical hats—begin appearing in the eighteenth century. The French engraver Claude Gillot put a sorcerer in a robe with long hanging sleeves and in a tall conical hat with a wide brim (de Givry 1931: 232), an outfit suitable for Gandalf, Middle-earth's champion in *The Lord of the Rings* trilogy, or any other celebrated wizard. Grillot de Givry called it a "comic opera sorcerer's costume" (ibid.: 230). By the nineteenth century, Agrippa has the standard robes and a floppy conical "Santa Claus" hat in *Struwwelpeter,* a German children's book (Wilson 1975: 69).

Perhaps the earliest instance of a wizard wearing stars is a fanciful portrait of Nostradamus, the quatrain-composing astrologer and seer. Nostradamus lived during the sixteenth century in France, but by the time Collin de Plancy put him into *Dictionnaire Infernal,* in 1863 (Seligmann 1948: 366), Nostradamus had acquired robes, a conical hat with a single five-pointed star, and a tele-

Figure 11.8. The celebrated medieval mage Dr. Faustus adopts the fashion of the day on the title page of the 1631 English chapbook edition of Christopher Marlowe's play The Tragicall Historie of the Life and Death of Doctor Faustus. *There are no suns, moons, and stars on Faustus's robe and hat, but the magical circle in which he conjures the Devil offers the protection of power from zodiac symbols and planetary signs. (From Lehner and Lehner 1971: 31.)*

scope (Figure 11.10). Even though the telescope had not been invented in time for Nostradamus, his alliance with astrology outfitted him in the nineteenth century with astronomical equipment.

Astrology had been practiced by magicians since Greece and Rome, but through the seventeenth century, the astrologer's wardrobe was as ordinary as any wizard's outfit (Schulman 1976: 17; Lyons 1990: 69; Whitfield 2001: 150, 151, 169, 173). As late as 1856, the painting *Hudibras and Ralph Visiting the Astrologer,* by Sir William Fetter Douglas, crowns the astrologer with what looks like a tall red nightcap and cloaks him in a dark robe, but no celestial symbols embellish his apparel (Lyons 1990: 71). In 1695, however, Nicolas de Larmessan included an allegorical depiction of an astrologer in *Customs of the Trades and Professions* (Delmar 2000: 113). The sun, moon, and stars turn his cape into the cosmos.

Figure 11.9. Cornelius Agrippa von Nettesheim, one of the most famous magicians of the sixteenth century, looks scholarly, not theatric, in this image based on the portrait in his book, The Occult Philosophy. *(From Seligmann, 1948: 317, reprinted from Scheible 1846.)*

Planet symbols occupy the tunic's hem. From head to toe, he is ornamented with the zodiac. Aries is on his head. Taurus and Gemini occupy his shoulders. The rest continue down to his feet, where he wears Pisces on his shoes. Unambiguously astronomical, he is walking past the Paris Observatory.

Symbolic celestial clothes also informed the sage shown in "The Hermetic Cosmos," an allegorical illustration of occult knowledge that originally

Figure 11.10. Wizards wearing celestial gear were at last in action in the nineteenth century. This fanciful portrait of Nostradamus, the sixteenth-century French seer, wraps him in familiar wizard robes, caps him with a star-punctuated cone-shaped wizard's hat, and equips him with a telescope, an instrument that did not exist in the middle of the sixteenth century, when Nostradamus was writing his elliptical quatrains. (From Seligmann 1948: 366.)

appeared in *Opus Medico-Chymicum* by J. D. Mylius and was republished in *Musaeum Hermeticum* by Janitor Pansophus in 1749 (Seligmann 1948: 165; Hall 1975: cxlv; Roob 1997: 465). Astrology, alchemy, Christian doctrine, and mystic cosmography are united in a scene that places the master of hermetic mysteries in the center of the mystic landscape. The presence of the sun, moon, stars, and zodiac signs signals the astrological and celestial dimensions of this universe, and the adept's star-studded cloak is bisected to represent day and night. The stars on the robe represent elemental command of all of nature's forces and their interactions.

In *Gulliver's Travels,* published in 1726, Jonathan Swift dressed all of the "better Quality" people on the floating island of Laputa in "Figures of Suns, Moons, and Stars" and satirically emphasized their dedication to astrology. In

1838, J. J. Grandville provided the book with illustrations of Laputans in celestially ornamented outfits that wizards would admire (Swift 1980: 249–264).

The relationship between astrology and magic, established since antiquity, was enhanced in the eighteenth and nineteenth centuries as distinctions between wizards and astrologers softened. As another channel for esoteric wisdom, the sky was regarded as magical territory accessed by the philosopher-magician. Horoscopes were a product of the specialized knowledge the wizard had labored to understand and apply. Astrology, believed to reveal nature's intent, fortified the wizard's reputation with celestial power, cosmic grandeur, and predictive insight. Although Nostradamus is not wearing stars in a portrait published in the eighteenth century, his alliance with the sky is indicated by the celestial globe in his hand and by four stars that frame him. He is accompanied by two skywatchers, one with a telescope and the other with a celestial sphere (Lyons 1990: 63).

In the nineteenth century, fortune-telling almanacs were marketed with images of astrologers wearing the wizard's ensigns: a long, loose robe and a tall conical hat, both elevated with value-adding moons and stars (Delmar 2000: 110; Dedopulos 2001: 98).

Grillot de Givry's 1931 survey of ceremonial magic and occult disciplines, *Witchcraft, Magic and Alchemy,* a rare piece of cultural history, examined the sorcerer's celestial reconfiguration:

> Every one knows the pictures, so widely disseminated among the public, illustrating those pedlars' books which contain debased occultist formulas for popular consumption. They never fail to depict the classic astrologer, in a pointed hat and robe painted with signs of the zodiac, looking at the sky through an enormous telescope. Nothing could be more erroneous or ridiculous. The pointed hat of the physicians and apothecaries of the age of Molière has been gratuitously lent to the astrologers, who never wore it. . . . The astrologer of former times is persistently portrayed on the lines of this stereotyped convention, which ought to have been worn out long ago. In actual fact, the men who exercised this profession, in those ages of unwavering uncertainty when no science had as yet dared to proclaim itself "exact," were regarded as learned men, the equals of other learned men, and they wore the costume proper to them as such, and nothing otherwise to single them out for public notice. (de Givry 1931: 230–231)

De Givry's dispassionate analysis of the astrologer's contrived sartorial transformation was lost on twentieth-century advertisers and entertainers.

Figure 11.11. Astronomically appareled wizards became iconic enough to market oranges on fruit crate labels in the twentieth century. (Collection E. C. Krupp.)

Nuevo Planeta oranges from Spain were promoted on the crate label by a stargazer in wizard's gear, including the pointed hat and starry gown, gazing through a telescope at an orbiting orange (Figure 11.11; Krupp 2003: 79). In the first scene of *A Trip to the Moon,* a fanciful silent film made in 1902 by the early moviemaker Georges Méliès (Méliès 1902), astronomers convene in conical hats and garments spangled in comets, stars, suns, and moons.

Mark Twain introduced the same kind of imagery into *The Mysterious Stranger,* his last story, published in 1916, after his death. The astrologer in the tale wears the sky on his sleeves. According to Twain, he possessed a big book of astrological lore, carried a staff charged with magical power, and wore a "tall, pointed hat and his long flowing robe with stars on it" (Twain 1961: 163). From there it is only a magic carpet ride to 1940, *Fantasia,* and Mickey Mouse.

CONCLUSION

The learned magician's integration of astrological knowledge is as old as antiquity, and during the Renaissance Agrippa and other occult philosophers explained and endorsed the magician's celestial expertise. The wizard, however, did not require an astronomical uniform until popular culture and mass media met in commercial embrace. By the nineteenth century, branding made wizards look for the celestial label. Like products, images are now marketed to consumers, and magic is not only redefined but repackaged for shelf space in the cultural supermarket.

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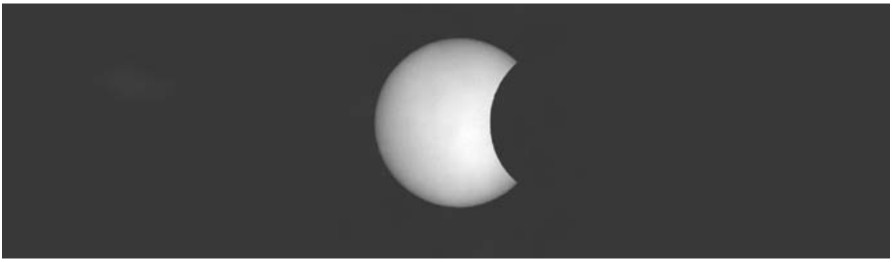

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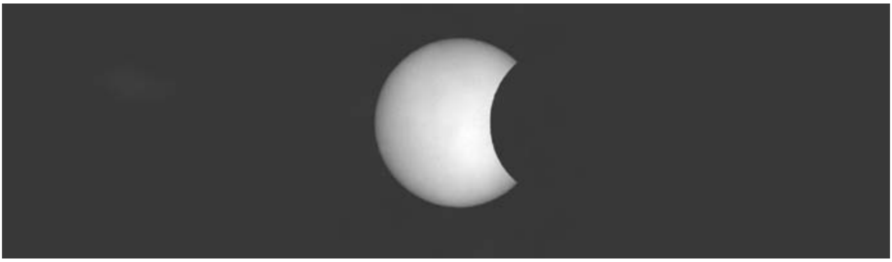

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