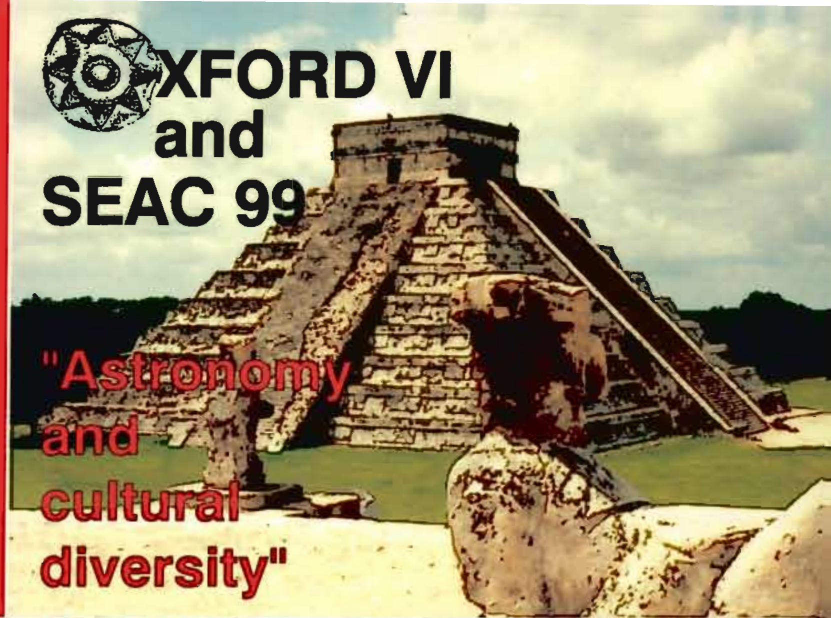
**MUSEO
DE LA
CIENCIA Y
EL COSMOS**

**ORGANISMO
AUTONOMO DE
MUSEOS Y CENTROS**

CABILDO DE TENERIFE

OXFORD VI and SEAC 99



"Astronomy and cultural diversity"

"Astronomía y diversidad cultural"

César Esteban
Juan Antonio Belmonte
Editores

OXFORD VI AND SEAC 99
«Astronomy and cultural diversity»

César Esteban
Juan Antonio Belmonte

Editors / Editores

Proceedings of the International Conference «OXFORD VI & SEAC 99»
held in Museo de la Ciencia y el Cosmos,
La Laguna, June 1999

Memorias del Congreso Internacional «OXFORD VI y SEAC 99»
celebrado en el Museo de la Ciencia y el Cosmos,
La Laguna, Junio de 1999

ISBN:
84-88594-24-0

DEPÓSITO LEGAL:
TF - 1480/2000

MAQUETACIÓN
Miriam Cruz (Museo de la Ciencia y el Cosmos)

PREIMPRESIÓN:
Contacto

IMPRESIÓN:
Producciones Gráficas

DEDICADO A LA MEMORIA DE

DEDICATED TO THE MEMORY OF

CARLOS JASCHEK

INDEX

THE ORIGIN OF CONSTELLATIONS

ETHNOASTRONOMY: THE SKY OF LIVING PEOPLE

FOREWORD

Astronomy and Cultural Diversity

The Sixth Oxford International Conference on Archaeoastronomy and the Seventh Annual Meeting of the *Société Européenne pour l´Astronomie dans la Culture* (SEAC, European Society for Astronomy in Culture) was held jointly in the days around the summer solstice of 1999 at the *Museo de la Ciencia y el Cosmos*, in the historical city of La Laguna, in the Island of Tenerife. One hundred participants from more than 20 countries of the five continents and almost 60 talks indicate undoubtedly the relevance of this meeting.

The Canary Islands are a crossroads of peoples and cultures, with strong fluxes of emigration/immigration. Belonging politically to Europe, their remote cultural roots are of African origin. However, the idiosyncrasy of the people as well as the soft accent of their spoken Spanish, are more linked to the ones of the warm Caribbean Latin American countries. Taken into account their magnificent clear skies and the presence of first-rank international astrophysical observatories on the top of the highest mountains of the archipelago, it is clear that this corner of the world was a good place to talk about "Astronomy and Cultural Diversity".

This proceedings volume gathers the texts of most of the contributed and posters papers presented at the meeting, as well as two invited talks (imparted by Prof. Antonio Tejera Gaspar and Prof. Michael Hoskin). All the papers have been carefully revised and refereed by the Editorial Committee and several external referees. Unfortunately, some of the manuscripts received could not be accepted for publication. The more than forty contributed papers appearing in this volume have been grouped in several broad topics as: archaeoastronomical studies (fieldwork and methodological), astronomy in history and Human thinking, the origin of constellations, calendrical studies, and ethnoastronomy.

The deeply interdisciplinary character of archaeoastronomy and cultural astronomy is reflected in the varied professional profiles of the authors: astronomers, historians, anthropologists, archaeologists, historians of science... Not many scientific disciplines can be enriched with so diverse points of view.

This proceedings book is complemented with volume 15 of *Archaeoastronomy. The Journal of Astronomy in Culture*. That volume contains the texts of most of the invited review talks given in the meeting. The general character of the articles included in that volume makes it very suitable for a wide readership.

The meeting was dedicated to the memory of Prof. Carlos Jaschek, who passed away in April 1999, only a few months before the celebration of the conference that he was also organizing as Senior Chairman of the Organizing Committee. Carlos Jaschek was Emeritus Professor of the University of Strasbourg (France) and a relevant and well-known astrophysicist, dedicated mainly to stellar physics and the taxonomy of stellar spectra. He was the founder of the European Society for Astronomy in Culture (SEAC). During the final years of retirement in Salamanca (Spain), he was still very active organizing biannual national meetings on "*Astronomía en la cultura*". An emotive article by Arnold Le Boeuf about him, his life, and his contributions to our discipline is included at the beginning of this volume.

Finally, the editors wish to express their gratitude to the many institutions and people who made this meeting possible and enjoyable, most notably the *Museo de La Ciencia y el Cosmos*, *Instituto de Astrofísica de Canarias*, and *Universidad de La Laguna*. We want to thank specially to our efficient secretaries: Mª José Alemán and Monica Murphy, to Rosa Schlueter for the excellent arranging of the two-day excursion to Gran Canaria, to María Antonia Perera for her work with the *Cabildo de Lanzarote* and the course "*Astronomía y Cultura*", which was a natural continuation of the activities related to the meeting in that island, to Miriam Cruz for her careful work with the modeling and design of this volume and the meeting poster, to Oswaldo González and María del Rosario Pérez de Taoro for their work as local organizers and with the web page, and finally, to the rest of the personnel of the *Museo de La Ciencia y del Cosmos*. All together formed a real "Dream Team".

La Laguna, vernal equinox, 2000

César Esteban and Juan Antonio Belmonte

Editors

SCIENTIFIC ORGANIZING COMMITTEE

Stephen L. N. McCluskey (USA)
Clive L. N. Ruggles (UK)
Juan A. Belmonte (Spain)
Johanna Broda (Mexico)
John B. Carlson (USA)
César Esteban (Spain)
Jesús Galindo Trejo (Mexico)
Alexander Gurshtein (USA/Russia)
Stanislaw Ivaniszewski (Poland)
William Breen Murray (Mexico)
Raymond E. White (USA)
Mariusz Ziolkowski (Poland)

LOCAL ORGANIZING COMMITTEE

Juan A. Belmonte (Chairman, IAC and Museo de la Ciencia y el Cosmos)
César Esteban (Scientific Secretary, IAC and Universidad de La Laguna)
Antonio Tejera Gaspar (Universidad de la Laguna)
José J. Jiménez González (Museo de la Naturaleza y el Hombre, Tenerife)
María A. Perera Betancort (Cabildo de Lanzarote)
Rosa Schlueter Caballero (UNED, Las Palmas de Gran Canaria)
Oswaldo González Sánchez (Museo de la Ciencia y el Cosmos)
María del Rosario Pérez de Taoro (Museo de la Ciencia y el Cosmos)
María José Alemán (Secretary, Museo de la Ciencia y el Cosmos)
Mónica Murphy (Secretary, IAC)

PREFACIO

Astronomía y Diversidad Cultural

La Sexta Conferencia Internacional Oxford sobre Arqueoastronomía y la Séptima Reunión Anual de la Sociedad Europea para la Astronomía en la Cultura (SEAC) se celebraron conjuntamente, en los días cercanos al solsticio de verano de 1999, en el Museo de la Ciencia y el Cosmos de la histórica ciudad de La Laguna, en la isla de Tenerife. La asistencia de un centenar de participantes y la presentación de unas 60 charlas indican la importancia indudable del evento.

Las Islas Canarias son una encrucijada de gentes y culturas sometida a fuertes flujos de emigración/inmigración. Aunque pertenecen políticamente a Europa, sus raíces remotas se hunden en la cercana África. Sin embargo, la idiosincrasia, así como el suave y dulce acento del hablar de sus gentes, es más cercana a la de los países caribeños de América Latina. Teniendo en cuenta, además, la magnífica calidad de sus cielos y la presencia de observatorios internacionales de primer orden en las cumbres de sus montañas, creemos justificado el haber elegido nuestro archipiélago como un lugar ideal para hablar sobre "astronomía y diversidad cultural".

Este libro de memorias recoge la mayor parte de las contribuciones orales y murales presentadas en la reunión, así como dos de las charlas invitadas (impartidas por los profesores Antonio Tejera Gaspar y Michael Hoskin). Todos los textos han sido revisados y arbitrados cuidadosamente por el Comité Editorial y varios árbitros externos. Desgraciadamente, varios de los manuscritos recibidos por el Comité Editorial no pudieron ser aceptados para su publicación. Los más de cuarenta artículos que aparecen en este volumen han sido agrupados en varios bloques temáticos: estudios arqueoastronómicos (de campo y metodológicos), astronomía en la historia y el pensamiento humano, el origen de las constelaciones, estudios sobre el calendario y etnoastronomía.

El carácter profundamente multidisciplinar de la arqueoastronomía y de la astronomía cultural se refleja en la muy diversa procedencia profesional de los autores, tenemos astrónomos, historiadores, antropólogos, arqueólogos, historiadores de la ciencia... No muchas disciplinas científicas pueden enriquecerse de tal pluralidad de puntos de vista.

Este libro de memorias se complementa con el volumen nº 15 de la revista *Archaeoastronomy. The Journal of Astronomy in Culture*. Dicho volumen recoge los textos de la mayor parte de las charlas de revisión invitadas que se impartieron en la reunión. El carácter marcadamente general de los textos que se presentan hace que dicho volumen sea muy indicado para un público amplio.

La reunión estuvo dedicada a la memoria del profesor Carlos Jaschek, que falleció en Abril de 1999, solo unos meses antes de la celebración del congreso que también estaba organizando como Presidente Honorario del Comité Organizador. Carlos Jaschek fue profesor emérito de la Universidad de Estrasburgo (Francia) y un astrofísico muy relevante y conocido, dedicado principalmente a la física estelar y a la clasificación de los espectros estelares. Fue el fundador de la Sociedad Europea para la Astronomía en la Cultura (SEAC). Durante sus últimos años, ya retirado en Salamanca, fue todavía muy activo organizando reuniones semestrales sobre "*Astronomía en la cultura*" en la universidad de aquella ciudad. Arnold Le Beuf, al comienzo de este libro, nos brinda un emotivo artículo sobre la vida de Carlos Jaschek y su imborrable contribución a nuestra disciplina.

Finalmente, los editores desean expresar su gratitud a las distintas instituciones y personas que hicieron posible la celebración de esta reunión, principalmente al Museo de La Ciencia y el Cosmos, al Instituto de Astrofísica de Canarias, y a la Universidad de La Laguna. Queremos agradecer especialmente a nuestras eficientes secretarias: Mª José Alemán y Monica Murphy, a Rosa Schlueter por la excelente preparación y ejecución del viaje de dos días a Gran Canaria, a María Antonia Perera por su trabajo en el Cabildo de Lanzarote y en la preparación del curso "Astronomía y Cultura", que fue una continuación natural de las actividades asociadas a la reunión que se celebraron en dicha isla, a Miriam Cruz por su cuidadoso y magnífico diseño y maquetación del presente volumen así como el cartel del congreso, a Oswaldo González y María del Rosario Pérez de Taoro por su trabajo en el comité local y con la página *web* del congreso, y finalmente, al resto del personal del Museo de La Ciencia y el Cosmos. Todos ellos juntos formaron un auténtico "*Dream Team*".

La Laguna, equinoccio de primavera, 2000

César Esteban y Juan Antonio Belmonte

Editores

COMITÉ CIENTÍFICO ORGANIZADOR

Stephen C. McCluskey (EEUU)
Clive L. N. Ruggles (Reino Unido)
Juan A. Belmonte (España)
Johanna Broda (México)
John B. Carlson (EEUU)
César Esteban (España)
Jesús Galindo Trejo (México)
Alexander Gurshtein (EEUU/Rusia)
Stanislaw Ivaniszewski (Polonia)
William Breen Murray (México)
Raymond E. White (EEUU)
Mariusz Ziolkowski (Polonia)

COMITÉ LOCAL ORGANIZADOR

Juan A. Belmonte (Presidente, IAC y Museo de la Ciencia y el Cosmos)
César Esteban (Secretario Científico, IAC y Universidad de La Laguna)
Antonio Tejera Gaspar (Universidad de la Laguna)
José J. Jiménez González (Museo de la Naturaleza y el Hombre, Tenerife)
María A. Perera Betancort (Cabildo de Lanzarote)
Rosa Schlueter Caballero (UNED, Las Palmas de Gran Canaria)
Oswaldo González Sánchez (Museo de la Ciencia y el Cosmos)
María del Rosario Pérez de Taoro (Museo de la Ciencia y el Cosmos)
María José Alemán (Secretaria, Museo de la Ciencia y el Cosmos)
Mónica Murphy (Secretaria, IAC)

CARLOS JASCHEK, IN MEMORIAM

Arnold Le Beuf
Institut d' Histoire des Religions
Université Jagiellone de Cracovie, Poland

Professor Carlos Jaschek is not here with us, Carlos Jaschek is gone. He died last April, on the twelfth. I am not especially fond of necrologies, but simply, when I received from Juan the news that Carlos had deceased, I replied that Professor Jaschek had always been dear to me, and if Juan found it suitable, I would carry the charge of telling a few words in his memory for the opening of the conference. Juan replied that Eulalia Perez, Carlos' good friend and collaborator, was preparing a biography of him to be read at this meeting. Of course, I agreed that a closer relative was better indicated to recall him. But a week ago or so, Juan mailed me that Eulalia could not come, kept home by family duties. Would I replace her for this sad but honourable presentation? -How could I refuse? But then I had no time left to contact the family and colleagues and build an exact and proper biography and bibliography of his long career as an astronomer. The details of his achievements will be published later in the volume of the present meeting, I hope.

I have fortunately very little acquaintance with death, funerals and official necrologies. I remember, when I was a kid, that my old aunt died, she had been thunderstruck sitting in her armchair near the chimney place and was, as all the rest of the room, furniture and floor, covered with a thick smooth velvetlike coat of black soot, the only colours in the picture were her pale blue eyes surrounded by red eyelids.

Then, the good old shepherd in the Pyrenees whom everybody, almost, treated somewhat despisefuly, because he used to grow flowers in his garden, the territory of women. He was a sort of a poet, the only scholar in the valley and never went to the mountains with his dog to look over sheep or cows without a book in the pocket. When he lost strength and started to decline, he called me once in his garden and said: «I shall not last long now, the doctor offends me saying that everything is all right. I know I am now good for nothing , and soon will be gone». He died.

And then, this telegram I received that my sister had been crushed in her car at a crossroad by a huge truck. She was a beautiful young lady and died on the spot together with her daughter, a beauty as well, a beauty of twenty years. I was frozen and fell nothing, I was so far away, it was so unreal, impossible. When I came back to France, I went with flowers on her grave and saw heaps of flowers and stones, but could never believe they were laying under them, and still cannot.

Crossroads between people and crosses on graves between worlds.

And now Carlos Jaschek at that crossroad. It would be an abuse to say that he was my good friend, simply he was always very friendly to me, but this was not, I guess, a special distinction, I never knew him to treat anyone unfriendly. Carlos Jaschek was a good man, a very good man, and a wise one.

I met him for the first time when he invited me to the Strasbourg Observatory for the fourth conference «Astronomie et Sciences Humaines». In 1985, he had planned with Paul Erny, director of the Institute of Ethnology at Strasbourg University, to organize at the observatory, twice a year, a meeting that would gather together researchers at the crossroad of astronomy and human sciences, at the crossroad between many disciplines.

The first of these meetings was held on the twenty fourth of October 1986. Carlos was then the Director of the Observatory. In the following years, this meeting took place regularly in May and November. Professor Carlos Jaschek, first of all an astronomer and the creator of the informatic center for stellar data, a laboratory unique in the world, has in fact written little in the field of astronomy in human sciences, but because he was a man of great generosity, curious of everything, gifted with an exceptionally broad mind and a philosophically tolerant attitude, he created the conditions of expression, exchange of views and publications for our somewhat strange field of interests. Carlos Jaschek would not reject new or weird ideas, he knew well that a new science still in its infancy should be allowed freedom of movement and first of all, freedom of speech, even if sometimes at the expense of amazement.

The publication «Astronomie et Science Humaines» counts thirteen numbers and eighty five papers, many of them, of great interest. The full collection is already an historical document of our discipline.

I participated to most of these meetings in Strasbourg, I was a poor student and Carlos Jaschek always reserved for me the tiny small room under the big dome with the telescope. He gave me a set of keys for the entrance fence, the dome, the room and the library, and sometimes I lived there for a couple of weeks. The park of the observatory at Strasbourg is a romantic place with its old nineteenth century buildings, large and small under domes like Greek or Latin temples. Temples and observatories are turned towards the sky, towards heaven are facing priests and astronomers, and Carlos was like the Good Lord of that garden of peace and delights. He really looked like the portrait of the Good Father, a tall man with a peaceful and charming smile and a grey beard on a beautiful face. In the autumn, when the wind was pushing leaves across the alleys, yellow and red, and rain was dripping from the venerable trees, I sat for days in the archives and library of old books on the second floor, picking systematically in a row, ancient volumes, covered in leather and stamped with gold. Old books that had been sleeping for ages, protected under their heavy coat of grey dust. And I knew that Carlos was sitting just under, at his desk on the ground floor, working, and I fell good.

I am also indebted to Carlos Jashek for the success of my PHD. He had been interested in my researches in Saint Lizier, read carefully my thesis and accepted to come to Paris as «the Astronomer» at the jury, otherwise consisting of cultural anthropologists. I was very glad he came.

Now, it was in 1990 or 1991, I do not know exactly, but what I clearly remember is how once, as we were chatting in his office, he became very serious and said: «You know, I shall soon take retirement, who knows what will become of our meetings in the future. I would like to create a society that would last after me, because men pass, but institutions last». He was a wise man and fell he was becoming old, and I guess he already knew his heart was not so strong anymore, which is often the case for tender ones. In 1992, he gathered at Strasbourg all his friends and colleagues, and presented them his plan for the creation of the «Société pour l'Astronomie dans la Culture». The principle was then accepted and it was realized the following year in Smolyan. Since then, the meetings of the SEAC were held every year.

1992 - Strasbourg -SEAC number 0

1993 - Smolyan - SEAC 1

1994 - Bochum - SEAC 2

1995 - Sibiu - SEAC 3

1996 - Salamanca - SEAC 4

1997 - Gdansk - SEAC 5

1998 - Dublin - SEAC 6, and now

1999 - La Laguna - SEAC 7

In the meantime, Carlos Jaschek retired from his work at the Observatory, and could have enjoyed good old age to travel here and there, where he was invited by his numerous friends. When we organized the conference for the 500 years anniversary of the travel of Columbus through the Atlantic, we very much wanted to have him with us, and we knew he was also eager to visit Poland, the country of his ancestors (a province which was then part of Germany), but his wife, Mercedes, also an astronomer, his life companion and collaborator, had fallen badly ill and he was lovingly taking care of her untill the end, he could hardly leave her but a few steps. He had then returned to Spain, Salamanca, near to his children. I saw him last at the beautiful fourth SEAC conference he personally organized at Salamanca in 1996 and keep in memory his peaceful and generous smile, and his specific way of speaking French, with a touch of Spanish accent, soft and mild.

When in 1997, we organized the already fifth SEAC meeting in Gdansk, we again insisted that he came, but then his heart had become very weak and he feared long travels, so he carefully resigned to come, to our great discontent.

I was so happy I would meet him again here, now, but he is missing, and missing very much, he is dead. There is one bad thing and one good thing in the death of good people. The bad one is that if we can still speak of them or speak to them, we cannot anymore talk with them, they are dramatically absent minded. The good thing is that when good men went their way, leaving only good deeds behind, we feel rather sad and lonely than hurt. They lived in peace, went in peace, left us and the world in peace. We are longing to meet them again ... only a question of time.

Carlos Jaschek was a good man, and all I can propose is a second or two of silence to bid him farewell.

.... Thank you, and now, long live the «Societe pour l'Astronomie dans la Culture» in the memory of Professor Carlos Jaschek.

INTRODUCCIÓN A LA MITOLOGÍA DE LOS CANARIOS PREHISPÁNICOS

Antonio Tejera Gaspar
University of La Laguna,
Canary Islands, Spain

La mitología de los antiguos canarios, que conformó su historia y su cultura, fue rememorada de generación en generación por tradición oral, perviviendo hasta el estadio final de su identidad como pueblo, fijada para la posteridad desde hace unos quinientos años por los testimonios escritos de los primeros cronistas e historiadores de los siglos XV y XVI.

Las similitudes de las mitologías canarias con las de otras culturas pueden ser comparadas, sin ir más lejos, con las sociedades prerromanas del Norte de África que participaron de un ambiente cultural común, así como con las poblaciones mediterráneas del Próximo Oriente.

1. EL MITO Y LA TRADICIÓN ORAL

En las sociedades antiguas los mitos tenían por finalidad guardar su memoria y la historia colectiva, que mediante la tradición oral, transmitían a las generaciones futuras, conformando así su identidad y su cohesión, como asimismo sucedió entre las comunidades canarias.

Los mitos son el mecanismo para explicar las manifestaciones de su realidad social y cultural, ya fuera su concepción del mundo y los fenómenos catastróficos producidos en la naturaleza, de los que desconocían sus causas, así como para todo lo relativo a su organización sociopolítica, o para los hechos más singulares de su cultura. Todas estas circunstancias hacen de los mitos un medio esencial para entender su pensamiento, ligado en la mayoría de las ocasiones al mundo religioso, en el que se vertebra la estructura social y política, siendo este el modo por el que conocieron el mundo que les rodeaba, y mediante el cual justificaron también su orden social e ideológico.

La transmisión y conservación de los mitos debía contar con personas especializadas, a quienes se les encomendaba esta importante función, probablemente por ser poseedoras de dotes de magia y adivinación y por considerarlas rodeadas de un hálito sagrado. En cada isla, unas veces los hombres, y en otras las mujeres, cumplieron la misión excepcional de guardar su memoria, atesorada a través de los siglos. «*También auía algunos dotores entre ellos que dificultaban cómo Dios hauía hecho el mundo y los sielos y los onbres cómo auía de naser y parirlo una mujer*» (Ovetense, F. Morales Padrón, 1978:168).

2. LOS MITOS COSMOGÓNICOS

Sobre la cosmogonía de las poblaciones canarias sólo nos han quedado retazos de una información, de muy difícil interpretación en la mayoría de las ocasiones, e irregularmente distribuida según las islas. Contamos con datos muy parciales de los que sus recopiladores sólo enfatizaron algunos aspectos excepcionales, pero sin entender probablemente el contenido de lo transmitido. Estas y otras circunstancias plantean problemas de comprensión sobre la verdadera dimensión que de tales hechos poseyeron, y sobre los que se explicaron el mundo que les rodeaba.

De las fuentes etnohistóricas hemos inferido el principio cosmogónico sobre sus Seres Superiores, asimilado a un Dios único e invisible, de manera que las diversas referencias al Cielo, Sol, Luna, estrellas, son transmitidas como equivalentes a los conceptos cristianos propios de la cultura europea de los siglos XIV al XVI, probablemente porque se les asocia a estos Seres Superiores un carácter demiúrgico similar al Dios cristiano.

Los términos de *Achaman* atribuido a la cosmovisión de los *guanches* de Tenerife, *Acoran* entre los *canarios* de Gran Canaria, el *Abora* de los *auaritas* de La Palma, el *Orahan* de La Gomera, o los teónimos de los *bimbaches* de El Hierro, *Eraoranzan* o *Moneiba*, nos parece que deben estar aludiendo a diferentes conceptos antropomorfizados de divinidades, de seguro asociadas con fenómenos astrales, que de seguro no concuerdan con los que las antiguas poblaciones canarias nominaron a quienes consideraron sus Seres Superiores o Seres Supremos.

3. LAS MONTAÑAS SAGRADAS, CENTRO DEL MUNDO

Una de las discusiones más interesantes sobre las manifestaciones cultuales de los aborígenes canarios, es la de determinar si en su mitología existió la creencia en el *Axis Mundi*, como parte integrante de su cosmogonía. El P. Espinosa al hacer referencia al «*Dios*» de los *guanches* y a la concepción que de él poseían, dice que conocían «*haber un hacedor y **sustentador del mundo** (que llamaban, como dicho tengo, Achguayaxerax, Achoron, Achaman, **sustentador de cielo y tierra***» (A. Espinosa, (1980):34-35). La primera cuestión que plantea el texto es dilucidar si se trata de una apelación más, atribuida a los Seres Superiores de los *guanches*, o si se refiere, por el contrario, a la concepción cosmogónica del *Axis Mundi*; a la creencia frecuente en múltiples culturas, de que el cielo se halla sostenido por un pilar que se representa en un punto del espacio, como soporte a las dos realidades físicas -el cielo y la tierra- y, por extensión a los dos mundos: el inferior y el superior, lugares en donde se hallan los espíritus benefactores y los seres malignos. Es el concepto ancestral de la separación del cielo y la tierra, que en los tiempos lejanos del origen del mundo se habían concebido unidos.

La concepción del *Axis Mundi* entre las poblaciones de Canarias, fue recogida por el gran historiador de las religiones Mircea Eliade, sin especificar a cuál de ellas se refiere: «*La misma imagen cosmológica reaparece en Roma (Horacio, Odas, III, 3), en la India antigua con el Skambha, Pilar cósmico (Rig Veda, I). Y también entre **los habitantes de las Islas Canarias***» (M. Eliade, 1979:36). En La Palma, el Roque de *Idafe* puede interpretarse como lugar sagrado en sí mismo, pero creo que también con este valor, según se desprende de la cosmogonía de los *auaritas*, entre quienes pervivió la tradición y fue transmitida por Abreu Galindo de los sacrificios de animales que se hacían en su base con la finalidad de que aquél roque no se cayese.

Es probable que la sacralización de las montañas más elevadas y singulares de cada isla pudiera ser explicada, entre otras causas, por este concepto. En las culturas canarias, en efecto, éstas lo fueron, según se confirma no sólo por las fuentes etnohistóricas, sino también por la arqueología, ya que los testimonios sobre estos lugares son relativamente numerosos. En la cima de la Montaña de *Tindaya*, en Fuerteventura, existe un importante conjunto de grabados rupestres con representación de pies humanos, podomorfos, semejantes a otros encontrados en distintos yacimientos de las islas.

En Tenerife, el *Teide* debió desempeñar este papel en la cosmogonía de los *guanches*, por tratarse del lugar más elevado de la orografía de la isla. A mi juicio, lo certifica el hecho de que en Las Cañadas, en el entorno de este volcán del *Teide*, se localicen numerosos hallazgos en escondrijos, lugares en donde se ocultan cerámicas, molinos y otros objetos, que poseen una significación mágico-protectora, como rogativa de un beneficio o para contrarrestar algún fenómeno maligno, como se documenta en muchas culturas mediterráneas; el que en este ámbito se encuentren muchas cuevas funerarias, además de otras cuestiones que se desprenden del análisis lingüístico, de los términos *Teide*, *Echeide*, como «*ser malo*», «*ser fatídico*», así como el de considerarlo como lugar en donde van los espíritus de los seres malvados. Son todos argumentos que evidencian alguna asociación de este carácter con la montaña y su entorno, y todo ello creemos que permite plantear estas cuestiones, aunque sólo sea por vía de hipótesis.

Otro aspecto de la discusión se centraría en el valor del Teide en la cosmogonía de las otras islas. El hecho de que un buen número de yacimientos arqueológicos, que no poseen una funcionalidad determinada en muchos lugares de las islas, desde donde el Teide es observado en toda su plenitud, se hallen orientados hacia él, permite pensar que esta montaña, que se manifiesta aún más majestuosa contemplada desde la distancia, emergiendo y elevándose sobre el mar, contribuiría a que se concibiera desde esta perspectiva, ya que quienes la observaban desde la distancia, podrían contemplarla, como si realmente estuviera uniendo los dos mundos, como «sustentador del cielo y tierra».

Al parecer fueron los *auaritas*, los primitivos habitantes de la isla de La Palma, quienes, según el testimonio de A. Espinosa, quienes dieron el nombre de Tenerife a esta isla, al decir que esta denominación concuerda «*con (la que) los palmeses le pusieron, que es Tenerife, porque según estoy informado Tener quiere decir nieve, y Fe monte, así Tenerife dirá monte nevado*» (A. Espinosa, 1980:26). El análisis lingüístico del berberólogo G. Marcy, confirma en parte, a través del bereber, el valor que este autor le había atribuido al término *Tener-Ife*, traduciéndolo por «*el campo de nieve* o *de la cumbre*» o «*él es luminoso, él brilla*» (G. Marcy, 1962). Por su parte, V. Grau Bassas creía que el *Teide*, que los *canarios* veían a distancia, pudo haber sido considerado por ellos como su montaña sagrada. A su juicio, los juramentos con la fórmula de «*Atis Tirma*» se refieren al *Teide*. Muchas zonas de Gran Canaria en efecto son un observatorio privilegiado para la contemplación de esta montaña de 3.715m de altitud. A pesar de que falta un estudio de conjunto sobre estos aspectos, existen una serie de evidencias arqueológicas muy significativas, ya que muchos yacimientos caracterizados por amontonamientos de piedras, a los que se les atribuye alguna finalidad asociada con manifestaciones religiosas, se encuentran, como es el caso del yacimiento de «*Castillete de Tabaibales*» en Mogán, claramente orientados en esta dirección desde donde éste puede ser bien contemplado.

4. MITOS DENDROLÁTRICOS

Los cultos dendrolátricos se hallan documentados en la isla de El Hierro, aunque en otras como Gran Canaria, Tenerife y La Gomera existen evidencias también, aunque bien es cierto que poco definidas, pero que pudieran ser interpretadas en este sentido, sin que en ningún caso contemos con una referencia precisa para asociarlas a un mito determinado. Faltan por estudiar otros aspectos de la tradición, bien arraigadas en la religiosidad popular, sobre la sacralización de algunos árboles, sin que alcancemos a comprender si pudieran explicarse como un nexo con estos fenómenos ancestrales de las culturas prehispánicas.

Seguramente de todos los árboles que debieron ser objeto de culto, el Garoe, árbol sagrado de los *bimbaches* de El Hierro, fue, sin duda, el que mejor define este fenómeno que sería común en la etapa preeuropea de las comunidades insulares. Este árbol, desaparecido en el siglo XVII (1604), es un til, propio de las Canarias y Madeira, perteneciente a la familia de las lauráceas, conocido por los botánicos con los nombres de *Ocotea foetens Benth et H.*, o bien *Oreodphne foetens Nees*. Se caracterizaba por su capacidad para condensar la lluvia, hecho conocido con el nombre de «*lluvia horizontal*». El agua concentrada en las nubes, que son arrastradas por los vientos alisios situados en zonas elevadas, a una altitud superior a los 600 metros, van destilando poco a poco el agua en forma de pequeñas gotas al entrar en contacto con la masa forestal. En el entorno del árbol existen -y así debió ser también en la antigüedad- una serie de recipientes excavados en las faldas de la montaña, que contienen agua.

Un fenómeno similar se documenta en Teror, en la isla de Gran Canaria, lugar en el que la tradición sitúa la aparición de la «*Virgen del Pino*». La existencia de dragos en el mismo entorno de este pino, permite plantear, ya sea sólo como hipótesis, el valor que este árbol poseería también entre los *guanches* de Tenerife. Hay en la obra del fraile dominico Alonso de Espinosa, una información de difícil interpretación en la que se alude a Icod, lugar en donde se ha conservado uno de los especímenes más singulares de una vegetación relicta, que antaño conformaban el bosque termófilo de esta isla: «*los naturales guanches viejos dicen que tienen noticia de inmemorable tiempo, que vinieron a esta isla sesenta personas, mas no saben de dónde y se juntaron y hicieron su habitación junto a Icod, que es un lugar de esta isla, y el lugar de su morada llamaban en su lengua* ***Alzanxiquian Abcanahac Xerac****, que quiere decir: «lugar del Ayuntamiento del hijo del grande*» (A. Espinosa, 1980:33). Este texto puede referirse al territorio sagrado del antecesor del linaje de los *menceyes*, los jefes de las distintas demarcaciones territoriales de la isla, o de los pertenecientes a la banda del Norte, que él ubica de forma imprecisa «*en un lugar de Icod*». Si bien es cierto que no existe argumento alguno para establecer una relación entre drago y lugar sagrado, no descarto en ningún caso esta posibilidad, ya que, como he dicho, el área en la que se conserva el denominado popularmeante «*drago milenario*», fue en otra época una zona en la que estos ejemplares eran bien abundantes. Para reforzar esta idea, quisiera proponer como complemento, el hecho de que desde el lugar en el que está ubicada la ciudad de «*Icod de los Vinos*», existe una extraordinaria perspectiva del *Teide*, por lo que cabría valorar estos dos aspectos como una simbiosis en la que ambos lugares desempeñarían algún papel relevante en la mitología de esta gente.

El culto a los árboles aparece con frecuencia formando parte de las mitologías de muchas culturas de la antigüedad, como entre los pueblos prerromanos del Norte de África, con los que nuestras culturas están vinculadas desde su origen, por lo que fue un fenómeno bien conocido en todas las culturas canarias y ha pervivido asimismo en las tradiciones beréberes norteafricanas.

5. MITO Y POLÍTICA

5.1. Los mitos fundacionales o del origen

En Tenerife, Gran Canaria y La Gomera se conservaron *mitos de origen* de los que se infieren aspectos de la historia política de *guanches*, *canarios* y *gomeros*. En Tenerife se explicaba la existencia de los nueve *menceyatos*, como resultado de una división progresiva de la isla entre los descendientes de un *Mencey* muy antiguo, el primer antecesor de los linajes que se localizaba en Adeje, de quienes todos habían heredado cada uno de los territorios en los que ejercían su control político. En estos mitos se recogen cuestiones sobre la génesis de los linajes que ejercían el poder en su demarcación, así como la manera en que concibieron esta realidad histórica que, aunque relatada de forma sincrónica, ha de entenderse como resultado de un proceso que se fué fijando en la memoria colectiva hasta fundir unos hechos, acaecidos en un tiempo indeterminado, que transformados con posterioridad en un «*tiempo mítico*», pasarían a formar parte de su identidad cultural.

«*Muchos años estuvo esta isla y gente della sujeta a un solo rey, que era el de Adeje, cuyo nombre se perdió de la memoria, y como llegase a la vejez, a quien todo se le atreve, cada cual de sus hijos, que eran nueve, se levantó con un pedazo de tierra. El mayor de los cuales, como lo era en edad, lo fue en discreción, fuerza y ánimo; llamábanlo Betzenuhya o Quebehi por excelencia. Este tiranizó y señoreó el reino de Taoro, que ahora llaman Orotava, cuyo término fue desde Centejo hasta la Rambla, aguas vertientes a la mar. Tras del y a imitación suya los demás infantes, tomaron y levantaron con sus pedazos, llamándose Mencey que es rey. Acaymo se llamó e intituló mencey de Güimar; de Abona Atguaxoña; y Atbitocazpe, de Adeje. Los demás reyes, cuyos nombres se ignoran, reinaron en Anaga, en Tegueste, en Tacoronte, en Icod y en Daute, pero sobre todos, y a quien todos conocían superioridad, era el rey de Taoro, que tenía seis mil hombres de pelea, según los naturales afirman*» (A. Espinosa, 1980:40-41).

Y en cuanto al orden social conocemos uno entre los guanches en el que se alude a su sistema social, reflejado en la mitología que formó parte de la historia de los antecesores de su Comunidad. «*Tenían los de esta isla que Dios (...) había criado tantos hombres como mujeres, y les había dado ganado y todo lo que habían menester, y que, después de criados, le pareció que eran pocos, y que crió más hombres y mujeres, y que no les quiso dar ganado; y que, pidiéndoselo, respondió que sirviesen a esotros, y que ellos les darían de comer; y de allí dicen que descienden los villanos, que llaman* ***Achicaxna****, que son los que sirven*» (Abreu Galindo, 1977 :297). El orden establecido no se podía transformar, al haber sido dispuesto por Dios que, como hacedor de todas las cosas, se encargaba de establecer y regular. Y quien había dispuesto con todo detalle lo que la Sociedad ha de menester para su funcionamiento.

Para los *guanches*, el ganado desempeña un papel principalísimo en su economía, del que dependen no sólo su supervivencia física, como seres individuales o como grupo humano, sino también por ser el nexo vertebrador del entramado social y del mundo religioso. La jerarquización reflejada en este mito sociogónico, viene determinada por la posesión o no de ganado, y por su mayor o menor riqueza, fundamento que explica las distintas categorías de Nobles o de gentes del común que forman parte del cuerpo social. Los poseedores de ganado se hallan en la cúspide de una sociedad jerarquizada controlada por normas que, transformadas en tabúes, protegen a sus miembros más destacados.

6. MITO, TRADICIÓN E HISTORIA

Como hemos visto, el mito es la forma mediante la que las comunidades antiguas transmitieron los relatos que al cabo del tiempo fueron conformando los referentes de su historia colectiva. Como es bien sabido, las formas de estas narraciones no responden en ningún caso al modelo en que nos ha sido transmitida la historia occidental, según la conocemos desde la historiografía clásica grecorromana.

Analizaré a continuación algunas de estas cuestiones en las que se recogen tradiciones de los *gomeros* y de los *guanches*. En primer lugar incluyo una vaga referencia de la crónica *Le Canarien* sobre los habitantes de La Gomera en la etapa preeuropea, mediante la que contaban y recordaban una tradición referida a la llegada de sus antepasados a esta isla. Este testimonio fue recogido por los monjes P. Bontier y J. Le Verrier en la citada crónica franconormanda de la primera Conquista de Canarias, cuando visitaron La Gomera en una fecha que tradicionalmente es fijada en torno a los años 1404-1405. La información se presenta de la siguiente manera: «*...cuentan que un gran príncipe, por algún crimen,* ***los hizo poner allí y les mandó cortar la lengua***» (Le Canarien, A. Cioranescu, 1980:62).

Este relato en el que recordaron y revivieron la llegada a la isla de sus antepasados, podría formar parte de los denominados «*mitos fundacionales o del origen*», al tratarse de una tradición que se transformó en un referente común, celosamente guardado en la memoria de todos los *gomeros*. Al mismo tiempo, como discutiremos más adelante, este recuerdo singular en torno a su origen plantea una duda inquietante sobre cómo este acontecimiento pudo preservarse vivo en su tradición durante tanto tiempo, ya que de haber sucedido de la manera en que fue recogido por los monjes-cronistas, despejaría los muchos interrogantes que aún poseemos sobre cómo se produjo el poblamiento del Archipiélago, o al menos el de esta isla.

Mucho se ha discutido sobre el tiempo que ha de pasar para que un acontecimiento se transforme en un referente colectivo. Se considera frecuentemente que en unas pocas generaciones su recuerdo ha desaparecido ya de la memoria de las gentes, a no ser que se trate de un evento muy singular, y cuyo impacto resultara traumático para quienes lo vivieron.

Cuando los europeos entraron en contacto con las poblaciones de las islas, mediado el siglo XIV, les llamó la atención su desconocimiento de la navegación «*carecen de embarcaciones para trasladarse de una isla a otra, a menos que atraviesen a nado la distancia que las separa*» (B. Bonnet, 1943:118). Resulta difícil imaginar a unos insulares carentes de esos conocimientos, ya que en la antigüedad no existió ningún otro medio para alcanzar las islas. Para explicar su ausencia se han propuesto diversas hipótesis que van desde quienes piensan en la pérdida u olvido de esta técnica, hasta los que consideran que estas comunidades africanas fueron traídas a las islas por pueblos marineros del Mediterráneo, ya fueran los púnicos primero, y con posterioridad los romanos. Como para otras explicaciones, estos supuestos aparecen ya en los primeros historiadores. Se trataría, según ellos, de que hubieran arribado aquí después de ser abandonados a su suerte en el mar, a raíz de un castigo infringido a las etnias bereberes rebeldes que se enfrentaron en el continente al poderío de Roma.

En lo que se refiere a la primera propuesta, la de una llegada con medios de navegación propios, conviene hacer algunas consideraciones al respecto. Algunas islas se hallan en efecto cercanas al continente africano, como Fuerteventura o Lanzarote. Otras como esta de La Gomera se alejan de la costa unos 400 kms, si el cálculo se hace contando en línea recta desde el punto más cercano de África; esta separación, sin embargo, debió ser mayor aún, si como parece, algunas de estas gentes procederían de zonas situadas más al Norte, y bastante más alejadas de lo que las islas orientales lo están de la vecina costa desértica africana. En todos los casos esta distancia no debía ser fácil de recorrer para quienes no fueran expertos navegantes. Es posible asimismo que otras etnias fuesen originarias del interior del continente, lo que hace más difícil aún atribuirles un conocimiento náutico relativamente sofisticado para internarse en el Atlántico, al estar separadas del mar, y por lo tanto desconocedoras de sus secretos. Y en el caso de que algunas comunidades que habitasen sus riberas lo conocieran, sus embarcaciones no parece que tuvieran la suficiente entidad como para aventurarse a una singladura de este calibre, al tener que sortear la distancia que separa el continente de las islas.

Entre otras propuestas manejadas para explicar el poblamiento, se hallan las de quienes han argumentado factores de carácter histórico-político acaecidos en el Norte de África, y el eco probable que debió tener la arribada de estos africanos a nuestras islas. Son las que han propugnado J. Álvarez Delgado (1977), A. Pallarés Padilla (1976) y S. Jorge Godoy (1993), entre otros, quienes consideran que estas etnias fueron traídas a las islas por pueblos mediterráneos, púnicos y/o romanos, buenos conocedores de la navegación en las costas africanas, así como de la existencia de las Islas Canarias, las *Afortunadas* de los romanos, según la propuesta de J. Álvarez. a) «*Las Islas Canarias estaban deshabitadas el año 100 a.C. b) Estas Islas fueron descubiertas paulatinamente y exploradas por marinos gaditanos y por el griego Eudoxo y el romano Estacio Seboso entre los años 125 a 25 a.C. c) Juba II de Mauritania, por mandato y con consentimiento de Augusto, a cuyo imperio pertenecían, las pobló y colonizó con gétulos del Africa cercana en el último cuarto del siglo I a.C. d) Estas Islas Canarias o Afortunadas volvieron a su secular olvido después del emperador Claudio (55 p.C.), hasta el siglo XIII, quedando inabordadas para los europeos y los africanos de esos siglos, hasta que las redescubrieron los genoveses entre 1290-1312. Y durante esa larga etapa sólo las citaban los libros sobre noticias de Mela, Plinio y Tolomeo, que tampoco estuvieron en ellas, sino escribieron sobre referencias anteriores*» (J. Álvarez, 1977:51).

En ambas hipótesis, ya sea por intervención de los púnicos o de los romanos, parece evidente que el problema habría de relacionarse necesariamente con la presencia activa de estos pueblos en las costas africanas, así como el de su incidencia sobre las poblaciones libias con quienes entraron en contacto. Los fenicios primero, y con posterioridad sus descendientes los púnicos, se habían asentado a lo largo de la costa atlántica marroquí hasta Mogador (Essaouira), en donde establecieron asentamientos para el intercambio comercial con estas comunidades.

Resulta cuando menos sugerente la semejanza entre el relato contenido en el texto del monje franciscano Abreu Galindo y la resistencia, por la vía de la fuerza, que sostuvieron los pueblos bereberes frente al sometimiento de Roma. «*Teniendo Roma sujeta la provincia de Africa, y puestos en ella sus legados y presidios, se rebelaron los africanos y mataron los legados y los presidios, que estaban en la provincia de Mauritania; y que, sabida la nueva de la rebelión y muerte de los legados y presidio en Roma, pretendiendo el senado romano vengar y castigar el delito e injuria cometida, enviaron contra los delincuentes grande y poderoso ejército, y tornáronla a sujetar y reducir a la obediencia. Y, porque el delito cometido no quedase sin castigo, y para escarmiento de los venideros, tomaron todos los que habían sido caudillos principales de la rebelión y cortáronles las cabezas, y otros crueles castigos; y a los demás, que no se les hallaba culpa más de haber seguido el común, por no ser destruidos, por extirpar en todo aquella generación, y que no fuesen por ventura causa de otro motín, les cortaron las lenguas, porque do quiera que aportasen, no supiesen referir ni jactarse que en algún tiempo fueron contra el pueblo romano, Y así, cortadas las lenguas, hombres y mujeres y hijos los metieron en navíos con algún proveimiento y, pasándolos a estas islas, los dejaron con algunas cabras y ovejas para su sustentación. Y así quedaron estos gentiles africanos en estas siete islas, que se hallaron pobladas*» (Abreu Galindo, 1977:31).

Como consecuencia de lo anterior, me inclino por creer que el recuerdo guardado en la memoria de los *gomeros* sobre el origen de su llegada pudo ser una manifestación propia de su tradición, y no necesariamente una creación erudita posterior, aunque no poseo tampoco los argumentos suficientes para sostener lo contrario. En nuestro supuesto se plantea también el problema de cómo pudo pervivir tal recuerdo, al menos en lo primordial, durante casi mil cuatrocientos años, desde que aquel acontecimiento hubiera tenido lugar. De haber sucedido así, debió acontecer con toda probabilidad en los siglos en torno al cambio de Era. No poseo datos veraces para saber si un hecho de estas características se transmitió por los mecanismos normales de la tradición oral, ya fuera a través de los relatos familiares, o lo que narraban las personas ancianas del grupo. Sin que rechace esta vía para que tal hecho quedase perpetuado en la memoria colectiva, he pensado que su recuerdo hubiera sobrevivido por incorporarse como un mito propio que explicaba sus orígenes, como uno más de los referidos a la génesis de sus dioses, al de su mundo, o a la manera en que su Sociedad estaba organizada.

Un hecho similar podría encontrarse entre los *guanches*, según el texto de A. Espinosa, a juzgar por las alusiones que en él se hacen sobre el recuerdo de las primeras sesenta personas que desde un tiempo indeterminado habían llegado a la isla de Tenerife. Nosotros lo interpretamos como una referencia al territorio del ancestro, posiblemente del primer *Mencey* de la zona Norte de la isla, y el lugar en donde la Comunidad se reunía en épocas determinadas para rememorar los hechos principales del origen, pero a la luz de lo analizado en el probable mito de La Gomera, no descarto que estemos ante uno de características similares, y que por los mecanismos a los que nos hemos referido ut supra, este recuerdo pudiera haber pervivido en la memoria ancestral de la Comunidad. Es bien cierto que, aunque como en tantas otras cosas, hemos de movernos en el terreno de la hipótesis, me parecía de interés plantear estas cuestiones por la aparente semejanza de ambos hechos que ayudarían en la posterior discusión científica. *«Los naturales guanches viejos dicen que tienen noticia de inmemorable tiempo, que vinieron a esta isla sesenta personas, mas no saben de dónde y se juntaron y hicieron su habitación junto a Icod, que es un lugar de esta isla, y el lugar de su morada llamaban en su lengua Alzanxiquian Abcanahac Xerac, que quiere decir: «lugar del Ayuntamiento del hijo del grande»* (A. Espinosa, (1980):33).

7. LA VISIÓN MÍTICA DE LA HISTORIA

Un aspecto que me parece igualmente de interés está relacionado con la forma en que los *canarios* de Gran Canaria entendieron el final de su historia en el acto simbólico en el que hicieron la entrega de la isla a los castellanos como final de su Conquista. En los párrafos que siguen pretendo explicar la manera de interpretar la suya propia, acudiendo al mito liminar del origen de sus linajes y de su descendencia, en el que se hallan diversos referentes de su identidad como pueblo.

Como consecuencia de los acontecimientos bélicos sufridos por los *canarios* durante unos cinco años, y en especial después del fuerte asedio a que fueron sometidos en el Sur de la isla, en el barranco de *Tirajana,* decidieron pactar el final de la guerra que sostenían con los castellanos, disponiéndose a ir al «*Real de Las Palmas*», en donde se encontraba la dirección militar para cumplir lo que habían prometido con anterioridad, es decir, deponer las armas y cesar las hostilidades. Como mediador ante los castellanos para fijar las condiciones en las que habrían de abandonar sus enfrentamientos, intervendría Fernando *Guanarteme* -el último jefe de la isla-, quien trató de hacerles comprender a los que estaban refugiados allí, la necesidad de buscar una salida honrosa a la guerra que sostenían desde hacía ya unos cinco años, mediante un compromiso pactado que culminaría con «*la entrega de la isla*» . Y como consecuencia de ello, se produce, desde la perspectiva de los *canarios*, uno de los acontecimientos más dramáticos y de mayor relevancia de este proceso que sería el de ceder su territorio en manos de otra gente. Este hecho se hacía, a mi juicio, con el deseo de que con esta entrega se preservara su continuidad como Etnia, ya que de otra forma estaban todos en trance de sucumbir ante la manifiesta superioridad del enemigo. En estas condiciones, el *Guanarteme*, su jefe, les propuso «*que no fuesen tercos ni brutos, que se entregasen a el Rey de Spaña i serían francos i libres, i assí procuró de pas vicitar a su prima, i hablar con sus tíos los faizanes de Telde i Gáldar. Pactaron, después de largas diferencias, que se entregarían todos i a la prima su señora, mas que los spañoles se fuessen a el Real de las Palmas i que ellos irían en su seguimiento voluntariamente i que no hauía de ser a otra persona que a la de el general Pedro de Vera en nombre de su Rey a quien todos obedecían*» (A. Sedeño, en F. Morales Padrón, 1978:364).

Los acontecimientos posteriores no sucederían, en cambio, como ellos los concibieron. En el final de la Conquista, los castellanos interpretaron la venida de los canarios al «*Real de las Palmas*» como el acto de su rendición, mientras que éstos, por su parte, debieron entenderlo como la «*entrega de la isla*», y no como una claudicación, tal como trataré de explicar a continuación. En este caso, cada uno estaba, pues, interpretando los hechos desde una perspectiva bien distinta.

En el texto de A. Sedeño relativo a estos acontecimientos, se dice que realizados los acuerdos entre ellos, «*los canarios salieron de Tirajana acompañando a su señora. Traíanla en unas andas sentada en ombros de quatro hidalgos de cauellos rubios; (...) Pedro de Vera la venida de los canarios a el Real fue grande la alegría que él i los suios tubieron; salieron a reciuirlos a el camino de Telde, onde llegaron los dos tíos i por medio de el faraute o lengua le dixeron a Pedro de Vera que en nombre de el Rey Católico* ***se la entregaban como a hija que era de el Guanartheme el bueno, que era señor de la tierra i isla i que la diese en guarda a Christiano que fuese noble i la tractase bien»*** (A. Sedeño, en F. Morales Padrón, 1978:364). En este acto los *canarios* entregan a los castellanos una niña de unos diez años, de piel blanca y cabellos rubios. Pero esa es sólo la apariencia externa. Los *canarios* están entregando también un símbolo, porque la niña, la *Tenesoya*, es considerada como la portadora del linaje y por tanto del poder que debía transmitir a quien con ella se casase, ya que a tenor de su *mito de origen, el mito de Autindana o Autidamana*, se infiere que la descendencia del poder era transmitido por línea materna. Y en esta niña que los *canarios* entregan a los castellanos, se hallaba depositada la memoria sagrada del origen de la Comunidad. «*Antiguamente, los canarios llevaban vida errante y sin jefe ni gobierno. Cada familia vivía independiente, y obedecía al más importante de ella (...),* ***ocurrió que una mujer de noble estirpe****, llamada* ***Attidamana****, (...) enamorándose de un fuerte y valiente capitán dicho* ***Gomidafe, se casó con él, y éste hizo después tal guerra a todos los demás, que vino a ser príncipe de ellos y de la isla***» (L. Torriani, 1978: 96-99).

Desde la cosmovisión de los canarios, ésta pudo haber sido la manera en que vivieron los últimos episodios de su historia, concebida desde la suya propia, esde sus referentes mitológicos, bien distinta, por tanto, a la de los castellanos. Esta historia, la historia de los vencidos, sólo la podemos conocer en el terreno de la hipótesis y no como sería nuestro deseo, mediante la contrastación de distintas fuentes documentales, como sucede con la otra historia, la historia de los vencedores.

8. HISTORIA MÍTICA

En relación a los temas expuestos se desprende uno de los tantos problemas suscitados por la correcta interpretación de las fuentes etnohistóricas. En el pasado, la historiografía canaria trató de interpretar estas cuestiones, aplicándole una concepción positivista de la historia. Esta corriente de pensamiento pretendía entender los hechos de estas comunidades de igual forma que si se tratara de otro período histórico o de otro tipo de Sociedad. Contribuía a ello, además, la manera en que los distintos autores exponían los acontecimientos que narraban, ya que es frecuente encontrar en ellos expresiones vagas al referirse al tiempo histórico de aquellas poblaciones: «*pocos años antes que se redujera a nuestra santa fe*» (Abreu Galindo, 1977:292), o este otro: «*muchos años estuvo esta isla y gente della sujeta a un solo rey...*» o presentándolo de esta otra manera «*cuyo nombre se perdió de la memoria*» (A. Espinosa, 1980:40). Esta indefinición acerca del espacio y del tiempo en que se narran los hechos, contribuyó poco a una determinación correcta del *tiempo histórico*. Pensamos que ese modelo para entender la sociedad aborigen en general y estos aspectos que estudiamos en particular, se halla periclitado. Se hace necesario hacer uso de otros criterios metodológicos que permitan una interpretación más apropiada.

En torno a estos problemas se han originado asimismo discusiones científicas estériles sobre la veracidad de estos aspectos en las fuentes documentales. No se nos ocultan, sin embargo, las dificultades derivadas de los textos que hemos analizado, referentes al concepto del tiempo en su Historia, en un sentido diacrónico de difícil paralelismo con la concepción que del mismo tiempo desarrollaron las sociedades europeas, pero al igual que éstas en los comienzos, sus inicios se hallan rodeados de la misma imprecisión cronológica que es común al horizonte liminar de las sociedades primitivas. En ellas, el concepto del tiempo se enmarca dentro de un término genérico denominado *tiempo mítico*. La dificultad al aplicar los mismos criterios metodológicos de estudio, propios de las Sociedades Históricas, como hemos indicado, y las contradicciones existentes en esa misma información, han facilitado muy poco una correcta interpretación de las fuentes para reconstruir su evolución histórica, pero si esta información es tratada desde otras perspectivas, me parece que es posible llegar a recuperar algo de lo que debió conformar un importante acervo cultural de las sociedades canarias prehispánicas, a juzgar por los pocos ecos que aquéllas nos transmitieron.

REFERENCIAS

J. ABREU GALINDO, 1977. *Historia de la Conquista de las siete islas de Canaria*. Goya, ed. Edición crítica con introducción, notas e índice por Alejandro Cioranescu. Goya Ediciones.

J. ALVAREZ DELGADO, 1945. *Teide. Ensayo de Filología tinerfeña*. La Laguna.

J. ALVAREZ DELGADO, 1977. Leyenda erudita sobre la población de Canarias con africanos de lenguas cortadas. *Anuario de Estudios Atlánticos*, nº23, pp. 51-81. Madrid-Las Palmas de Gran Canaria.

J. A. ALVAREZ RIXO, 1991. *Lenguaje de los antiguos isleños*. Ed. con estudio y notas por Carmen Díaz Alayón y Antonio Tejera Gaspar. Ed. C.C.P.C.

E. AZNAR VALLEJO, 1986, (Ed.). El Capítulo de Canarias en el Islario de André Thevet. *VI Coloquio de Historia canario-americana.*

G. BENZONI, 1989. *Historia del Nuevo Mundo*. Alianza Editorial.

B. BONNET, 1940. Un manuscrito del siglo XV (El navegante Diago Gomes en las Canarias). *Revista de Historia*. Vol. VII, n° 52-53, pp. 92-100.

B. BONNET, 1943. La expedición portuguesa a las Canarias en 1341. *Revista de Historia*, IX, pp. 112-133

A. CA DA MOSTO, 1895. *Relation des voyages de la côte occidentale d'Afrique*. Ed. Charles Schefer. Leroux, Paris.

A. CIORANESCU, 1980, (Ed) *Le Canarien. Crónicas francesas de la conquista de Canarias*. ACT. Santa Cruz de Tenerife.

M. DETIENNE, 1985. *La invención de la mitología*. Ed. Península.

M. ELIADE, 1979. *Lo sagrado y lo profano*. Ed.Guadarrama.

A. ESPINOSA, 1980. *Del origen y milagros de la Santa Imagen de nuestra señora de Candelaria, que apareció en la Isla de Tenerife, con la descripción de esta isla*. Ed. e introducción de A. Cioranescu. Goya, ed.

J. FRAZER, 1986. *Mitos sobre el origen del fuego*. Ed. Alta Fulla.

G. FRUTUOSO, 1964. *Las Islas Canarias («De Saudades da Terra»)*. Fontes Rerum Canariarum XII. Instituto de Estudios Canarios.

GÓMEZ ESCUDERO, 1978, *Libro Segundo prosigue la Conquista de Canaria*. En F. Morales Padrón, pp. 383-468

R. GONZÁLEZ ANTÓN Y A. TEJERA GASPAR, 1981. *Los aborígenes canarios. Gran Canaria y Tenerife*. Col. Minor, Universidad de La Laguna.

GRAU-BASSAS Y V. MAS, 1980. *Viajes de exploración a diversos sitios y localidades de Gran Canaria*. El Museo Canario.

S. JORGE GODOY, 1996. *Navegaciones por la costa Atlántica africana y por las Islas Canarias en la Antigüedad*. Viceconsejería de Cultura y Deportes. Gobierno de Canarias.

S. JORGE GODOY, 1993. Los cartagineses y la problemática del poblamiento de Canarias. *Tabona*, VIII, T. I, pp.236.

G. MARCY, 1962. Nota sobre algunos topónimos y nombres antiguos de tribus bereberes en las islas Canarias. Traducción y comentarios de Juan Alvarez Delgado. *Anuario de Estudios Atlánticos*, n° 8, pp. 239-289.

T. A. MARÍN DE CUBAS, 1986. *Historia de las siete islas de Canaria*. Ed. Real Sociedad Económica de Amigos del País. Las Palmas de Gran Canaria.

M. MARTÍNEZ, 1992. *Canarias en la mitología*. Cabildo Insular de Tenerife y Centro de la Cultura Popular Canaria.

M. MARTÍNEZ, 1992. Canarias en la antigüedad: Mito y Utopía. En *Historia de Canarias*, Ed. Prensa Ibérica, S.A. Las Palmas de Gran Canaria.

F. MORALES PADRÓN, 1964. *Canarias en los cronistas de Indias*. Anuario de Estudios Atlánticos, n°10, pp. 179-234.

F. MORALES PADRÓN, 1978. *Canarias: Crónicas de su Conquista*. Sevilla-Las Palmas de Gran Canaria.

A. PALLARES PADILLA, 1976. Nueva teoría sobre el poblamiento de las Islas Canarias. *Almogaren*, VII, pp. 15-26.

E. ROMEU PALAZUELOS, 1984. Tradiciones gomeras. Gara y Jonay, los amantes, la montaña y la muerte. *Periódico El Día*, 2-9-1984.

L. DE LA ROSA OLIVERA, 1960. El adivino Aguamuje y los reyes de armas. *El Museo Canario*, XXI, pp. 199-233.

L. DE LA ROSA OLIVERA, 1961. Una leyenda sobre la conquista de La Gomera. *Revista de Historia Canaria*, XXVIII, pp. 436-441.

A. RUMEU DE ARMAS, 1943. Comunicaciones a la dirección: El Garoe. *Revista de Historia*, T. IX, n°64, pp. 339-341

M. SAHLINS, 1988. *Islas de Historia*. Ed. Gedisa. Barcelona.

A. SEDEÑO, 1978. *Brebe resumen y Historia muy verdadera de la Conquista de Canaria scripta por Antonio Cedeño, natural de Toledo, vno de los conquistadores que vinieron con el General Juan Rexon*. En F. Morales Padrón, pp. 343-381

A. TEJERA GASPAR, 1987. La religión en las culturas prehistóricas de las Islas Canarias. *I Coloquio sobre religiones prehistóricas de la Península Ibérica*, pp. 3-15.

A. TEJERA GASPAR, 1988. *La Religión de los guanches. Ritos, mitos y leyendas*. Ed. CajaCanarias. Santa Cruz de Tenerife.

A. TEJERA GASPAR, 1991. *Mitología de las culturas prehistóricas de las Islas Canarias*. Lección inaugural, Curso 1991-1992. Universidad de La Laguna.

A. TEJERA GASPAR, 1996. *La Religión de los gomeros. Ritos, mitos y leyendas*. Ed. A. Tejera.

A. TEJERA GASPAR Y R. GONZÁLEZ ANTÓN, 1987. *Las culturas aborígenes canarias*. Ed. Interinsular, Santa Cruz de Tenerife.

A. TEJERA GASPAR Y J. C. CABRERA PÉREZ, 1989. Mitos y leyendas de los majoreros (Fuerteventura. Islas Canarias). *III Jornadas de Estudios sobre Fuerteventura y Lanzarote*. T. II, pp. 237-246.

L. TORRIANI, 1978. *Descripción de las Islas Canarias*. Goya Ediciones, Santa Cruz de Tenerife

M. TRAPERO, 1984. La leyenda de Gara y Jonay en La Gomera. *Rev. Aguayro*, nº 153, Mayo-Junio.

R. VERNEAU, 1889. Habitations, sepultures et lieux sacrés des anciens canariens. *Revue d'Etnographie*. Paris.

D. J. WÖLFEL, 1960. La religión de los canarios. En *las religiones de la Europa Preindogermánica*, pp.410-425.

G. E. ZURARA, 1841. *Chronice do descobrimento e Conquista de Guiné*. París

TOMBS, TEMPLES AND ORIENTATIONS IN THE WESTERN MEDITERRANEAN

Michael Hoskin
Churchill College, Cambridge, U. K.

I like to imagine archaeologists of the very distant future studying the ruins of mosques and churches. The importance of Mecca in the religion of the mosques will be information still surviving in the ruins, but accessible only to those enlightened archaeologists who measure and collate the orientations of the ruined mosques. In the same way, medieval churches were often built to face the rising sun on the day when construction began.[1] If (and only if) the archaeologists of the distant future measure and collate their orientations and then notice that the range of church orientation is identical with the range of sunrise, will they appreciate the immense importance of sun symbolism in Christianity.

Note that of the two historical examples I have just cited, one is celestially motivated but the other terrestrially, by the direction of the city of Mecca. I regret the term 'archaeoastronomy' because it implies we assume that the motivation in the minds of the builders of monuments was always astronomical — or that we intend to persevere until we have somehow contrived to impose an astronomical interpretation. A declaration that the prehistoric builders of a given culture were focused on the skies must always be a conclusion resulting from a convincingly-argued interpretation of the orientations, not a presupposition before we even get off the plane. One possible argument is that the monuments display a uniformity of orientation despite their being spread over a wide geographical area, and that it is difficult to see how this uniformity could have been achieved except by reference to the sky.

IN PRAISE OF ARCHAEOTOPOGRAPHY

I am very careful always to distinguish between the *facts* of the orientations, which my archaeological colleagues and I measure together and which are uncontroversial (this aspect of the investigation I term 'archaeotopography'), and the *interpretations*, the discussion of what may have motivated the constructors to choose these orientations, which involves speculation.

Archaeotopography alone can provide valuable insights into archaeological issues. There is controversy over the origin of the Bronze Age culture of the Balearic Islands, which was at its height around 1000 BC. According to some there is a striking similarity between the towers of Menorca known as *talayots* (which give their name to the culture) and the towers of Sardinia known as *nuraghe*. And they also see a striking similarity between the communal tombs of Menorca, which are known as *navetas* because they resemble an upturned boat, and the communal tombs of Nuraghic Sardinia known as 'tombs of giants'.[2] They conclude that people came in boats from Sardinia and arrived on Menorca, where they settled, founding a culture that followed the construction customs of the motherland of Sardinia.

I think these similarities are wholly unconvincing to anyone who has worked extensively in both islands. But this might be thought a matter of opinion. What is not a matter of opinion, is that nearly all the tombs of giants faced the eastern half of the horizon,[3] and nearly all the navetas faced the western half.[4] This hard, indisputable, quantitative evidence from archaeotopography creates a serious problem for those who think Sardinians arrived on Menorca and followed the building customs they had known back home; and no controversial astronomical interpretation is involved.

For the past dozen years I have been measuring the orientations of prehistoric communal tombs and sanctuaries throughout the Mediterranean, of the Neolithic, Chalcolithic and Bronze Ages. I have myself visited nearly two thousand monuments, and I have reliable information on a thousand more. In the next section of this paper I report on a Minoan cemetery on Crete, exceptional in both the quality and the quantity of its data. In the following section I discuss orientations of megalithic and tholos tombs in the western Mediterranean, this being the primary object of my fieldwork; and in the final section I shall consider the specific question of the orientations of the sanctuaries of Menorca.

Fig. 1. A typical tomb from the cemetery at Armenoi, Crete.

THE CEMETERY OF ARMENOI

A few kilometres inland from the port of Rhethymnon in northwest Crete is the remarkable cemetery of Armenoi.[5] It consists of some three hundred family tombs cut into the bedrock of a small hill. Each tomb was approached via a lengthy passage or *dromos*, with perfectly straight and parallel sides (Figure 1). This passage led to the entrance, which gave into a sizeable chamber. The cemetery belongs to Late Minoan IB, a little before 1000 BC. After it was abandoned the passages filled with leaves and earth, and so the tombs were sealed by natural processes and disappeared from human view until rediscovered in our own times. About three-quarters of the 300 tombs have so far been excavated. Each has its contents — the bodies of those interred and the elaborate grave goods — in excellent condition, an archaeologist's dream. Furthermore, each passage has its sides in perfect condition, so that the orientation can be determined with an accuracy of minutes of arc, an archaeoastronomer's dream. Measures of the tombs therefore yielded a wonderful treasury of data all from a single culture: well over two hundred orientations of wholly exceptional accuracy.

Every one of the tombs faced easterly (see Figure 2). *Nearly all* the tombs faced within the range of sunrise, with equal numbers to the north and to the south of due east. *All* the tombs faced within the range of moonrise. These facts encourage us to consider two possible interpretations: either the tombs were intended to face sunrise at some time of the year, but precision was not important; or the tombs were intended to face moonrise and care was taken that this was indeed so.

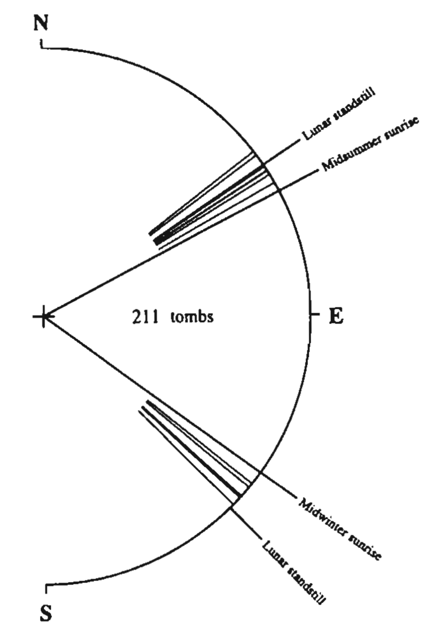


Fig. 2. The orientations of 224 tombs at Armenoi, showing individually those that lie more than a degree or so outside the range of sunrise.

The moonrise interpretation is endorsed, first, by the known importance of the moon to the Minoans, and second, by the presence, a short distance to the east, of the mountain of Vrysinas, on the top of which was an important earlier sanctuary that may well have been dedicated to a lunar god. If so, then the tombs were located so that they looked at the moon rising on a mountain dedicated to the moon.

The population whose dead filled the cemetery must have been very extensive, but it is not known where they lived. It is more than likely that the remains of their dwellings lie under the modern buildings of the port of Rhethymnon, a few kilometres to the north. If so, and if our interpretation is correct, then the site of the cemetery would (so to speak) have chosen itself: it would be the nearest place to Rhethymnon where tombs of this type could be located so that the dead might look towards the moon rising on the mountain sacred to the moon. A cemetery nearer Rhethymnon would not look towards the mountain. From a cemetery further west, the mountain would appear smaller and so at times the moon would be seen to rise on flat ground north or south of the mountain, not on the mountain itself. Finally, a site further east, and so nearer the mountain, would present an uphill slope in the direction of the mountain, whereas the construction of a dromos requires a downhill slope.

COMMUNAL TOMBS OF THE CENTRAL AND WESTERN MEDITERRANEAN

I now turn to the communal tombs of the central and western Mediterranean, and I limit myself to the islands and the European mainland. I shall say nothing of those on the north African coast, for although we were lucky enough to find in Tunisia one small site with European-style tombs and European-style orientations,[6] in Tunisia at least nearly all the many hundreds of dolmens are very late indeed, being mostly from the Punic or even Roman period. They are therefore separated by thousands of years from the tombs on the European mainland, which date between 4000 and 2000 BC. Also, in my opinion most of the Tunisian dolmens simply faced downhill.

Stone-built communal tombs may be constructed from a small number of large stones or megaliths, or from a large number of small stones. In the central and western Mediterranean, nearly all the communal tombs are megalithic, but in southern Iberia there are indeed a number of beehive or false-cupola tombs made of many small stones and known by the Greek name of *tholos*.

Among those built with megaliths, there are innumerable forms of construction. Some forms are widespread: in many places we find in great numbers the simple rectangular or polygonal chamber of orthostats with a massive capstone that is brought to mind by the term 'dolmen'. Other forms are special to a particular culture. The Sardinian tombs of giants, of which I have measured some 250, and the Menorcan navetas are each quite unlike tombs found anywhere else. In the centre of Portugal and adjacent regions of Spain the tombs built two thousand years before the navetas and tombs of giants have chambers constructed of seven massive stones; the backstone is set into the ground and so is a true orthostat, but the two next stones (one to each side) simply lean against it, while the two next lean against these and the two next lean against these. This results in a classic Portugese *anta*, a tomb with an eight-sided chamber, formed of seven stones of which only the backstone is actually set into the ground, while opposite the backstone is the entrance to the chamber. I have measured approaching two hundred of these, and more of the similar nine-stone-chambered tombs in the north of Portugal. Then again there are the false cupola or tholos tombs (Figure 3), whose greatest concentration is in Almería on the Spanish Mediterranean coast. Yet in the midst of this great variety of form and culture, spread over a wide geographical area and extending through two and even three millennia, there is a remarkable uniformity of customs of orientation.

First, nearly all these tombs faced the eastern half of the horizon, and to the south of midsummer sunrise. So for example, in a paper published in 1998 we listed orientations of 400 tombs of northern and western Iberia,[7] and of these 400 only two clearly faced westerly; 398 of the 400 faced easterly (or close to south), and only one of the 398 faced north of midsummer sunrise.

Fig. 3. One of the better-preserved tholos tombs at Los Millares.

There are only three limited areas of the western Mediterranean where tombs faced westerly rather than easterly in some numbers, and more on these in a moment. But as a first generalization, and putting on one side the very late tombs of North Africa, we can say that *almost all communal tombs of the central and western Mediterranean faced the eastern horizon, and to the south of midsummer sunrise.*

Second, within this overall pattern we find two main subdivisions: those cultures in which nearly all the tombs faced sunrise at some time of year, and those where this was not the case. There are considerable areas of Portugal, Spain and France where all or almost all the tombs of the given culture faced sunrise. I say 'sunrise' rather than 'moonrise' or 'Venusrise' or whatever because of the frequency with which the southern limit of tomb orientation coincides very exactly with the southern limit of sunrise, that is, midwinter sunrise (Figure 4). I find this coincidence so frequent and so precise that I cannot interpret the evidence except by reference to sunrise. This can be true of tholos (Figure 5) as well as of megalithic tombs. It applies to tombs across a wide region of southern France, and it applies with amazing consistency to the antas of central Portugal (Figure 6).

Indeed almost every tomb in Portugal faced sunrise, and in many of the various regions we find that midwinter sunrise was the southern limit of the range of orientations. If the ancient tomb builders laid out their monument to face sunrise on the day when building started, like the constructors of medieval churches, we might expect patterns of tomb orientations similar to those we actually find; for the winter would surely be the normal time for this activity, when there was less work to be done in producing food. It therefore seems very possible that we can even use the orientation of a given tomb to identify the time of year when construction began, exactly as we can with Christian churches. If so, then archaeoastronomy offers archaeologists of Portugal an insight into the annual rhythm of life in prehistoric times.

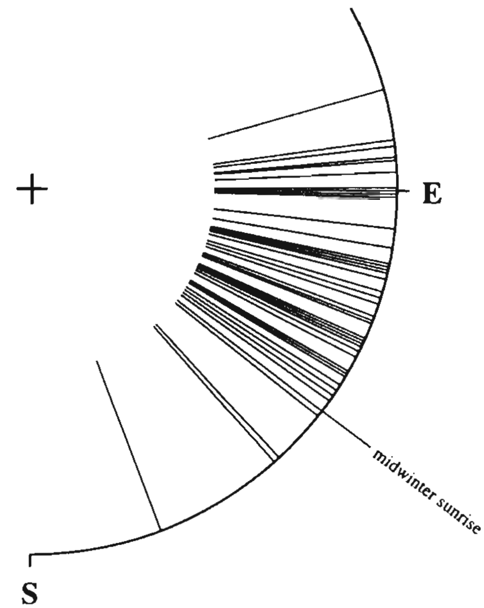


Fig. 4. The orientations of 41 megalithic sepulchres at Montefrío, to the west of Granada. 38 of the tombs faced sunrise at some time of year, most of them in the autumn (or spring) and winter.

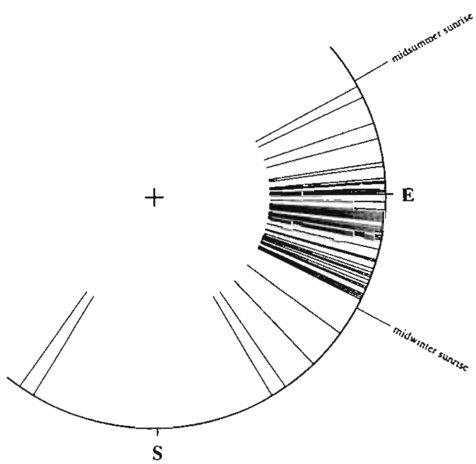


Fig. 5. The orientations of 48 tholos and related tombs at Los Millares. A further 18 tombs were in too poor a state to permit a quantitative measure of their orientation, but all clearly faced between east and midwinter sunrise

In other regions, however, the choice of orientation was more flexible: the tombs either faced easterly, that is, sunrise (or, if you prefer, moonrise), or they faced further south, when the sun (or moon) was climbing in the sky or around culmination (Figure 7). Until I am convinced otherwise, the sun alone is good enough for me, and so I characterise the first custom we discussed as 'sunrise' (SR), and this more general one as 'sunrise/sun-climbing/sun-around-culmination' (SR/SC). In a few places — a small area of the Spanish Basque country, or parts of southwest Mediterranean France — all the tombs faced well south of midwinter sunrise, and I would term these simply SC.

These three customs — SR, SR/SC or SC — embrace perhaps 95% of the two-thousand-plus tombs of the western Mediterranean islands and of the mainland of Italy, southern France, Spain and Portugal on which I have data. Only in Languedoc and thereabouts, and in a tiny region of Spanish Cataluña, are there tombs in some numbers that faced the western half of the horizon, while on the Balearic Islands this was invariably the case.

In Languedoc and neighbouring regions of France there are large numbers of small rectangular tombs of the early third millennium that mostly faced around southwest.[8] In a tiny region of Spanish Cataluña, located between Girona and the French frontier, there are likewise small rectangular tombs of the third millennium, but about half of these faced the southeast quadrant in classic SR/SC style while about half faced southwest;[9] interestingly, this is the only place in the western Mediterranean where we find these two customs coexisting. Finally, the small rectangular tombs of Mallorca and Menorca of the late third millennium also faced southwest, as did the much later navetas of Menorca built around 1000 BC.[10]

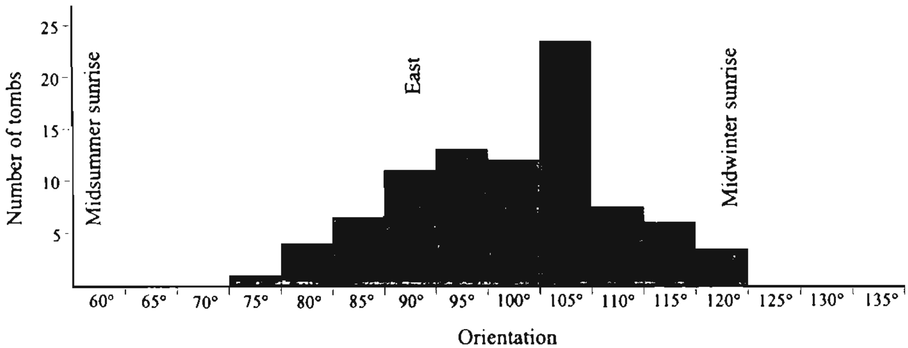


Fig 6. Histogram of the orientations of 91 seven-stone-chambered antas from the central Alentejo region of Portugal. A similar number have been measured from the neighbouring areas of Portugal and Spain, and all without exception faced sunrise at some time of year, most of them in the winter months. This extraordinary consistency, in tombs spread over the southern half of Portugal and four provinces of Spain, is a strong argument for astronomical motivation on the part of the builders.

Links between the cultures of these three regions have long been recognised, and in particular the influence of Languedoc and Cataluña on the Balearic Islands.[11] But how to relate Languedoc and Cataluña, and how to account for the coexistence in Cataluña of two contrasting customs?

A solution to this intriguing problem has recently been proposed by the leading authority on these Catalan tombs, Josep Tarrús.[12] In his opinion, the westerly custom originated in Languedoc, while at first in Cataluña the normal easterly custom prevailed. Then there was influence in Cataluña from Languedoc, resulting in westerly tombs being built in Cataluña alongside other tombs that continued to observe the original easterly custom of the region; but according to Tarrús this Languedocian influence soon died out, and the later Catalan tombs are exclusively easterly once more.

If this is so, then we can summarise by saying that almost all the communal tombs of the central and western Mediterranean faced the eastern half of the horizon, except that in Languedoc and thereabouts a wholly-exceptional western custom arose that had temporary influence in Cataluña and permanent influence in the Balearics. We are left then with the question of why the Languedocians were different from everyone else and faced their tombs to the southwest, and one archaeologist has suggested the strength of the winds from the northeast.[13]

These, then, are the three limited regions where westerly-facing tombs are common. Elsewhere we find a remarkable consistency in the easterly orientation patterns observed by the communal tomb builders, a consistency all the more surprising when one considers the great ranges of time and space and the many cultures involved.

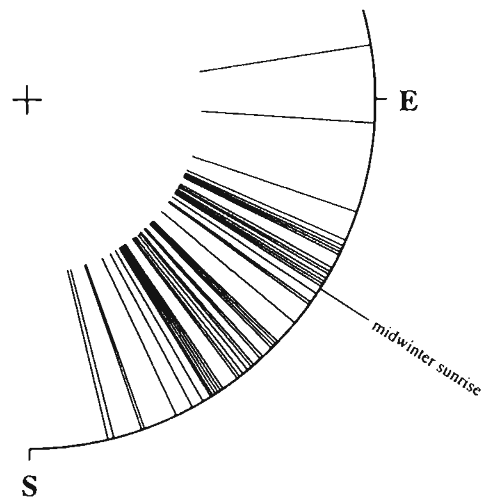


Fig. 7 The orientations of 34 megalithic sepulchres on the east and west plateaux of the Rio Gor, to the east of Granada, an example of 'SR/SC' orientations.

Fig. 8. The taula of Talati de Dalt, Menorca. In the foreground is one of the pilasters of the precinct wall, while to the left another pilaster has toppled and by chance is leaning against the central stones.

THE TAULA SANCTUARIES OF MENORCA

Tombs are numerous, prehistoric sanctuaries are rare. By far the most impressive of those in the Western Mediterranean are on the tiny islands of Menorca and Malta.

The Menorcan santuaries date from around 1000 BC (and are therefore far later than the mainland tombs we have been discussing, nearly all of which date from the fourth or third millennia BC). They belong to the Bronze Age 'talayotic' culture; but although a parallel talayotic culture existed on the nearby island of Mallorca, for some reason Menorcan-type sanctuaries are not to be found there.

The central feature of a Menorcan sanctuary (Figure 8) consisted of a vertical slab of stone, from two to four metres high, set into the ground, and on top of it a horizontal slab, the pair of stones together having the shape of a capital T.[14] This is known as a *taula*, from the Catalan for 'table'. Around the taula was a sanctuary wall, studded at intervals with pilasters, and the taula faced out through the entrance to this wall, so that the monument had a well-defined orientation.

I found that, with a single exception, the taulas concentrated in the southern half of the island faced southerly. I also found — and this was crucial — that they were all located so as to have a perfect view to the southern horizon. Some looked straight out to sea, while others looked down from an eminence and across a flat plain. That this location could not have occurred by chance is easily confirmed by study of other monuments of the same culture, such as the navetas, numbers of which face rising ground and so could not see the southern horizon.

Why then was it essential for a taula to see the southern horizon? There is no land in that direction nearer than Africa, and today there is nothing of interest low in the sky. But if we calculate backwards the effect of precession, we find that when the taulas were built, the fine spectacle of the Southern Cross and the bright stars of Centaurus that follow the Cross were to be seen low in the south. My hypothesis therefore is that the taulas looked towards this star group, a group so striking that it is depicted today on the flags of Australia and New Zealand.

With this hypothesis I can explain several puzzling facts known to archaeologists. First, why are there numerous taulas on Menorca and none on Mallorca? It is important to remember that Menorca is very flat and it is always possible to find some little rise that gives a view to the southern horizon; but Mallorca is mountainous, and the prehistoric occupation was often in the fertile valleys. From these valleys the surrounding mountains blocked the view to the Southern Cross. My answer to the puzzle is then: there are taulas on Menorca because the Southern Cross could easily be seen from almost anywhere on this flat island, whereas Mallorca is mountainous and the Southern Cross was frequently invisible.

In one taula the excavators found the remnants of a bronze statue, three hooves which they interpreted as the feet of a horse. This was puzzling, as there are no horse gods in the Mediterranean. In another taula the excavators made the astonishing discovery of a bronze statue of a man seated on a throne, with an inscription in Egyptian hieroglyphics saying that the figure is in fact the God of Medicine. I offer a possible explanation. The Southern Cross and the following bright stars, Alpha and Beta Centauri, were in ancient historic times all part of the constellation of the Centaur. Let us suppose that among the Menorcans a few centuries earlier this was already the case. According to the Greeks the Centaur was Chiron, who taught medicine to the god of medicine. If so, then the taula sanctuaries may well have been (or have become) places of healing, associated, if not with the god of medicine, then with the teacher of the god of medicine, who was visible in the Menorcan sky just as in contemporary Egypt Isis and Osiris were visible in the sky as Sirius and Orion. It would therefore make sense for a passing sailor from Egypt to deposit in a taula sanctuary a statue of his god of medicine. And the bronze hooves of a horse would in fact be the feet of the Centaur.

On Mallorca there are no taulas, but there are a handful of later, widely separated sanctuaries of different construction. Outside one of these is a big rock with a groove that the archaeologist involved[15] believes to be man-made. I was therefore invited, as part of the team for a popular U.K. television programme, to visit the site and see if I could make sense of this groove. It did in fact face south, and looked up a valley between two hills. Around, say, 2000 BC, the Southern Cross would have appeared in the valley, framed between the two hills, making a magnificent sight. My problem was that about 1700 BC precession would have caused stars of the Cross to begin to disappear permanently from view. If the rock and groove were indeed part of an earlier sanctuary facing the Southern Cross, there would have been a crisis around 1700 BC, and I could see no evidence for this.

I confided my problem to another member of the team, the head of a Dutch radiocarbon laboratory who had made a special study of the site. With an odd expression he pulled from his pocket the draft of a paper on radiocarbon dates for the site, in which he and his fellow author, the archaeologist of the site, listed numerous dates before 1700 BC, but then found a gap for several hundred years beginning in 1700 BC. For this abandonment of the site around 1700 BC they had been able to offer no explanation.

The two of us looked at each other in amazement. I was expecting a crisis around 1700 BC but had no evidence for this; he had site abandonment around 1700 BC but could offer no reason for this. The producer of the programme swore us to secrecy until next day, when we could present our conclusions on camera.

It had proved a model collaboration. The archaeologist was convinced, from the pottery excavated, that the later sanctuary site had seen earlier occupation, and that the groove in the rock was a relic of this. I had measured the groove and found that it would have faced the Southern Cross until around 1700 BC. And the radiocarbon expert had found evidence of site abandonment around 1700 BC, until a later culture reoccupied this sacred area and built their own sanctuary. It would be hard to find a happier example of how the archaeoastronomer can contribute as a member of the archaeological team.

NOTES AND REFERENCES

1. "One end of every Church doth point to such a Place, where the Sun did rise at the time the Foundation thereof was laid, which is the Reason why all Churches do not directly point to the East; for if the Foundation was laid in *June*, it pointed to the North-east, where the Sun rises at that time of the Year; if it was laid in the Spring or Autumn, it was directed full East; if in Winter, South-east; and by the standing of these Churches, it is known at what time of the Year the Foundations of them were laid." HENRY CHAUNCY, *The historical antiquities of Hertfordshire* (London, 1700), I, 88.

2. Thus the respected L. PERICOT GARCÍA, in his *The Balearic Islands* (London, 1972), writes: "The 'giants' tombs' of Sardinia have always been mentioned as possible prototypes for navetas, for the building techniques employed are similar" (p. 79).

3. MAURO ZEDDA, MICHAEL HOSKIN, RENATE GRALEWSKI and GIACOBBE MANCA, "Orientations of 230 Sardinian *tombe di giganti*", *Archaeoastronomy* (supp. to *Journal for the history of astronomy*), no. 21 (1996), S33–54.

4. MICHAEL HOSKIN and JUAN JOSÉ MORALES NÚÑEZ, "The orientations of the burial monuments of Menorca", *Archaeoastronomy* (supp. to *Journal for the history of astronomy*), no. 16 (1991), S15–42; HOSKIN, "Baleares: Arqueoastronomía de la cultura talayótica", *Arqueoastronomía hispana*, ed. by J. A. Belmonte A. (Madrid 1994), 159–81.

5. MARÍA PAPATHANASSIOU, MICHAEL HOSKIN and HELEN PAPADOPOULOU, "Orientations of tombs in the Late-Minoan cemetery at Armenoi, Crete", *Archaeoastronomy* (supp. to *Journal for the history of astronomy*), no. 17 (1992), S43–55; PAPATHANASSIOU and HOSKIN, "The Late-Minoan cemetery at Armenoi: A reappraisal", *Journal for the history of astronomy*, XXVII (1996), 53–59.

6. Paper by SEBASTIANO TUSA, GIORGIA FODERÀ SERIO and MICHAEL HOSKIN to appear in *Archaeoastronomy* (supp. to *Journal for the history of astronomy*), no. 25 (2000).

7. MICHAEL HOSKIN and colleagues, "Studies in Iberian archaeoastronomy: (5) Orientations of megalithic tombs of northern and western Iberia", *Archaeoastronomy* (supp. to *Journal for the history of astronomy*), no. 29 (1998), S39–87.

8. YVES CHEVALIER, "Orientations of 935 dolmens of southern France", *Archaeoastronomy* (supp. to *Journal for the history of astronomy*), no. 24 (1999), S47–82; GÉRARD SAUZADE, "Orientations of the Provençal dolmens", *ibid.*, no. 25 (2000), in preparation.

9. MICHAEL HOSKIN and TONI PALOMO I PÉREZ, "Studies in Iberian archaeoastronomy: (4) The orientations of megalithic tombs in eastern Catalunya", *Journal for the history of astronomy*, XXIX (1998), 63–79.

10. *Ibid.*, 76–78; HOSKIN and MORALES, *op. cit.* (ref. 4); HOSKIN, "Baleares" (ref. 4).

11. For example, WILLIAMS H. WALDREN, "Early prehistoric settlement in the Balearic Islands" (Deya Archaeological Museum and Research Centre, Series no. 13, 1982).

12. JOSEP TARRÚS, contribution to Chevalier, *op. cit.* (ref. 8), S75–78.

13. YVES CHEVALIER, *L'architecture des dolmens entre Languedoc et centre-ouest de France* (Bonn, 1984), 32.

14. MICHAEL HOSKIN, "The orientations of the taulas of Menorca (1): The southern taulas", *Archaeoastronomy* (supp. to *Journal for the history of astronomy*), no. 14 (1989), S117–36; HOSKIN, "Baleares" (ref. 4).

15. Dr. WILLIAM H. WALDREN, who has been excavating in the area for decades.

THE STONE ROWS OF THE WEST OF IRELAND: A PRELIMINARY ARCHAEOASTRONOMICAL ANALYSIS

Frank T. Prendergast
Department of Geomatics, The Dublin Institute of Technology,
Bolton St., Dublin 1, Ireland
frank.prendergast@dit.ie

1. INTRODUCTION

The erection of standing stones on the Irish landscape was a common practice during the Bronze Age (2500-500BC), the Iron Age, and even later. They were frequently sited on elevated ground. Unhewn boulders were chosen in the majority of cases, and these were erected either singly, in rows or as circles.

The simplicity of the single standing stone generally prevents this group of monuments being ascribed to any specific period or cultural context (O'Riordain, 1979). While some may have marked ancient burial sites, others may have served as markers of prehistoric boundaries or roadways. When taken in context with rows and circles however, it is more likely that their purpose was ritual or ceremonial in some cases. Where single standing stones exhibit a rectangular or oval shape in plan, the possibility that the deliberate orientation of the longer axis was a factor in their placement must be considered. Available dating evidence indicates that single standing stones continued to be erected until early Christian times. O'Riordain also points to the danger of interpreting some standing stones as such. They may have formed part of an entirely different type of structure, long since destroyed.

Lynch (1998) defines a stone row, in its broadest sense, as "a prehistoric setting of regularly spaced stones and would therefore include stone pairs, avenues, tangential rows, long rows and short rows". To investigate a group of such monuments for meaningful evidence of astronomical intent, several criteria are used to first establish if an implied association exists between the stones in the row. The long axis of each individual stone should ideally be orientated to, and reasonably coincident with, the mean axis of the row itself, for example. Any pattern of increase in the height of the stones from one end of the row *i.e.* height gradation, may also be significant. Such criteria, when combined with the study of the relative proximity and type of horizon in each of the two possible view directions at each row, may help determine whether a particular view direction might have been important to the builders of the monuments. The subsequent investigation of the data for azimuth clustering, astronomically significant declinations, or a preference for orientation towards prominent mountains for example, may then yield an explanation as to the likely purpose of such monuments. The use of these and other criteria have been extensively developed and applied to the stone rows of south-west Ireland by Ruggles (1994, 1996). That work has revealed a pattern of orientations more suggestive of an interest in the moon than the sun, and with no clear preference for SW over NE orientations or vice versa. Analysis of stone height gradation by Ruggles has also revealed a clear relationship between the directionality of the monuments and prominent hills.

In this paper, new data relating to 30 stone row sites in the west of Ireland is presented. A preliminary analysis of the orientations and indicated declinations is carried out. The data set comprises sixteen rows in the two-stone row category, thirteen rows in the three to six stone row category, and one double row.

2. GEOGRAPHICAL SETTING AND PREVIOUS WORK

The 30 monuments are sited across Counties Mayo and Galway in the west of Ireland. The geology of the area (west Connacht) is dominated by igneous and metamorphic rocks, which form mountain ranges separated by lowland valleys. Granite, schist, gneiss and quartzite are common. During the last ice age, eroding ice deepened the valleys, created deep corries, and scoured the rock surfaces. There was little glacial deposition in the area, even in the lowlands. The area was subsequently covered by blanket bog, which still covers the region extensively (Aalen *et al.* 1997).

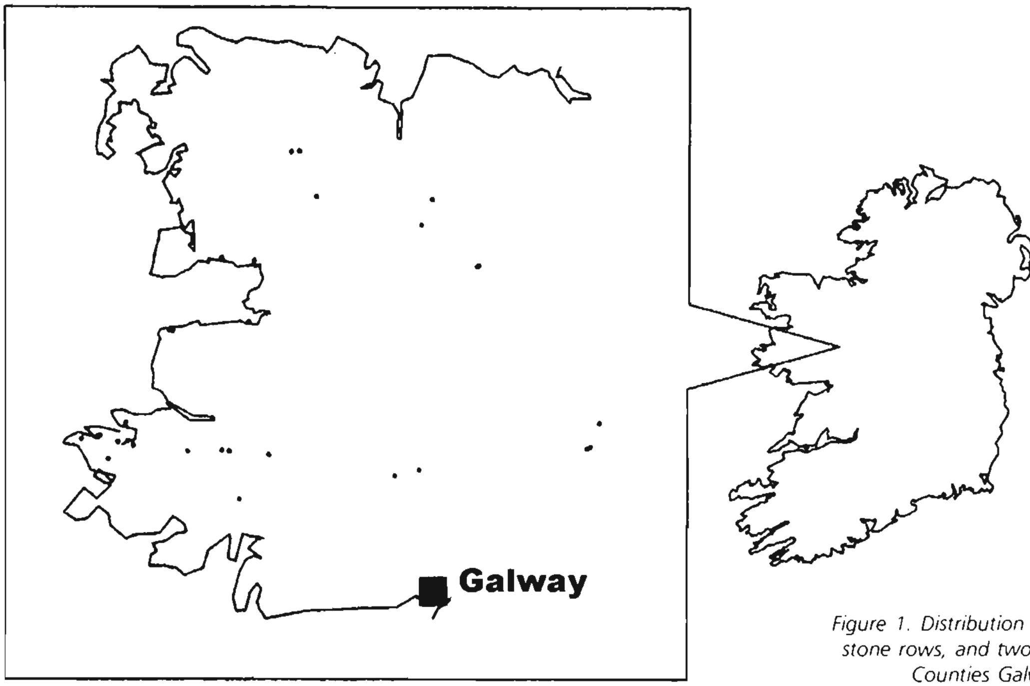


Figure 1. Distribution of three to six stone rows, and two-stone rows in Counties Galway and Mayo

The west of Ireland group shown in Figure 1 constitutes the third largest of the stone row groups in Ireland, after those found in Counties Cork and Kerry in the south-west, and those occurring in counties Tyrone and Fermanagh in Northern Ireland. Amongst the west of Ireland group, a significant cluster of rows occurs in the Connemara region. The vast majority of the monuments are situated on elevated ridges or mounds. In common with the Cork/Kerry rows, their distribution is almost exclusively inland. Unlike the Cork/Kerry rows, which overlap with the distribution of the stone circles, the area is almost devoid of any circles.

The stones in each row are mostly glacially rounded unhewn boulders. Being local to the area, they consist either of granite, schist or quartzite. At two of the long rows (Derryinver and Gleninagh), both granite and schist are used. Seven of the monuments are located east of Lough Corrib and Lough Mask, in an area of Carboniferous limestone. Notably, four of the two-stone rows (Ballynew, Crocknaraw (2) and Knockaunbaun) and one of the three to six stone rows (Poundcarton) consist of milky white quartz. This hardest of the common minerals would have been quarried from veins found in the locality. Although quartz was used extensively at many prehistoric sites throughout Ireland, the most striking utilisation of this very hard mineral rock was for single standing stones and stone rows. Its use may have been restricted to certain monuments, and its visual impact on both the people and landscape would have been considerable (Koeberl, 1997).

In common with stone circles, stone rows have proved generally disappointing in dateable finds. Very few sites have been excavated. As part of a research project aimed at reconstructing the environmental background of the stone row/circle complex of south-west Ireland, a stone row at Maughanasilly, County Cork was excavated by Lynch in 1997.

Finds included a thin scattering of quartz pebbles around the base of the stones. Very little evidence of prehistoric activity was discovered but significantly, two charcoal samples from the site each yielded similar date ranges of 1678-1438 cal BC (95.4% probability level). Lynch advises that "neither date can be definitively linked to the construction of the row, and the most that can be inferred is that the construction of the Maughanasilly row belongs to the middle centuries of the second millennium BC....". In addition, the calibration of available dates obtained by Lynch from other sites in south-west Ireland, now extends the likely period of construction to c.1650 – c.800 cal BC (Lynch, *ibid*). That range appears consistent with the few dates available from sites elsewhere in Ireland. In the west of Ireland, the fieldwork of archaeologist Michael Gibbons has contributed significantly to the inventory of such monuments. Gibbons attests to the area as a Bronze Age ritual landscape (pers. comm.). Previous investigations conducted at sites in the region provide no conclusive evidence to indicate any chronological difference between the different standing stone monuments (Corlett 1997, 1998). Interestingly, new sites continue to emerge from beneath the blanket bogs of the area, through erosion and road excavation.

3. DATA COLLECTION AND PROCESSING

Measurement campaigns to acquire position, orientation and horizon data at each site were undertaken between October 1998 and August 1999. Paul Walsh of Dóchas (The Heritage Service) provided outline site location and description information. Supplementary information was obtained in the archaeological inventories for County Galway (Alcock et al., 1995, Gosling 1993), and the Sites and Monuments Record data base (SMR) of Dóchas.

The plan position of each site was determined both in Geodetic Latitude and Longitude format and in Projection Eastings and Northings format. A hand –held code GPS receiver was used in non-differential mode for this purpose. By averaging the data, a vector error of c. ±35 m was achieved.

Fig. 2 Baunoge Stone Row (profile view east), County Galway

At each site, the horizon in each of the two directions of interest was photographed. In addition, row profile views were recorded (Figure 2). Theodolite measurements of direction and altitude were observed with a precision of ±1 arc minute to points on the horizon adjacent to, and coincident with, the axis of monument. Where cloud cover was absent, astronomical azimuths were recorded using timed solar observations (hour angle method). The instrument used (Wild T0) functions either as a compass theodolite or a normal theodolite, with equal precision. This enables a precise value of magnetic declination to be determined, and applied at sites when the sun is not visible at the time of survey. Normal safeguards to minimise errors associated with magnetic bearings were applied (Prendergast, 1998). Horizon distances in the sectors of interest were estimated in the field, although the use of digital terrain models has the potential to provide such information. All computations for azimuth and declination were carried out using software developed by the author.

4. RESULTS

The values of azimuth, altitude, and solar/lunar declinations for the 30 sites are shown in Table 1. Given the low precision with which the axes of the rows can be defined, no distinction was made between the upper and lower limbs of the astronomical bodies in the computation of declination. Horizon altitudes are therefore corrected for atmospheric refraction and geocentric parallax only.

Collectively, the orientations of the axes reveal an apparent clustering in the third quadrant, with a marked bias towards the most southerly part of the horizon (Figure 3). At four of the sites, stone height gradation is not evident and reciprocal views of the horizon are equally possible (these are shown as dotted lines in Figure 3a). More than 90% of the sites are orientated between azimuths 151° and 218°. By treating the orientations of each of the two classes of monuments separately, no obvious conclusion can be reached as to patterns of preferential azimuths (Figure 4). The solar declinations of horizon points intersected by the axes of the rows are shown in Table 1 (Sun Dec.°). These show a marked shift towards the extreme negative. Predominantly, they lie outside the extreme declination values for the sun ($\pm \varepsilon$), where $\varepsilon = 23.87°$ for c.1500 BC - the likely period suggested by Lynch for the construction of the monuments. Notably, the alignment of the two sites at Killadangan, and at Gleninagh, is consistent with the position of the setting sun at the Winter Solstice. There is no evidence in the data of an interest in the equinox.

The lunar declinations of horizon points intersected by the axes of the rows are shown in Table 1 (Moon Dec.°). They similarly show a shift towards the extreme negative. By treating the declinations of each of the two classes of monuments separately, no obvious conclusion can be reached is apparent at this stage (Figure 5). Five sites (Rosgaliv, Corlee, Cloonederowen, Oorid and Dooleeg More) yield a declination value, which suggests the possibility of deliberate orientation towards the setting moon at southern standstill. In 1500 BC, the declination of the moon at the southern major standstill would have been c. –29.0°. There appears to be no evidence of an interest in the moon at minor standstill.

For those monuments whose southerly orientations lie beyond the extreme azimuth limits for the rising and setting positions of the sun and moon, there were no conspicuous astronomical bodies rising or setting on those alignments at that latitude during the second millennium BC. If an interest in such a southerly direction could be inferred, it may have been associated with a ritual interest in the culmination of the sun or moon, or perhaps a conspicuous constellation or planet in the night skies. That view is speculative and is not supported by the data.

5. CONCLUSIONS AND RECOMMENDATIONS

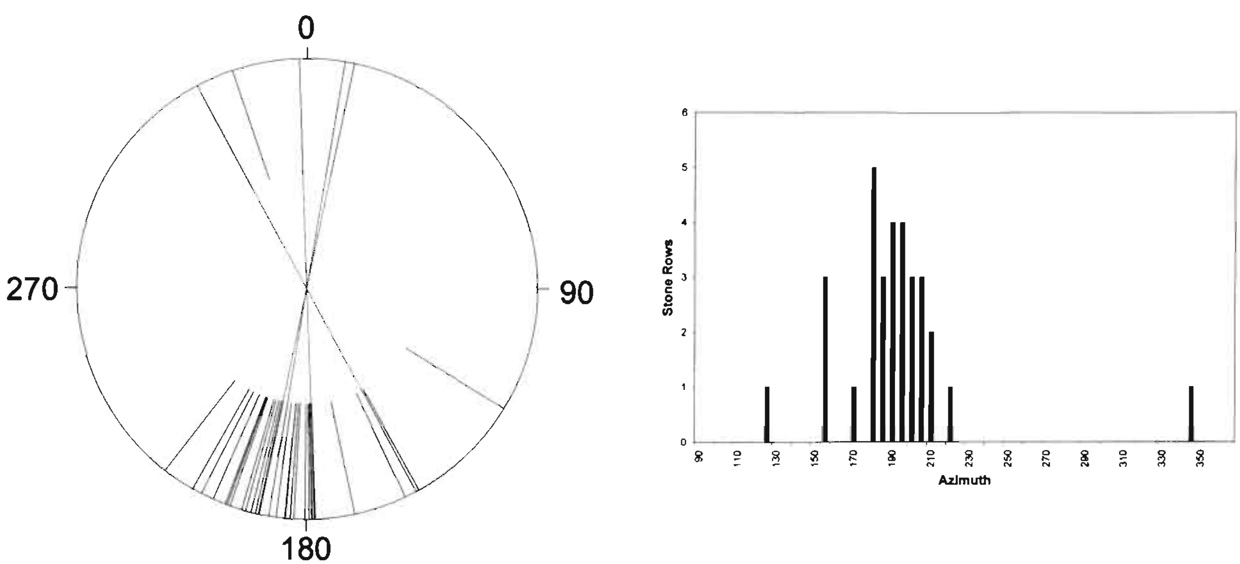


Figure 3. Orientations of all rows

TABLE 1. Two-stone rows and three to six stone rows, Counties Galway and Mayo

COUNTY	SMR Ref.	1:50,000 Sheet Number	TOWN LAND	LAT.°	LONG°	N° in ROW	Ht. GRAD	Axis Azim.°	Observ. Horiz. Alt.°	Sun Dec.°	Moon Dec.°
Mayo	085:027	30	Askillaun	53.7627	-9.8591	5	Y	185.2	1.20	-35.2	-34.3
Mayo	085:027	30	Askillaun	53.7627	-9.8591	3	N	191.8	1.47	-34.3	-33.3
Mayo	086.002	30	Askıllaun	53.7602	-9.8469	4	Y	154.7	0.93	-31.8	-30.9
Mayo	049:015	24	Corlee	54.0229	-9.0231	3	Y	207.1	1.50	-30.4	-29.5
Mayo	Not Listed	38	Crimlin	53.5300	-9.5293	3	Y	167.9	20.03	-15.7	-14.8
Mayo	061:009	31	Cuillonaghtan	53.9736	-9.0558	3	Y	341.0	0.70	34.0	35.0
Mayo	072:128	32	Curryaun	53.8958	-8.8739	2	Y	180.4	-0.18	-36.9	-36.0
Mayo	047:022	23	Derryhillagh	54.0421	-9.3971	2	Y	179.3	2.00	-34.3	-33-3
Mayo	028:006	23	Dooleeg More	54.1093	-9.4807	3	Y	203.9	0.92	-31.9	-31.0
Mayo	028:00304	23	Eskeragh	54.1105	-9.4543	5	Y	192.0	2.05	-33-3	-32.3
Mayo	067:011	31	Keeloges	53.8993	-9.5919	2	Y	187.6	1.50	-34.6	-33.6
Mayo	087:01402	31	Killadangan	53.7819	-9.6032	4	Y	196.3	11.43	-23.4	-22.5
Mayo	087:014	31	Killadangan	53.7758	-9.6043	2	Y	193.9	11.73	-23.5	-22.6
Mayo	067:001	30	Rosgaliv	53.9029	-9.6964	2	Y	217.8	-0.05	-28.3	-27.5
Mayo	123:06006	38	Toorard	53.4947	-10.1259	2	N	151.6	0.00	-32.1	-31.2
Galway	022:002	37	Attigoddaun	53.5502	-9.0481	2	N	189.4	0.00	36.5	-35.5
Galway	042:010	38	Ballinvoher	53.5053	-10.0684	2	Y	209.6	0.00	-31.7	-30.8
Galway	022:099	37	Ballynew	53.5583	-9.9598	2	Y	121.2	1.08	-17.3	-16.5
Galway	023:038	37	Baunoge	53.5406	-10.0107	3	Y	178.7	1.03	-35.8	-34.9
Galway	022:023	37	Cloonederowen	53.5468	-10.0246	2	Y	200.1	3.38	-30.9	-29.9
Galway	022:028	37	Crocknaraw	53.5347	-10.0144	2	Y	184.0	4.07	-32.5	-31.5
Galway	022:03003	37	Crocknaraw	53.5377	-9.9870	2	Y	178.5	3.57	-33-1	-32.1
Galway	010:003	37	Derryinver	53.5836	-9.7870	6	Y	195.3	1.55	-33.8	-32.8
Galway	024:002A	37	Gleninagh	53.5334	-9.6538	6	Y	199.4	9.22	-25.2	-24.3
Galway	025:010	37	Knockaunbaun	53.5350	-9.6186	2	Y	200.6	17.42	-16.9	-16.0
Galway	052:007	45	Oorid	53.4439	-9.6783	2	Y	185.4	5.07	-31.5	-30.5
Galway	025:012	37	Poundcarton	53.5361	-9.9783	4	Y	177.7	20.13	-16.4	-15.4
Galway	023:30A	37	Rosleague	53.5491	-10.0743	2	Y	183.2	2.10	-34.6	-33.6
Galway	022:60	37	Sheeauns	53.5548	-10.0743	3	Y	150.7	5.17	-26.5	-25.6
Galway	Not Liste	37	Sheeauns	53.5553	-10.0761	3	N	178.0	4.07	-32.5	-31.6
Galway	022:67	37	Streamstown	53.5143	-10.0391	2	Y	192.8	1.78	-34.0	-33.0

A preliminary evaluation of the data has been carried out. The astronomical targets considered to be of interest are the extreme positions of the sun and of the moon (at major standstill). The equinoxes and the minor lunar standstill are excluded, there being no evidence in previous studies of similar monuments to support their inclusion. A criterion of closeness of $\pm 1.25°$ (suggested by the data) to the target declinations, with a corresponding azimuth sector width of $\pm 2.45°$ was adopted for the test. The probability of eight astronomically significant alignments occurring in a group of 30 by chance is estimated at 0.01 or 1% which is statistically interesting. Additional statistical testing is therefore justified. Further fieldwork is also envisaged at several other sites, not included in the original data base list.

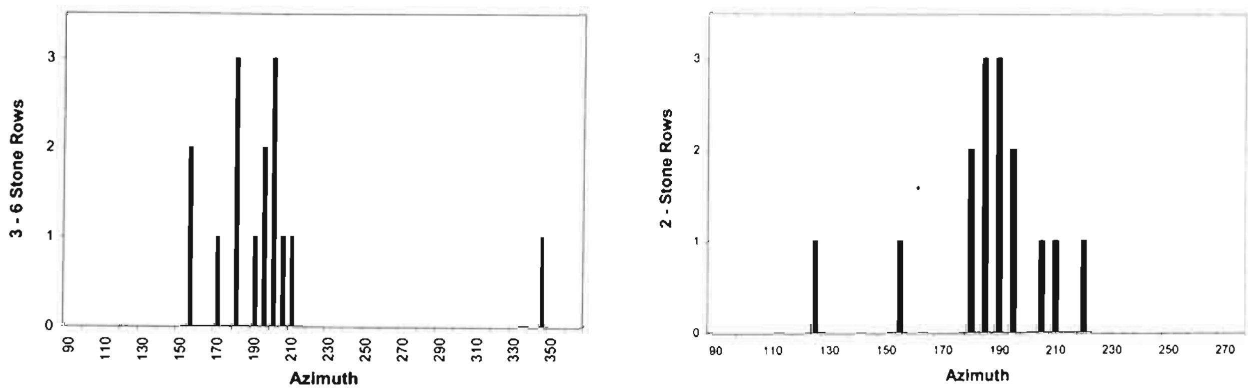


Figure 4 Orientations of 3-6 stone rows and 2-stone rows

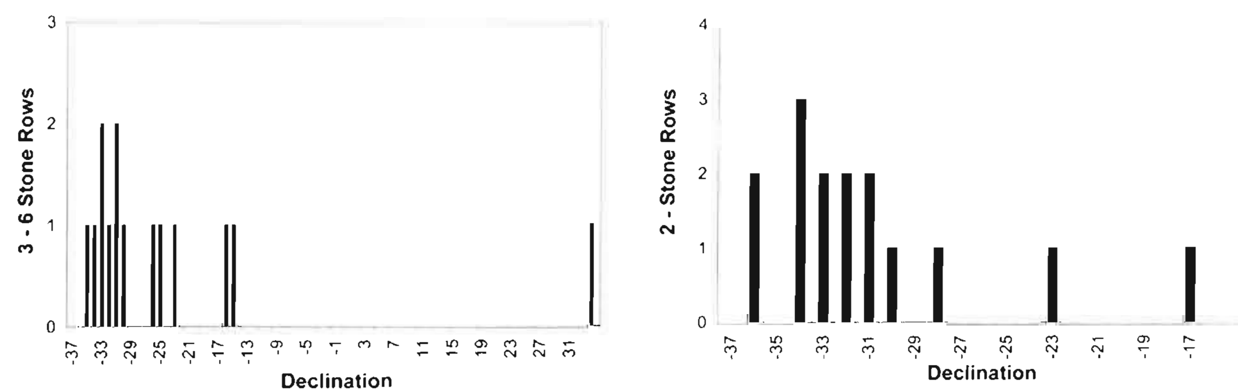


Figure 5. Declinations of 3-6 stone rows and 2-stone rows

ACKNOWLEDGEMENTS

The project would not have been possible without the financial assistance of the Dublin Institute of Technology. My sincere thanks are also due to Paul Walsh and Muiris de Buitlir of Dóchas, Colm Murphy (DIT), and to my wife Paula for considerable assistance with fieldwork

REFERENCES

F. H. A. AALEN, K. WHELAN and MATTHEW STOUT (eds.), *Atlas of the Irish rural landscape*, (Cork University Press, 1997), 329-344.

O. ALCOCK, K. DE HÓRA, P. GOSLING, *Archaeological Inventory of County Galway*, (Stationery Office, 1999), Vol.2: North Galway.

C. CORLETT, "The prehistoric archaeology of the parish of Kilgeever, South-West County Mayo", *Journal of the Galway Archaeological and Historical Society*, (1997), 49, 65-103.

C. CORLETT, "A survey of the standing stone complex at Killadangan, County Mayo", *Journal of the Galway Archaeological and Historical Society*, (1998), 50, 135-150.

P. GOSLING, *Archaeological Inventory of County Galway*, (Stationery Office, 1993), Vol.1.

N. KOEBERL, "Quartz: Some of its uses in Irish prehistory", *Trowel* (1997), 8, 7-11.

A. LYNCH, "Excavation of a stone row at Maughanasilly, Co.Cork", *Journal of the Cork Historical and Archaeological Society*, (1999), Vol. 104.

S. P. O'RIORDAIN, *Antiquities of the Irish countryside*, 5th edn. Revised by R. de Valera, (Methuen, 1979).

F. T. PRENDERGAST, "Orientation for Archaeoastronomy: a geodetic perspective", *SEAC 98 Proceedings 1998* (in press).

C. L. N. RUGGLES, "The stone rows of S. W. Ireland: A first reconnaissance", *Archaeoastronomy* (supp. to *Journal for the history of astronomy*), *no.*19 (1994), S1-S20.

C. L. N. RUGGLES, "Stone rows of three or more stones in South-West Ireland", *Archaeoastronomy* (supp. to *Journal for the history of astronomy*), no.21 (1996), S55-S71.

GAZING AT THE HORIZON: SUB-CULTURAL DIFFERENCES IN WESTERN SCOTLAND?

Gail Higginbottom[1,2], *Andrew Smith*[2], *Ken Simpson*[2] *and Roger Clay*[2]
[1]Centre for European Studies and General Linguistics, University of Adelaide, Adelaide, South Australia, Australia, 5000.
[2] Department of Physics and Mathematical Physics, University of Adelaide, Adelaide, South Australia, Australia, 5000.

1. BACKGROUND

As recognised by Ruggles and Burl in 1995, investigations of British Isles sites:

"Must be done in the absence of independent evidence from historical documents, literature (and) myth... indeed of any *direct* evidence apart from the archaeological record itself... One thing we can do, however, is *to look for repeated trends* within the archaeological record, using them to suggest general principles that influenced people's actions *within certain areas at certain times*.[1]"

In independent recognition of this technique, the orientation of the free-standing stones of western Scotland were investigated using cluster analyses previously developed for astronomy and astrophysics (see Figure 1).[2] Conclusive evidence was published by Gail Higginbottom and Roger Clay supporting the deliberate orientation of megaliths in this area.[3] In particular, it was shown that there is a greater geographical extent and strength of orientation preferences in this area than previously reported in the literature. Whilst *within* each of the 4 regions of Uist, Islay (with Jura), Mull (which includes North Argyll, Coll and Tiree) and Argyll (which includes Lorn) the majority of the sites face similar directions, further investigation has demonstrated that there is a difference in directional between these regions. This may support the existence of sub-cultural indication preferences.

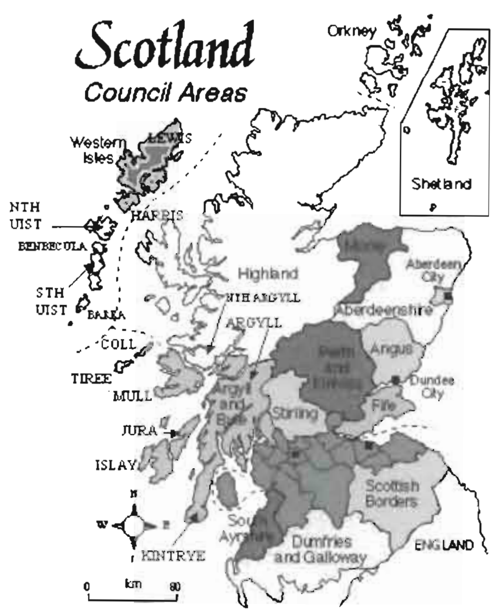


Figure 1: Scotland – Research areas designated by capitals. (Map adapted from http://www.geo.ed.ac.uk/scotgaz/scotland.imagemap)

To discover whether these regional orientation differences were astronomically significant, it was necessary to calculate their corresponding declinations and investigate whether or not the *distribution* of these *observed* declinations could be attributed to chance factors. This part of the project hinges on a type of assessment never attempted before. With generous support from the Ordnance Survey, United Kingdom, we have been able to initiate a major pilot study that allows us to assess the likelihood that an indicated astronomically significant observed declination, or group of observed declinations, is not just an artefact of the surrounding horizon shape or profile. This is necessary as the declinations considered in the archaeoastronomy of

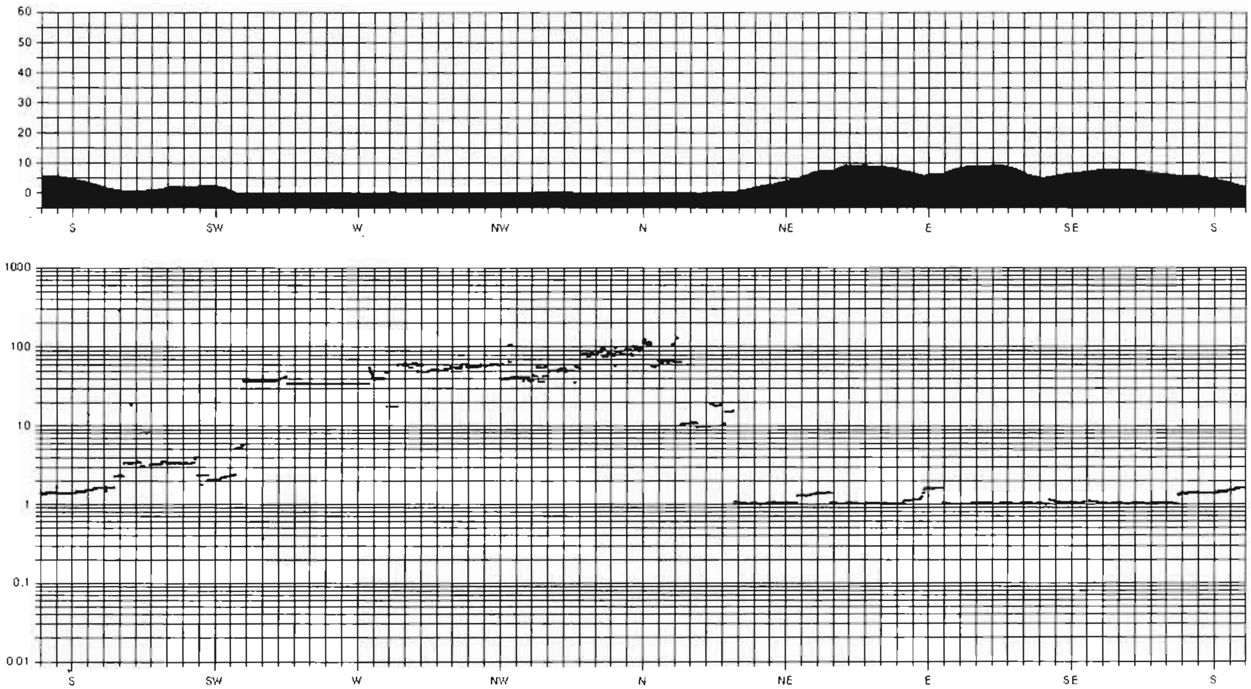


Figure 2: Profile and corresponding horizon distances generated graphically by the Horizon profile program.

the British Isles are based on the assumption that the ancient peoples were interested in celestial bodies as they rose and set along it. In regions that have very undulating horizons it becomes even more imperative to investigate the impact that a horizon may or may not have on observed declination assessment. We can discover whether or not there was an overall interest in the horizon by the builders of the monuments by analysing the over all declination distribution first, and then, by analysing the individual declination ranges (bins) within the declination distribution we can investigate the likelihood that the sites were constructed with astronomical phenomena in mind.

2. METHODOLOGY

Using programs written and tested by Dr. Andrew Smith it was possible to generate the horizon profile of each alignment from the Ordnance Survey digital elevation data, numerically and graphically (see Figure 2). [4] In producing an horizon profile we had to consider each horizon as viewed from the National Grid Reference (NGR) point of each alignment that was given an orientation reading by Ruggles (*Op. cit.*). Determining which NGR went with which alignment was not always obvious from the site descriptions and some had to be calculated by plotting

2.1 Creating a model of expected declinations:

Once all the horizon profiles were generated, we were able to create a single expected model of what the "average" declination distribution would look like for each region. To create this "average" distribution, we sampled each individual horizon profile at uniform intervals of 0.1 degree in azimuth, extracting the corresponding elevation and horizon distance for each of these azimuth points.[5] The azimuth and elevation, along with the NGR (converted to latitude) of the site or alignment, allowed us to calculate the declinations of each elevation point along the entire horizon profile.

We then had a number of declination data files with 3600 declinations each, remembering that the number of declination files you originally have equals the number of *unique NGRs* that you have. To produce the six data files for each region used in the creation of our six expected declination profiles, we had to include an horizon profile for every single *orientation* listed, whether or not it had the same horizon profile as another orientation. For example, you may have a unique NGR representing an alignment made from a simple row of stones (say Stones a-c) that gives no clear indication as to which way the alignment should be viewed, from Stone a or Stone c. You would have, therefore, two orientation measurements for this alignment, say 30^0 and 210^0, and, as the stones are so close they are associated with the *same NGR*. So the same horizon profile's list of declinations has to be included more than once in the statistical analysis. Once all this was done, every single declination file was then concatenated according to region to produce the 6 ultimate files.

With these calculated declinations we were able to create a model of what the *expected* declination spread would be under the null hypothesis for each major geographical region, and with them, we could compare our *observed* pattern of declinations. Remembering that the observed declinations are associated directly with the azimuth readings(orientations) of the site alignments for each region.

2.2 The expected distribution model:

To compare the two different distributions, expected versus observed, it was necessary to scale down the numbers(n) of the expected data files so that the literal overall n in the expected distributions would match that of the observed whilst maintaining the original ratio of *n within* the expected distribution.

2.3 The observed distributions:

Each horizon "point" *indicated* by an alignment is actually variable in width and thus is not a point at all but a linear range or window along the horizon. To assist in understanding the indications, Ruggles divided the indicated azimuths, and thus their corresponding declinations, into 2 sections: the inner azimuth range (IAR), which consists of 2 values which mark the inner indicated range by the monument (the monuments axis), and the AAR, which indicates the furthest possible boundaries on the horizon that the monument could possibly be indicating. For statistical analyses the *mid-point* of the declination windows were used.

2.4 The observed distribution model:

The observed model is created from the observed declinations which are calculated using the azimuth readings (orientations) of the site alignments for each region, the altitudes of the horizon for the corresponding azimuth and the national grid reference of the observer.

2.5 The statistical tests to be used in distribution analysis:

It was decided *a priori* to use the Kolmogrov-Smirnoff (K-S) test to compare the two distributions, as we consider this to be a pilot project, and, such a test, being non-parametric, specifies fewer conditions about the parameters of the populations from which samples are drawn. More over, the K-S test, like the Smirnoff, under the conditions that the population is assumed to be continuous, is distribution free.[6]

2.5.1 The Kolmogrov-Smirnoff test

Though the K-S test has the advantages of specifying fewer conditions it is quite a weak test and thus may accept the null hypothesis when it should be rejected. Also the very nature of declination data is known to lead to a bi-modal distribution, and the K-S test is known to be insensitive to bi-modal distributions. This is because it treats a bimodal distribution as two single mode distributions and though recognising there is twice as much data, it computes the same maximum deviation (the K-S statistic), or difference between the expected and observed distribution, whether there are two modes or one. To obtain a more realistic estimation of the chance probability it was necessary to fold the data at the zero degree (0^0) point, so that we had all positive readings for declination. Remembering, at this point, specific declinations or groups of declinations are not at issue here, only the *differences between the distributions* of the declinations.

2.5.2 The statistical test to be used in the binned declination comparison:

To run the K-S test we had to bin the observed and expected data. The bin sizes were determined by the minimum number(n) that could be placed within a single bin for sensible statistical comparison whilst maintaining a valid spread of data across declinations. Known declination dimensions, or widths, of astronomical phenomena further guided the assessment. Five-degree bins were chosen. It was upon these bins of the unfolded distribution that the next test was run.

There is a way of calculating the chance probability of n occurring *within* a bin. Poisson distribution allowed us to compare the observed distribution with that of the expected, despite n being small. We used the Poisson probability distribution to calculate the probability of observing n sites in a bin where m were expected.[7]

TABLE 1. Kolmogrov-Smirnoff probabilities, where p = probability.

REGION	P	SIGNIFICANCE
Mull	0.00817	YES
Argyll	0.00593	YES
Islay	0.00105	YES
Uist	0.20815	NO
Lewis/Harris	0.65137	NO
Kintyre	0.96539	NO

3. RESULTS

3.1 Kolmogrov-Smirnoff test:

As pointed out by Ruggles in his 1984 study, the expected distribution of declinations is non-uniform (see Figure 3). The K-S test revealed that three of the six observed horizon profiles differed significantly from the expected under the null hypothesis, namely those of Mull, Argyll and Islay (see Table 1). For the regions of Uist, Lewis/Harris and Kintyre, however, we must accept the null hypothesis, for no significant difference was found.

3.2 The binned declination comparisons:

At this stage of the research, we can only outline *possible* interests in astronomical phenomena. As mentioned previously the elevation data does not allow us to calculate exact expected horizon profiles thus disallowing higher resolution comparisons. What we can say, however, is that we have firm evidence for an interest in specific horizon areas corresponding to particular declinations ranges.

When comparing the individual bins (5 degrees) of the horizon distributions, particular observed declination ranges of Mull, Argyll and Islay were found to significantly deviate from the expected bins (Figure 3 and Table 2).

TABLE 2. Poisson distribution outcomes showing significant results of individual bin analyses, where *p is the probability* of outcome. Probabilities in bold are where p<0.05, others are where p <0.1.

REGION	Significant Declination Bin-Widths in degrees	p
Mull	-30 to -35	**0.025**
	-25 to -30	0.0095
	25 to 30	0.077
Argyll	-20 to -25	0.062
	25 to 30	**0.026**
	30 to -35	**0.002**
Islay	-15 to -20	0.051
	-5 to -10	**0.035**
	0 to -5	0.096
	0 to 5	0.095
	15 to 20	**0.005**

4. DISCUSSION

4.1 Gazing at the horizon: distribution evidence?

The results of the declination distribution assessment, along with the previous azimuth assessment, revealed to us that for the areas of Argyll, Mull and Islay, the *horizon* was of significant consideration in the positioning, and perhaps design, of the monuments. Uist has shown a very strong interest in the deliberate orientation of monuments (B= 15.93; p< .005), however general interest in the horizon is not supported by the K-S tests.

4.2 Astronomical significance: bin evidence?

The declinations for the monuments in Mull (Nth. Argyll, Coll & Tiree) have the strongest statistical support for the southerly range -30 to -35; along with the flanking range of -25 to -30 having minor support. For the former range, the declination windows for 5 of the 6 indications, span from -30.4 to -32.6, and for the latter, the declination windows for 4 of the 6 values range from -28.2 to -30.1. The northerly declination range 25 to 30 also has minor support and it should be noted that *all* the mid-declinations investigated in this range fell between 28 and 29.85 degrees with the windows ranging from 27 to 30.2. As this is the case, it is tempting to infer that all of the observed declinations may indicate an interest in the Major standstill of the moon which is approximately +28 and -30 during the second and third millennia B.C. .

When taking into account the declinations corresponding azimuths we discover that for all the declinations within the -30 to -35 and -25 to -30 ranges, exactly half are focused upon a rising phenomena, and half upon the setting for each range. The geographical position of these indicated ranges may also have some social significance, for, of the ten back-sight sites, 4 are on Coll/Tiree (CT 1,2,7,9) and four are in Northern Mull (ML1,2,4,11). This spread is similar for 25 to 30, where 4 of the 5 back-sight sites reside in the same areas (ML 10; CT 1, 3, 9).

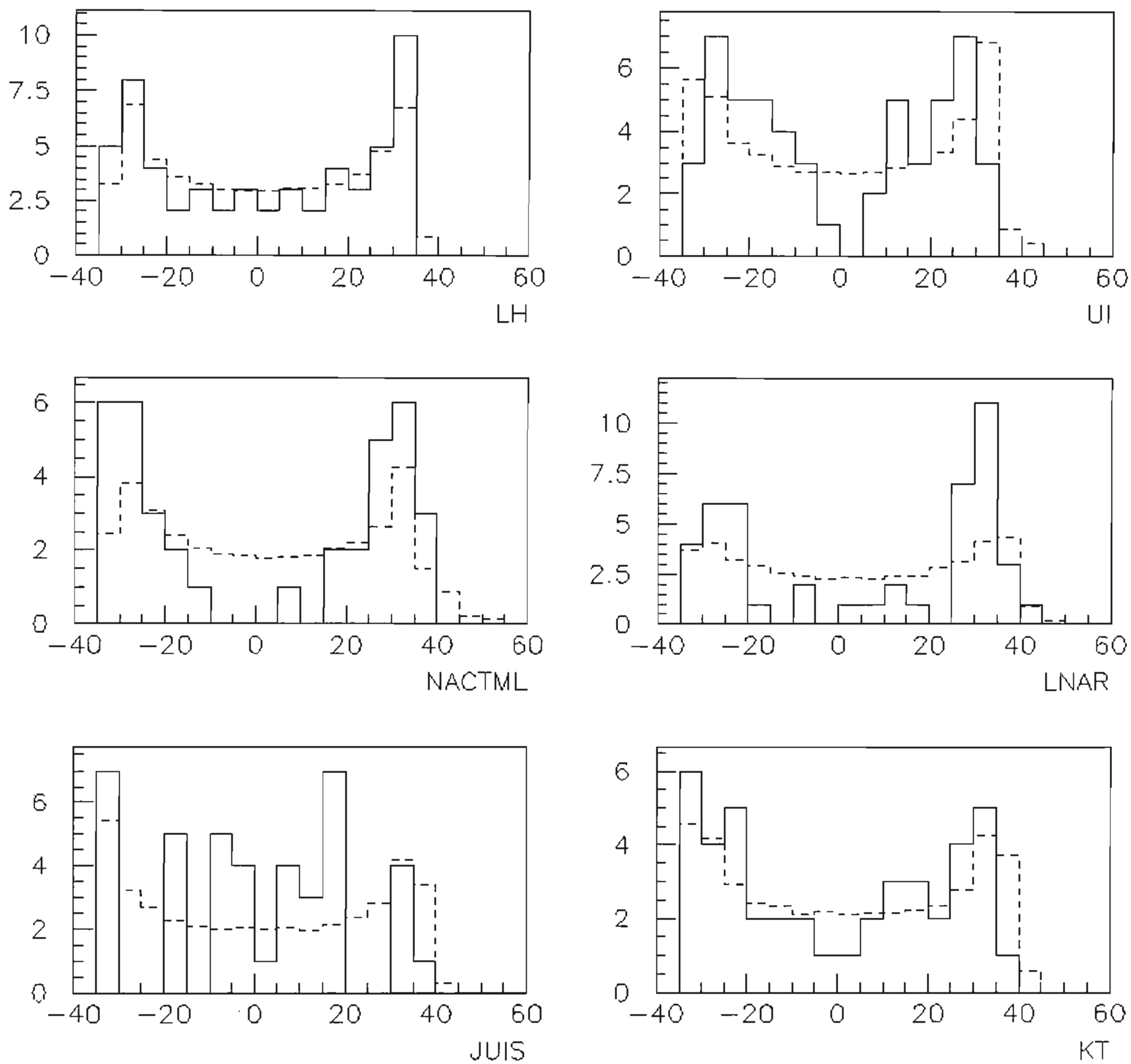


Figure 3. Graph showing the expected and observed declination comparisons for each region. The dashed lines are the expected distribution and the solid, the observed.

Argyll's significant declination ranges include -20 to -25, 25 to 30 and 30 to 35. The southerly indications (-20 to -25) fall around the solstice, 4 about the midwinter sunrise and 2 about midwinter sunset (+24 = solstice). The orientations associated with the northerly declinations of 25 to 30 maybe indicating an interest in lunar phenomena towards the Major standstill (+28) , in the same way that Mull's may have. The corresponding declination windows range from 23.3 to 30.6, with 5 of 7 falling above 26.

The range of 30 to 35 is a little perplexing from the solar-lunar perspective, for 11 of the 13 declination windows have a minimum value above 32.2 degrees thus primarily falls outside of the range of probable interest in the sun's and the moon's movements. Even though there is some anthropological evidence for a society focusing on the "negative" areas of the sky (i.e. areas *without any* celestial objects), it seems unlikely, with there already being a concentration upon these 2 major objects in this region, that there may also be a deliberate attempt to avoid *all* lunar and solar events.[8] The most likely celestial phenomena of interest along the horizon that can be hypothesised, at this stage of the project, is the Milky Way. At these latitudes and this declination range it has a great concentration of bodies and Magallanic cloud formation and is very striking in appearance.

Islay's ranges are most unusual in that the significant ones fall within those very ranges that Ruggles found an overall avoidance for in western Scotland, namely -15 to +15 degrees. We know that -5 to +5 in declination flanks the equinox points of east and west, and can be loosely calculated by dividing the horizon in half between solstices (which is a simple arc in shape). The ±15 to ±20 range may indicate an interest in the Lunar phenomena of the minor standstill. Interestingly Islay significantly avoids all solstitial ranges by completely shunning the -30 to -20 and 20 to 30 ranges. We have no simple explanation or hypothesis for the range -15 to -10.

On the theme of specific *phenomena* preclusion, it should be noted that there is a significant avoidance of the ranges -10 to -15, and 15 to 20 and 20 to 25 in the region of Argyll. While Mull shows disinterest in -5 to +10 and 10 to 15. Uist has significant avoidance between -5 to +5 and 30 to 35.

5. CONCLUSION

Our investigations have initially shown us that the deliberate consideration of monument direction was an integral part of monument design, further, that for 3 of these 4 regions the horizon was of significant interest to the builders of those same monuments. For those regions of Islay, Mull and Argyll, particular astronomical phenomena were specifically chosen to be the focus of the direction of these monuments.

5.1 Subcultural differences

The combination of information from avoided and preferred ranges shows us that there *are* significant *regional differences* in the designing, and perhaps placement, of the monuments. It appears that deliberate choices have been made within each of the three regions for an indication preference and thus a preferred direction. However, there are still unanswered questions or quandaries. For instance, if Uist has the highest significance rating for the deliberate orientation of the western monuments studied here ($\beta = 15.93$, $p < .005$), what are the monuments "facing" if the horizon is of no apparent general interest (K-S probability = 0.20815)?. Why is the range -15 to –10 of interest to the people of Islay?

5.2 Work in preparation:

In an attempt to answer these perplexing questions, and in the hope of understanding the monuments at a deeper level, we will be combining these results with other landscape studies and the placement of other sites and objects within these regions. In this way we will be implementing a multi-faceted, regionally based study that may help us further unearth the regional qualities that exist within western Scotland.

NOTES AND REFERENCES

1. C. L. N. RUGGLES and A. BURL, "Astronomical influences on prehistoric ritual architecture in north-western Europe: the case of the stone rows", *Vistas in Astronomy*, 39 (1995), 517.

2. Data from C. L. N. RUGGLES, (principal author), P. N. APPLETON, S. F. BURCH, J. A. COOKE, R. W. FEW, J. G. MORGAN, and R. P. NORRIS; "Megalithic Astronomy: A New Archaeological and Statistical Study of 300 Western Scottish Sites", BAR (Oxford, 1984), **123**.

3. G. HIGGINBOTTOM and R. CLAY, "Reassessment of sites in northwest Scotland: a new statistical approach. "Archaeoastronomy (supp. to Journal far the history of astronomy), no. 17 (1992), S43-55.

4. We used the Landform Panorama Digital Height Data at nominal 1:50 000 scale - Digital Terrain Models (DTMs), created from Ordnance Survey's 'Landranger®' paper maps;

5. The program for this extraction was also designed and tested by Dr. Andrew Smith.

6. C. MITCHELL, *Terrain Evaluation*, (1991, 2nd edition), 157.

7. For large (approx. greater than 30) values of n, the Poisson distributions well approximated by the normal distribution.

8. This is the hypothesis that Ruggles (1984) proposes, 277.

ARCHAEOASTRONOMY STUDY ON THE DISPOSITION OF SARDINIAN NURAGHES IN THE BRABACIERA VALLEY

Mauro Peppino Zedda
lover of Astronomy and Archaeology, Isili, Sardinia
and
Paolo Pili
Topographer, Mandas, Sardinia

INTRODUCTION

In the last years, archaeoastronomical investigations, guided by Michael Hoskin[1], showed that dolmen and *tombe di giganti* in Sardinia, are faced (excepting some anomalies in the southern part of Sardinia) in the direction where the sun or the moon rise, climb and culminate in the sky.

Considering the importance Sardinian people attached to the sun or to the moon to orientate their tombs during the Nuraghic period, it's very interesting to begin a systematical archaeoastronomical investigation of the thousands of mysterious buildings well known as *nuraghes*.

The first impulse to utilise archaeoastronomy to investigate about nuraghes was given by the well-deserving anthropologist Carlo Maxia, together with the astronomer Edoardo Proverbio. They measured the orientations of the entrances of a significant number of nuraghes, and data showed an orientation faced to the arc of horizon comprised between east and south[2]. Even if we appreciate the merits of their research, we criticise the way in which Maxia and Proverbio interpreted the collected data. In fact, there is not sufficient evidence to support an astronomical meaning connected with particular stars, but only the possibility to establish that nuraghes' entrances were faced to the sun or the moon rising, climbing and culminating in the sky, as Hoskin and others have supposed for the tombs[3].

In the '90s one of the writers started out some researches about nuraghes. One of these examined the relations among the nuraghes in the Brabaciera Valley and pointed out a series of astronomical alignments connected to the points where the sun or the moon rise and set in their standstills[4].

Now the analysis of the relations among nuraghes in the Brabaciera Valley is reprocessed through accurate measures in order to give an answer to the following questions:

1) Are there alignments referring to the solstices and lunar standstills?

2) If so, is it possible to know their intentionality or casualness?

3) If they are intentional, have they a calendar or a symbolic meaning?

4) Are there alignments referring to the half-point (in time) between the two solstices?

THE ARCHAEOLOGICAL CONTEXT

The nuraghe is, undoubtedly the most peculiar monument of Sardinia. It gave its name to the mysterious Nuraghic civilisation dated, until a few years ago, according to Giovanni Lilliu to the period between 1855-238 B. C. [5]. This chronological supposition has been overcome by up to date studies that indicate the presence of nuraghes back to 2000 B. C. [6] and indicate the ninth century B. C. as the end of the Nuraghic civilisation[7].

We don't know the exact number of extant nuraghes: they should be about 7500. We can classify them into two classes: the *cupola* or *tholos* construction and the *corridor* construction[8]. The cupola ones are the greater part and are further subdivided into the "simple" (only one tower) and "complex" (with more towers). The simple nuraghes can have one or two superposed floors, and the complex nuraghes sometimes have three floors. They all have a stair, situated inside the wall face, which leads, as a spiral staircase, to the terrace placed on the top of the nuraghes.

The nuraghic civilisation is still surrounded by mystery. In fact there is a lot of disagreement about the theories of the nuraghes' function: fortresses, towers where the corpses lost their flash, homes, mausoleums where the incubation ceremony took place, temples of initiation, towers of sun worship, oracle temples[9]. We think that the most scientific hypothesis are those drawn up by the architect Franco Laner[10], by the archaeologist Giacobbe Manca[11] and by the anthropologist Giorgio Baglivi[12] that from different points of view show that to different typologies of nuraghes corresponds an unique constructive technique where it is possible to discover buildings with different functions. It is interesting to observe that Laner's theory indicates that the great part of nuraghes has a symbolical meaning whose aim was to order, with their territorial orientation, the time and the spiritual life of people who built them.

THE TERRITORY, THE NURAGHES AND THE TYPE OF ARCHAEOASTRONOMICAL ANALYSIS

The territory, object of our study includes the Brabaciera Valley and the surrounding relieves. It is 30 km squared wide and includes some of the countryside of Isili, Serri and Nurri, with an altitude comprised between 500 and 700 metres on the sea level. It is located 39°43' and 39°46' north latitude. In this valley there are 33 nuraghes.

In this study we tried to understand if the disposition of the nuraghes has been carried out in conformity with astronomical standards. In order to do that, we have considered the alignments – occurring among some of the 33 nuraghes – formed by a nuraghe of observation and a nuraghe of reference.

We want to specify that the function of observation is a prerogative of all nuraghes (the terrace is the natural place), while not all nuraghes can be used as a point of reference, because it is possible to use them as targets only seeing them in outline on the horizon. We have analysed every nuraghe under these two aspects, and on the basis of their particular location in the territory the nuraghes' function has been defined. In the greater part of the alignments the nuraghes of observation and of reference have been outlined by the nature of the territory. But, it's interesting to consider that some alignments have a double functionality due to the fact that both nuraghes are seen in relief on the horizon.

If it was possible from each nuraghe – in the Brabaciera Valley – to see all the others in outline on the horizon there would be 1056 (32x32) alignments to consider, but since in the most part of these alignments none of the two nuraghes can act as nuraghe of reference, their number lowers to 205. For this reason the archaeoastronomical analysis will concern 205 alignments that show the features above described and, we repeat it, they are composed by a nuraghe of observation and a nuraghe of reference which can act as a foresight.

The theodolite used to make measuring is a station WILD TC 1600 K. Declinations have been determined using the "Clive Ruggles Software" provided by Michael Hoskin. Tables 1 and 2 show the data about alignments oriented with solar and lunar standstills.

TABLE 1: significant alignments that show a great precision, with the declinations relative to altitudes data of the horizon beyond the nuraghes of reference and the ones concerning their top.

Backsight	Foresight	Azimuth	Alt. Hor.	Declinat.	Lunar dec.	Alt. top nur.	Declinat.	Lunar dec
Atzinnara	Sa Fiskida	118°58′	3°21′	+19°41′	+19°01′	3°26′	+19°37′	+18°58′
Angusa	Is Paras	301°37′	0°42′	-23°56′	-24°36′	1°01′	-24°11′	-24°51′
Asusa	Calameda	116°27′	1°14′	+19°27′	+18°48′	1°18′	+19°23′	+18°44′
Cumbiduc.	Tacquara	116°07′	0°00′	+20°11′	+19°32′	0°06′	+20°05′	+19°26′
Is Paras	Tacquara	130°00′	0°25′	+29°40′	+28°53′	0°28′	+29°38′	+28°56′
Ladumini	Asusa	307°49′	0°00′	+27°42′	+28°24′	0°00′	+27°42′	+28°24′
Longu	Su Filixi	241°39′	1°54′	-20°19′	-19°40′	1°57′	-20°17′	-19°37′
Longu	Pitzu Runcu	291°59′	3°44′	+19°04′	+19°41′	3°50′	+19°08′	+19°45′
Longu	Sa Fiskida	120°22′	4°18′	-19°59′	-19°19′	4°23′	-19°55′	-19°15′
Maurus	Longu	67°38′	1°24′	+17°42′	+18°20′	1°37′	+17°51′	+18°29′
Maurus	Is Paras	292°16′	0°54′	+17°15′	+17°53′	1°08′	+17°26′	+18°04′
Musera	Nuraccioni	67°20′	1°51′	+18°15′	+18°53′	1°57′	+18°20′	+18°57′
Nueddas	Antini	58°57′	1°23′	+24°04′	+24°44′	1°23′	+24°04′	+24°44′
Nueddas	Is Paras	300°43′	0°54′	+23°28′	+24°07′	1°08′	+23°38′	+24°18′
Ruina Franca	Tacquara	130°57′	1°02′	-29°47′	-29°05′	1°08′	-29°42′	-29°00′
Ruina Franca	Asusa	301°23′	0°33′	+23°40′	+24°19″	0°33′	+23°40′	+24°19′
Ruina Franca	Is Paras	308°35′	0°20′	+28°31′	+28°12′	0°31′	+28°40′	+29°21′
S'acqua Salia	Tannara	122°55′	2°00′	-23°29′	-22°49′	2°08′	-23°23′	-22°43′
Minda Maiore	Nuraccioni	55°04′	2°58′	+28°02′	+28°42′	3°09′	+28°10′	+28°50′
Perdosu	Longu	52°35′	1°21′	+28°33′	+29°14′	1°49′	+28°55′	+29°36′
Perdosu	Calameda	131°23′	2°27′	-28°55′	-28°12′	2°43′	-28°42′	-28°00′
Angusa	Tannara	117°26′	0°55′	-20°24′	-19°45′	2°04′	-19°31′	-18°52′
Antini	Nuraccioni	126°38′	4°19′	-24°18′	-23°37′	4°50′	-23°55′	-23°13′
Minda Maiore	Tannara	127°13′	4°16′	-24°44′	-24°01′	4°41′	-24°24′	-23°42′
Ladumini	Asusa	307°49′	0°00′	+27°42′	+28°24′	0°00′	+27°42′	+28°24′

TABLE 2: significant alignments that show a smaller precision, with the declinations relative to altitudes data of the horizon beyond the nuraghes of reference and the ones concerning their top.

Backsight	Foresight	Azimuth	Alt. Hor.	Declinat.	Lunar dec	Alt. top nur.	Declinat.	Lunar dec
Atzinnara	Su Filixi	234°39′	2°14′	-25°01′	-24°20′	2°07′	-25°06′	-24°25′
Crastu	Gruxedu	116°52′	0°41′	-20°10′	-19°31′	1°10′	-19°48′	-19°09′
Gruxedu	Tacquara	123°31′	0°22′	-25°13′	-24°33′	0°29	-25°08′	-24°27′
Ladumini	Gruxedu	291°52′	1°17′	+17°15′	+17°53′	1°37′	+17°29′	+18°07′
Nueddas	Longu	60°04′	1°09′	+23°06′	+23°45′	1°28°	+23°20′	+23°59′
Nueddas	Angusa	299°01′	0°54′	+22°14′	+22°53′	1°18′	+22°32′	+23°11′
Perdosu	Antini	54°02′	1°18′	+27°31′	+28°11′	1°34′	+27°43′	+28°24′
S'acqua Salia	Calameda	125°41′	1°45′	-25°37′	-24°56′	1°51′	-25°32′	-24°51′
Trucciu 1	Pitzu Runcu	298°38′	2°06′	+22°52′	+23°30′	2°13′	+22°57′	+23°35′
Trucciu 1	Gruxedu	236°35′	0°17′	-25°13′	-24°33′	0°11′	+25°18′	+24°38′
Trucciu 2	Pitzu Runcu	302°53′	1°38′	+25°36′	+26°16′	1°49′	+25°44′	+26°23′
Guddidroxiu	Nuraccioni	56°22′	3°12′	+27°18′	+27°57′	3°22′	+27°25′	+28°04′
Minda Maiore	Calameda	135°19′	2°44′	-31°13′	-30°28′	3°04′	-30°57′	-30°13′
S'acqua Salia	Sa Mandara	239°58′	3°52′	-20°04′	-19°24′	4°00′	-19°57′	-19°17′
Maurus	Tannara	123°12′	2°40′	-23°11′	-22°30′	2°48′	-23°05′	-22°24′

ANALYSIS OF DATA

After these previous statements, we'll go into details with the analysis of the orientations occurring among the nuraghes in the Brabaciera Valley.

Describing the kind of archaeoastronomical analysis we explained that there are 205 alignments having the necessary features (we refer to the presence of a reference nuraghe) to take them into account. When we observe the data in the tables we can answer in an affirmative way to the question concerning the presence of alignments oriented in direction of the solstices and lunar standstills.

After checking the presence of alignments that have an astronomical meaning, we can discuss the other question: are these intentional or fortuitous orientations?

An important fact to establish the non-casualness is given by the alignments where Longu, Antini and Asusa act as nuraghes of reference. We consider a very good proof of their intentionality, the fact that these three nuraghes can act as nuraghes of reference only seven times and that all alignments they are part of, have an astronomical meaning (7 out of 7). The intentionality comes out from the four astronomical significant alignments where Is Paras is the reference nuraghe. Even though they come out of the context where Is Paras can act as a nuraghe of reference for seventeen nuraghes in the Brabaciera Valley (4 out of 17), we believe that there is no doubt about their intentionality. In fact, trying to shift the position of nuraghe Is Paras is not possible to obtain, at the same time, more than one significative alignment connected with the solar and lunar north-western stanstills.

The intentionality widely comes when we consider the alignments that have as observation place the nuraghes Nueddas, Maurus, Ruina Franca and an altitude lower than 2°, i.e. the alignments Nueddas-Antini, Nueddas-Is Paras, Nueddas-Longu, Maurus-Is Paras, Maurus-Longu, Maurus-C. Serri, Ruina Franca-Tacquara, Ruina Franca-Asusa, Ruina Franca-Is Paras. Well, 8 of these 10 alignments (3 out of 4 Nueddas, 2 out of 3 Maurus, 3 out of 3 Ruina Franca) have an astronomical meaning!

The extraordinary position of Nueddas (for the sunrise and the sunset at the summer solstice) and of Maurus (for the moonrise and the moonset at the minor northern lunar standstill) as to the nuraghes of reference Antini-Longu at rising and Is Paras at setting, induces us to wonder why these two nuraghes of reference have not the same nuraghe of observation both at the moonrise and the moonset on major north-western lunar standstill, since they have two – Perdosu at rising and Ruina Franca at setting -. This situation is explained by observing that in the place where there should be the nuraghe suitable for this purpose the nuraghe Longu is not visible standing out on the horizon. We think that the lack of this basic requisite (since it's not possible to use it as a reference nuraghe) conditioned and determined the choices. Our observation meant to show the existence of a *nuraghes system* astronomically ordered. This system is depicted in a drawing (Figure 1).

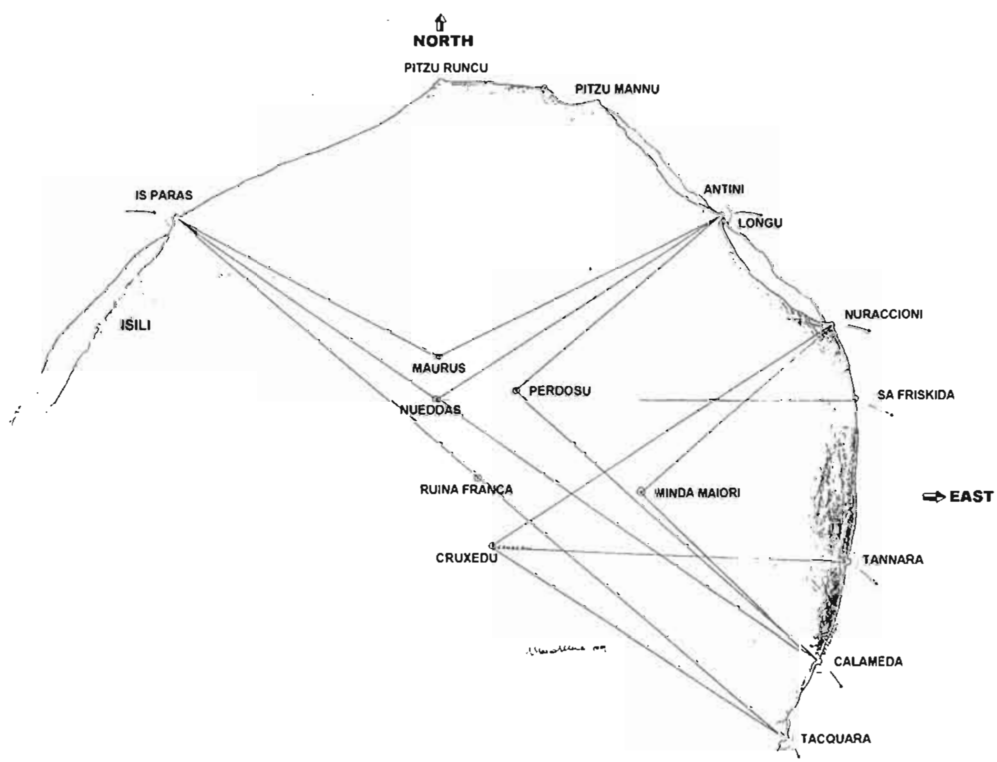


Figure 1. The most sifnicative alignments and the horizon surrounding the Brabaciera Valley. We see the nuraghes of references on the horizon (as seen from Nueddas) and those of observation in planimetric plane.

Very interesting is also the position of the nuraghes Sa Fiskida, Su Filixi and Pitzu Runcu in relation to Longu (this time as a nuraghe of observation), because they give rise to three orientations suitable for surveying the moonrise and moonset at the minor lunar standstills (except for north-eastern standstill). We should now wonder about the absence of the fourth nuraghe of reference (as well as heralding unexpected developments of the whole future research). The position of the nuraghe Longu (situated on the relief closing the north-eastern sector of the Brabaciera Valley) permits to observe a north-eastern horizon entirely changed in comparison with the one that can be observed from Nueddas. The mountainous territories of Sadali and Seui, which in that direction delimit the horizon's outlines, are tens of kilometres far from Longu, a distance that not allows a nuraghe to be a reference point, because it cannot be seen. This geographic situation is of a great interest to us since it introduces another question, i. e. the possibility that the fourth reference point was a point on that distant horizon, for it couldn't be a nuraghe. To evaluate this hypothesis it would be opportune to investigate, by mean of archaeoastronomy, the horizon which surrounds the nuraghes (or at least the one which surrounds the most ancient nuraghes) in the same way it has been done for some monuments in Scotland, Ireland and Canary Islands[13].

We think that the illustrated situations are sufficient to answer the second question, that is if in the Brabaciera Valley the disposition of a congruous number of nuraghes (not all of them) has been done following astronomic rules concerning the points in which the sun and the moon rised and set in their standstills.

Now, after pointing out the astronomic motivations that brought about the choice of the place where to situate the nuraghes, we will proceed to answer the third question related to alignments' meaning, that is if they were referred to calendar or symbolic functions. For this purpose, we arranged to refine the measures of alignments oriented to the directions of the solstices and lunar standstills. This kind of work enabled us to obtain, with a good approximation, data relative to the top of nuraghes' terrace which, we believe, was the natural observation place. Data so refined have been quoted in columns 7,8 and 9 of the tables 1 and 2. The subdivision of the alignments in two tables has been done on the basis of what we think to be their different meaning. The alignments that show a great precision have been included in table 1, while those with a smaller precision are in table 2. The examination of these data makes us prone to hold the answer to the third question in abeyance, and to put it off until archaeoastronomic investigation will be concerned about other areas of Sardinia.

Let's go on to the fourth question: are there any alignments referred to the half-point in time between the two solstices? It is obvious that the way in which we refer to the day that today we consider as an astronomic event, imply that on this subject we share Ruggles' argument [14]. We think that Ruggles position is right, not for a terminological formalism but because when we interprete the collected data we should leave out the present occidental oriented way to intend astronomy, and adopt (as far as we can) that of the culture under survey. Going back to the answer to the fourth question, two alignments Nueddas-Sa Fiskida (Az. 92° - Alt. 3°32' – Dec. +0°35') and Gruxedu-Tannara (Az. 91°30' – Alt. 1°55' – Dec. –0°08') have an orientation that can be referred to the half-point in time between the two solstices. It is very difficult to establish the intentionality or the casualness of these alignments. Considering that Nueddas and Gruxedu act as nuraghes of observation in alignments connected with the solstices (see tables 1 and 2) we are inclined to think about intentionality, but considering the weakness of the element that support it we also believe that in this case is opportune to postpone the answer until researches will be concerned about other Sardinian areas.

At the end of this paper, we must stress that the examined nuraghes represent only the 0.5% of the extant and we hope that in the next years the investigation will be expanded to other areas of Sardinia. Among the several questions that could be investigated in the future we point out the following:

1) Is the astronomical significance we checked among the nuraghes of Brabaciera Valley present in other areas of Sardinia?

2) If so, has it a calendar or a symbolic meaning?

3) What degree of knowledge about the lunar motion had the nuraghic civilisation?

4) The disposition of the *talayots* (Balearic Islands) and *torri* (Corsica) has been carried out in conformity with astronomical standards?

Beside the study on relationship among nuraghes, it is important to investigate about orientations of architectural details of every single nuraghe (in their various typologies) as well as it has been done by J. Belmonte, A. Aparicio and C. Esteban about the "Majanos de Chacona" in the Canary Islands [15] and by Mauro Zedda about the triangular nuraghes [16].

ACKNOWLEDGEMENTS

The authors are much indebted to Donatello Orgiu, Michael Hoskin, Juan Antonio Belmonte and Franco Laner for their advice and information; to Pietro Mura, Francesca Pili, Roberto Siddi, Paolo Sanna and Marco Porcu for their assistance; to Angela Fadda and Samuele Pucci for the English translation; to Marco Mura for the drawings. A further acknowledgement goes to Clive Ruggles for his computer program used to calculate declinations.

REFERENCES

1. M. HOSKIN, E. ALLAN and R. GRALEWSKI, *"Tombs and Temples of Nuraghic Sardinia"* in *Archaeoastronomy* (supplement to J. H: A.) n. 18, Cambridge 1993; MAURO ZEDDA, M. HOSKIN, R. GRALEWSKI and GIACIBBE MANCA, *"Orientation of 230 Sardinian Tombe di Giganti"* in *Archaeoastronomy* n. 21, Cambridge 1996; M. HOSKIN and M. ZEDDA, *"Orientation of Sardinian Dolmens"* in *Archaeoastronomy* n. 22, Cambridge 1997.

2. C. MAXIA and EDOARDO PROVERBIO, *"Orientamenti astronomici di monumenti nuragici"* in *Scientia* vol. 107 pagg. 861-867, Roma 1972; C. MAXIA and LELLO FADDA, *"Il mistero dei nuraghi svelato con l'astroarcheologia"*, Cagliari 1984.

3. M. HOSKIN and M. ZEDDA, op. cit. (ref. 1).

4. M. ZEDDA, *"I nuraghi il sole la luna"*, Cagliari 1992.

5. G. LILLIU, *"La Civiltà dei Sardi, dal paleolitico all'età dei nuraghi"*, Torino 1988; idem, *"La Sardegna Nuragica"*, Sassari 1982

6. G. S. WEBSTER, *"Barore, loc. Duos Nuraghes"* in *Scavi e Scoperte, Bollettino Arch. M. BB.CC.AA.*, Roma 1990.

7. G. MANCA, in several issues of *"Sardegna Antica Culture Mediterranee"* and *"Premessa Critica"* in *I Nuraghi e loro importanza* di A. M. Centurione, Nuoro 1995.

8. G. LILLIU, op. cit. (ref. 5).

9. Idem, (ref. 5); M. PITTAU, *La Sardegna Nuragica*, Sassari 1977; CARLO MAXIA and LELLO FADDA, op. cit. (ref. 2); MAURO MAXIA, *Un tesoro riscoperto*, Nuoro 1991; RAFFAELE SARDELLA, *Il sistema Linguistico della Civiltà Nuragica*, Cagliari 1994; GIANNI ATZORI and GIGI SANNA, *Omines*, Oristano 1996; ERCOLE CONTU, *La Sardegna preistorica e nuragica*, Sassari 1997; DOLORES TURCHI, *"L'incubazione nella civiltà nuragica"* in *Sardegna Mediterranea* n. 4, Oliena (Nuoro) 1998; GIORGIO BAGLIVI, *"Nuraghe Arrubiu, immagini di una storiografia matriarcale"* in *Sardegna Antica* .C. M. n. 12, Nuoro 1997; Idem, *"Nuraghe Arrubiu, i simboli della trasformazione"* in *Sardegna Antica* C. M. n. 15, Nuoro 1999.

10. F. LANER, *"La construction des Nuraghi en Sardaigne, le Nuraghe envisagé comme machine de lui-meme"*, at page 21 of *Entre Mécanique et architecture*, Ginevra 1993; Idem, *"Dalla tettonica all'architettura, il nuraghe Is Paras o Su Idili di Isili"* in *Sardegna Antica Culture Mediterranee* n. 13, Nuoro 1998; Idem, *Accabadora, Tecnologie delle costruzioni nuragiche*, Milano 1999.

11. G. MANCA, op. cit. (ref. 7) and text of documentary film *"Il racconto dei nuraghi"* produced by "Centro Studi Culture Mediterranee", Nuoro 1997.

12. G. BAGLIVI, op. cit. (ref. 9).

13. See C. RUGGLES and colleagues in several issues of *Archaeoastronomy* (supplement to J. H. A.) and see CÉSAR ESTEBAN, ROSA SCHLUETER, JUAN BELMONTE and OSVALDO GONZÁLEZ, *"Pre-Hispanic Equinoctial Markers in Gran Canaria"* in *Archaeoastronomy* (supplement to J. H. A.) n. 21 and n. 22.

14. C. RUGGLES, *"Whose Equinox?"* in *Archaeoastronomy* (supplement to J. H. A.) n. 22, Cambridge 1997.

15. J. A. BELMONTE, A. APARICIO and C. ESTEBAN, *"A Solstitial Marker in Tenerife"* in *Archaeoastronomy* (supplement to J. H. A.) n. 18, Cambridge 1993.

16. M. ZEDDA, *"I trilobi orientati con le stazioni del sole"* in *Sardegna Antica* C. M., n. 11, Nuoro 1997.

ORIENTATIONS OF THE PHOENICIAN AND PUNIC SHAFT TOMBS OF MALTA

Frank Ventura
University of Malta, Msida MSD 06, Malta

INTRODUCTION

When the Phoenicians extended their sea trade to the western Mediterranean, they found Malta's exceptional harbours a convenient refuge from bad weather and a safe place for wintering. It is not known when the first contacts with the indigenous population occurred and how they affected the prevailing Bronze Age culture. Diodorus Siculus hints that the impact was very positive when he comments that the inhabitants of the island received assistance in many respects from the sea-merchants which enabled them to shoot up quickly in their manner of living and increase in renown.[1] One of the earliest indications of the extent of penetration of Phoenician culture is provided by the discovery of Phoenician remains dating to the late eight Century B.C. (about 725 B.C.) in a tomb at Ghajn Qajjet on the Mdina/Rabat plateau, the area of the highest population density at that time, which is about 8 km away from the nearest harbour. The fairly rapid spread of Phoenician burial customs is manifested by the presence of many roughly rectangular shaft tombs in several localities in Malta and Gozo dating to between the seventh and the sixth Century B.C. and later. Interestingly, the pottery found in maltese tombs of the early period is different from that of other colonies in the central Mediterranean, that is Carthage, Sicily and Sardinia.[2] Then, from the mid-sixth Century B.C. onwards, as Phoenician supremacy declined and Carthage assumed control of the central and western Mediterranean, Malta became a Carthaginian colony with a difference. Since the island was not on the main trade route between Carthage, Sicily, Sardinia and the western colonies, Malta preserved its Phoenician culture and only acquired a Punic character very gradually. This deep-rooted Phoenician-Punic culture persisted until at least the first century A.D. even though the island had fallen under Roman rule in 218 B.C.[3]

BURIAL CUSTOMS

A study of the burial customs that prevailed and, in particular, the orientations of the tombs is important because it may reflect the cultural evolution of the central and western Mediterranean from the eight century B.C. onwards. Thus, the shaft tombs that are so frequent in many former Phoenician and Punic colonies as well as in ancient Phoenicia could serve as markers of cultural dissemination and diversity. Relevant information already exists both from archaeological and archaeoastronomy surveys, though the extent of the data is limited. A good example from archaeology is the study of burial patterns and cultural diversity between 1550 B.C. and 1200 B.C. on the east coast of the Mediterranean, the site of ancient Canaan, the precursor of Phoenicia.[4] The results show that although there is no uniform positioning of pit burials, in some cemeteries there is a distinct pattern apparently based on the custom of orienting the head of the deceased in a particular direction. The most preferred orientation is the west, but in other locations the burials point south, south-east and south-west. Another archaeological study notes that the orientations of some Phoenician tombs of the seventh to sixth century B.C. in Ibiza are N-S, E-W and NE-SW.[5] The later Hellenistic Punic tombs at Monte Luna in Sardinia are positioned towards NE-SW and NW-SE probably because, according to the investigator, it was convenient for the diggers to follow the lie of the land.[6] In Malta, the azimuths of the axes of the six rectangular tombs in two localities not far from the Grand Harbour, which are now built over, can determined from published plans.[7] Two of the tombs have a N-S orientation, another pair of tombs have an E-W orientation, while the other tombs have azimuths of 120-300° and 155-335°. From archaeoastronomy, there is the work by Belmonte and colleagues who measured the orientations of the Punic tombs at Utica, Byrsa and Menzel Temine in Tunisia and compared them to the dolmens of an earlier period. Interestingly, they found that the tombs at Menzel Temine could be associated with sunrise at the equinoxes and the winter solstice.[8]

A survey of the orientations of the Phoenician and Punic shaft tombs of Malta can provide further data about any local preferences of direction and possible association with astronomical events. In Malta, the tombs typically consist of a rectangular shaft about 2m long and 1.3m wide cut vertically into the rock to a depth of about 1.5m with one, two or sometimes three openings at the bottom, each of which leads to an oval or square burial chamber. Access to the bottom of the shaft is usually facilitated by means of three narrow steps on one side of the shaft or by a series of footholds. Occasionally there is a bench at the bottom stretching along one of the sides. Many of the tombs occur in groups of two to four separated by a few metres but much larger groups are found; the largest single cemetery contains 156 tombs. In the majority of burials the body was interred but occasionally the dead were cremated, their ashes placed in cremation urns and buried in the tombs. After inhumation, the burial chamber was sealed with a flat stone and the shaft filled with stones, soil and debris to form a mound. Archaeologists have recorded 668 tombs so far, but unfortunately urban development in modern times has contributed to the complete destruction and loss of many known tombs, and others that were unearthed during construction works but never reported.

MEASURING MALTESE SHAFT TOMBS

For the present study, since it was not known whether the tomb excavators could have been interested in orientating the long axis of the tomb or the opening of the burial chamber in a preferred direction, measurements were made of both orientations. In effect, the orientations of the long axes of 63 tombs were recorded as well as the orientations of 37 burial chambers of those tombs for which it could be ascertained, without excavation, that they only had a single chamber. The azimuths were measured with a compass and the altitude of the skyline in both directions was measured with an accurate clinometer to within ½°. The Maltese Islands are formed of sedimentary limestone and there is no reason to expect any magnetic anomaly. However, only approximate azimuths to within ±2°, at best, could be obtained because the tombs have a relatively short axis, the edges are not perfectly rectangular, and occasionally dense vegetation obstructs the measurement. In three cases, the azimuth of the central axis was measured either because the shape of the shaft was distinctly trapezoidal or it had a curved edge. Five tombs with a square plan presented another difficulty which was resolved by measuring only the axes whose directions were similar to those of adjacent tombs and ignoring the directions at right angles to them. This decision conforms to the pattern observed in this study and in previous work[9] that tombs in the same area tend to have similar azimuths, though this is not a rigid rule.

The measured tombs are distributed in sixteen different localities, most of which are on the Mdina/Rabat plateau in the west, while five tombs are found in the Mosta/Naxxar area on the east side of the island. The largest measured necropolises occur at Mtahleb with eleven tombs (though there could be two more tombs), Qallelija and Bingemma (Tax-Xini) with ten tombs each. When the orientations of the long axes (two azimuths for each tomb) are aggregated in 20° bands and plotted radially (Figure 1), a symmetrical pattern emerges that shows definite preferences for two, or possibly three, general orientations summarised in Table 1.

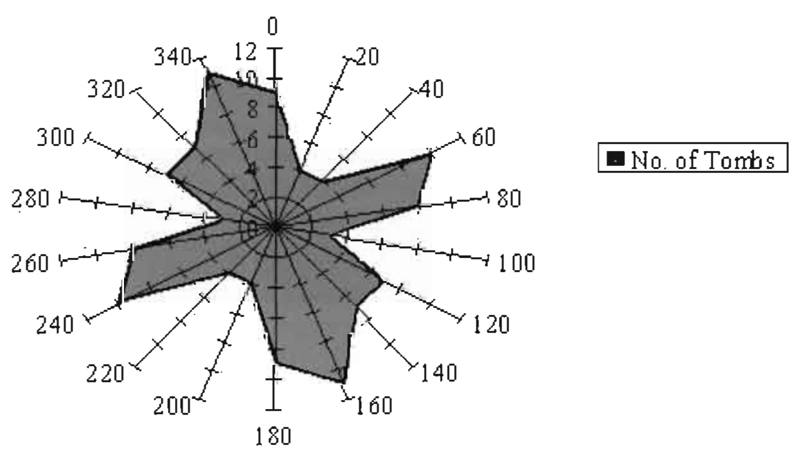


Figure 1. Orientations of the long axes of 63 shaft tombs in Malta

Table 1. General orientations of the long axes of three groups of tombs

GROUP	No. of TOMBS	RANGE OF AZIMUTHS	MEAN AZIMUT	STANDARD DEVIATION
1	19	165°-185° / 345°-005°	175°-355°	6°
2	19	057°-095° / 237°-275°	076°-256°	9.5°
3	15	115°-155° / 295°-335°	137°-317°	12°

The smaller number of tombs with single burial chambers and the wide dispersion of their orientations (Figures 2) make it difficult to reach definite conclusions about preferred directions. Except that there is concentration of twelve tombs with azimuths between 150° and 175° which can hardly be a chance occurrence. These have a mean azimuth of 163° and an angular standard deviation of 6.6°. Tentatively, other looser concentrations can be proposed in the general directions of E (five tombs), W (five tombs) and SE (four tombs).

DISCUSSION

Two explanations for these patterns of orientations have been investigated: first, that the patterns reflect an interest in astronomical events; second, that the orientations simply follow the local topography. If the orientations were originally determined astronomically then the azimuths should convert to declinations that are significant astronomically. Alternatively, if originally no importance was given to astronomy in determining the orientations then the azimuths would convert to a random distribution of declinations. Correspondingly, if the orientations were determined by local topography then the azimuths would be related to significant topographic features and the lie of the land, while the declinations would either be distributed randomly or some of them may correspond to an astronomical target by chance.

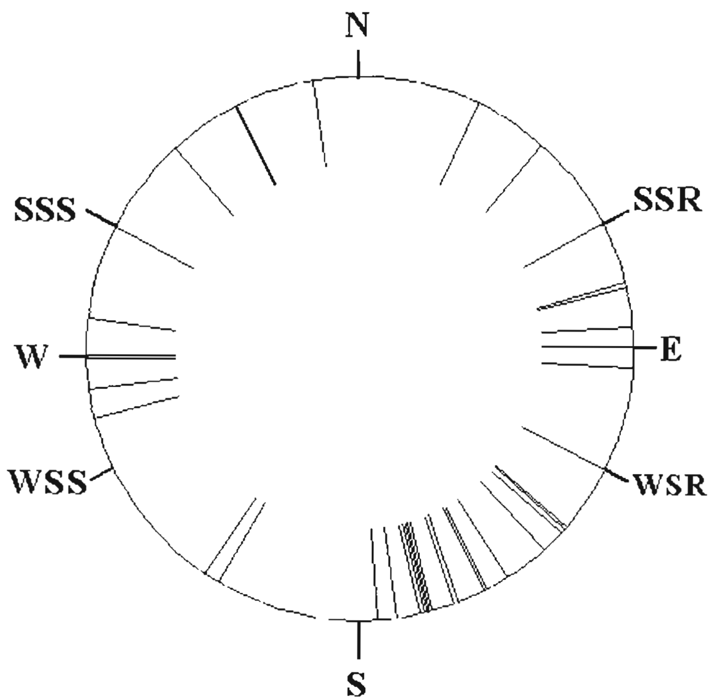
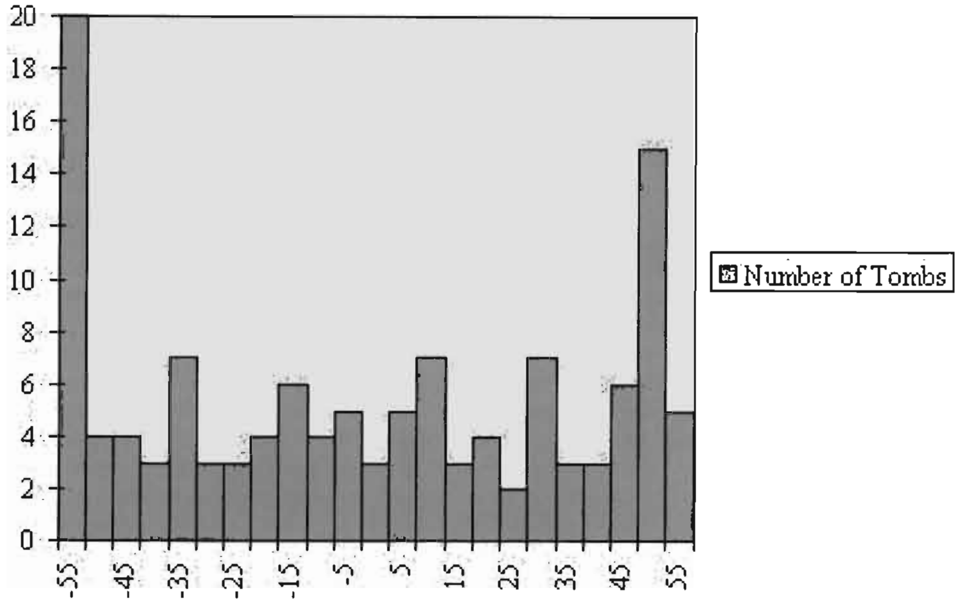


Figure 2. Orientations of the Burial Chambers
(Note: SS=Summer Solstice, WS=Winter Solstice, R=Rise, S=Set)

When the declinations of both directions of the long axes of the shaft tombs are plotted as histograms (Figure 3, above) the clearest signal is a definite interest in the N-S direction, indicated by peaks at declinations of about -55° and +50°, and no real preference for any other declination. For the burial chambers, Figure 3 (below) exhibits sharp peaks at declinations -55° to -50°, that correspond to approximately to the culmination of the sun, the moon and all other celestial bodies, and declinations -35° to -40°, that do not seem to have any particular astronomical significance, except perhaps the climbing sun particularly at the winter solstice. There is also a broad peak centred on declination 0°, possibly related to sunrise and sunset at the equinoxes.

Declinations of the Long Axes of Shaft Tombs



Declinations of Burial Chambers

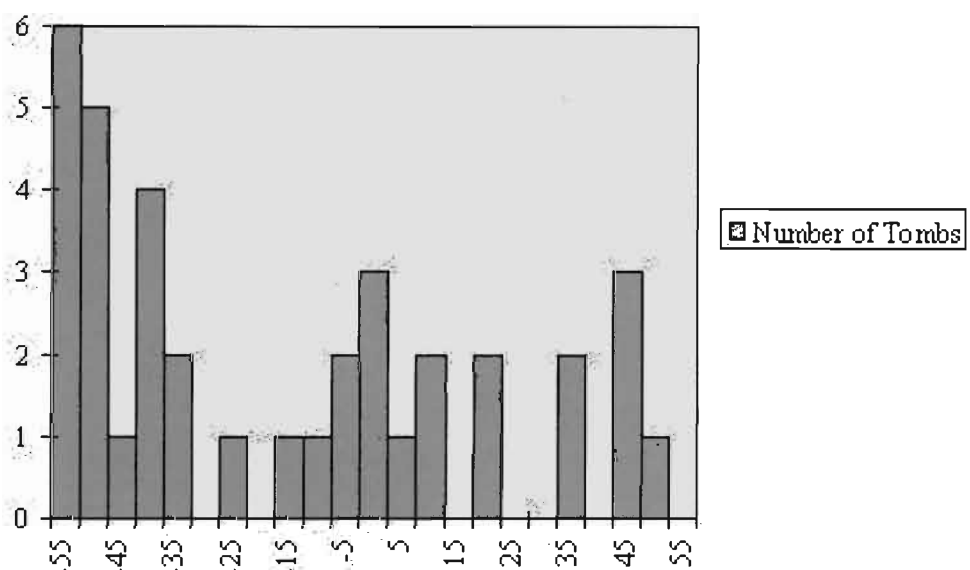


Figure 3. Above: Declinations of Long Axes of Shaft Tombs
Below: Declinations of Burial Chambers

The best evidence that the tomb excavators may have considered local topography can be found in Figure 1 which shows the azimuths of the long axes of the tombs. The broad band with a mean azimuth 076° - 256° seems tantalisingly close to the E-W direction and consequently to sunrise and sunset at the equinoxes. Yet the axes of the majority of tombs in this band point 10° to 20° away from this direction. A more plausible explanation is related to the fact that many of the measured tombs are found on the slopes of one of the main ridges of Malta, all of which run in an approximately ENE - WSW direction (67.5° - 247.5°). It appears that the tombs are cut parallel the ridges possibly so that the tomb excavators could take advantage of naturally occurring solution pits which they could shape and deepen as required.

In conclusion, the orientations of the burial chambers are more indicative of interest in astronomy than the orientations of the long axes of the shaft tombs. While both groups of orientations exhibit a clear preference for the approximate N-S direction, which must have been determined astronomically, it is the burial chambers which indicate interest in the rising, setting or climbing sun. These conclusions can only be tentative because of the limitations of the accuracy of the measurements and the relatively small sample of tombs that could be measured. Furthermore, the grouping together of tombs whose ages span about 700 years introduces a variance between the orientations of the tombs because during that period burial customs could have changed substantially several times. This variance has to be seriously considered when the orientations of the Maltese tombs are compared to those of similar tombs in other localities in the central and western Mediterranean that came under the influence of the Phoenician and Punic cultures.

NOTES AND REFERENCES

1. DIODORUS SICULUS, V, 12.1-4

2. M.E. AUBET, *The Phoenicians and the West: politics, colonies and trade* (transl. Mary Turton) (Cambridge, 1993) and S. MOSCATI, 'Some reflections on Malta in the Phoenician world', *Journal of Mediterranean Studies*, 3(2) (1993), 286-290 give different interpretations. Aubet believes that maltese pottery of this period is closely related to that of the western phoenician colonies. Moscati maintains that it shows connections with the coastal area of the Near East.

3. G. A. SAID-ZAMMIT, *Population and land use and settlement in punic Malta: a contextual analysis of the burial evidence* (Oxford, 1997).

4. R. GONEN, *Burial patterns and cultural diversity in Late Bronze Age Canaan*. American Schools of Oriental Research (Indiana, USA, 1992).

5. B. COSTA RIBAS, J.H. FERNÁNDEZ GÓMEZ, C. GÓMEZ BELLARD, "Ibiza Fenicia: La primera fase de la colonización de la Isla (siglos VII y VI a.C.)", in *Atti del II Congresso Internazionale di Studi Fenici e Punici*, Roma 9-14 Nov. 1987 (Roma, 1991), 759-795.

6. A. M. COSTA, 1983. "Monte Luna: una necropoli punica di etá ellenica", in *Atti del I Congresso Internazionale di Studi Fenici e Punici*, Roma 5-10 Nov. 1979 (Roma, 1983), 741-750.

7. J. G. BALDACCHINO, and T. J. DUNBABIN, "Rock Tomb at Ghajn Qajjet, Near Rabat, Malta", in *Papers of the British School at Rome*, no. XXI (new series VIII) (London, 1953), 32-41, plates XII-XIV.

8. J. A. BELMONTE, C. ESTEBAN, J. J. JIMÉNEZ GONZÁLEZ, "Mediterranean Archaeoastronomy and Archaeotopgraphy: Pre-roman tombs of Africa preconsularis", *Archaeoastronomy* (supp. to *Journal for the history of astronomy*), no. 23 (1998), S7-S24.

9. G.A. SAID-ZAMMIT, *op. cit.* (ref. 3).

ORIENTATION OF DANISH GEOMETRICAL VIKING FORTRESSES

Emília Pásztor
Planetarium, H-6000 Kecskemét, Hungary
Curt Roslund
Section of Astronomy, Gothenburg University,
S-41296 Gothenburg, Sweden

ABSTRACT

Three geometrical Viking ring-fortresses in Denmark have generally been taken to be orientated closely towards the four cardinal points. By measuring the orientations of their main axes with a precision theodolite, it was found that the fortresses differ considerably from each other in orientation, in spite of their similar geometrical design, and from the cardinal points. Alternative suggestions for the deviation in orientation are presented.

In Denmark four impressive circular fortresses built around 980 at the end of the Viking Age have come to light. They are known for their precise layout. Their ground plans are dominated by a perfectly circular ring-rampart divided into four segments of equal length by the gates for two straight roads that meet at right angles in the centre of the ramparts. The construction is enhanced by the fact that the roads seem to be aligned with the cardinal points of the compass.

DESCRIPTION OF THE SITES

The best known of the ring-fortresses is Trelleborg situated at the confluence of the Tude and Vårby rivers on a flat tongue of land four kilometres from the shore of the Great Belt on the island of Zealand. The site was excavated by Paul Nørlund between 1934 and 1942 (Nørlund 1948) and the rampart reconstructed and the outlines of the roads and houses within the rampart marked on the ground. The interior diameter of the rampart is 134 metres which is also the length of the two roads. In each quadrant formed by the two roads, four houses were built along the sides of a square aligned with the roads. All houses had the same ground plan and measured about 30 metres in length.

Aggersborg was the second site to be recognised as a ring-fortress. It is situated on the Jutland peninsula on the northern shore of the Limfjord at its narrowest point at Aggersound. It was partly excavated in the late 1940s (Roesdahl 1981). The ground plan is similar to that of Trelleborg but Aggersborg is built on a much larger scale with a diameter of 240 metres with 48 long-houses in twelve square blocks.

The Fyrkat ring-fortress also lies on the Jutland peninsula on a low ridge above the Onsild river four kilometres from its outlet in the Mariager Fjord 35 kilometres from the sea. It was excavated in the 1950s (Olsen *et al.* 1977). It has exactly the same layout as Trelleborg but is somewhat smaller or 120 metres in diameter.

The last site to be identified as a ring-fortress in Denmark was Nonnebakken on the island of Funen (Thrane *et al.* 1982: 109) located on a hill overlooking the Odense river seven kilometres from its outlet in the Odense Fjord thirteen kilometres from the sea. Few traces of the fortress remain above ground. The rampart was removed in 1905 but the fortress seems to have been of the same size as Fyrkat.

As recently as 1989, a ring-fortress was discovered in the Swedish town of Trelleborg in the province of Scania, belonging to Denmark at the end of the Viking Age (Jacobsson 1995). It is located some hundred metres from the open shore of the Baltic. It was of the same size as the Danish Trelleborg but it lacked the strict geometry and symmetry of the latter. There might also be signs of another ring-fortress in Scania at Borgeby on the Kävlinge river five kilometres from its oulet into the Sound between presentday Denmark and Sweden.

HISTORY

A prototype for the Danish ring-fortresses has been searched for. No immediate forerunner has so far been identified in Denmark. The closest analogy in design comes from a series of fortifications in Flanders and Zeeland. The best researched fortress is at Oost-Souburg in the presentday Netherlands. Although its construction date probably is somewhat earlier than its Danish counterparts, both its size and layout are the same as those of Trelleborg. Two roads at right angles cut through its circular rampart in four places, dividing the rampart into four equal segments, the differences being that the roads deviate significantly from the cardinal points and that the houses in each quadrant do not conform to a regular pattern (Trimpe Burger 1975).

The high degree of conformity of the ground plans and their sophisticated geometrical design, coupled with the great demand for manpower and material for the execution of the massive fortresses, prove that there must have been an incontestable centralised authority behind their planning and construction. The dating of Trelleborg and Fyrkat is based on dendrochronology and corroborated by traditional archaeological dating of artifacts. All the available evidence points to a construction date around 980 for Trelleborg (Bonde *et al.* 1984) which is also a plausible date for the other three fortresses. This was a time when king Harald Bluetooth had united all Denmark which added to his prestige and responsibilities. His building activities did not end with the ring-fortresses. He is remembered for building the 700 metre long bridge over the Vejle river at Ravning (Ramskou 1980), for erecting the famous Jelling monuments (Krogh 1982) and for reconstructing the border rampart of Danevirke (Andersen 1977). His works are characterised as being impressive, innovative and prestigious.

On the basis of the archaeological evidence, there is no clear answer to what purpose the ring-fortresses would have served. A function as military strongholds is indicated by their huge ramparts and their strategical position in secluded spots well away from the open sea lanes. On the other hand, their location near trade routes both by overland and by sea, points at defended commercial centres. Although located some distance away from the sea, they could all be reached by ship. Finally, their orderly design could be seen as an expression of a romanticised concept of an ideal city.

SYMBOLISM

The ground plan of the fortresses in the form of a circle with two perpendicular diameters could have been a geometrically graceful way of dividing a circular area into four quadrants that would have appealed to military engineers. However, the figure of a circle with four spokes might have had a deeper meaning. It is a well-known symbol in Scandinavian rock carvings and archaeological finds, especially from the Bronze Age (Malmer 1981: 66-75). The famous Trundholm sun chariot like many others has wheels with such impractical divisions for carrying a heavy load (Gelling *et al.* 1969: 14-15; Green 1991: 66). It is generally assumed to have been a sun symbol (Green 1991) but it could also very well have been a symbol of cosmos with its four cardinal directions.

Sometimes, the quadrants in rock carvings are filled with squares or dots like the square blocks of houses in the ring-fortresses. This more elaborate design also becomes more frequent with time in northern Europe. It is found on the rim of a shield from the migration period (Fettich 1930: 223). It was carved on the cross-guard of a sword from the ninth century (Pósta 1930: 293) and on the top of a weight from the Viking Age (Reinerth 1941: 1354). The same motif can be seen on an iron ring to an entrance gate to a church in Sweden (Paulsen 1939: Fig. 123). The symbol has been wide-spread to the present time in other parts of Europe as well. It appears on objects as diverse as embroidered textiles and coloured eggs. From having been a unique solar symbol, it has been transformed into a magical sign with protective and averting properties (Sági 1951).

ORIENTATIONS

The ground plans of the ring-fortresses demonstrate that those who were responsible for their construction were able to solve a number of problems of geometrical and metrological nature. They knew how to set out accurate circles and to draw lines at right angles to each other in order to fit the houses, ramparts and moats into a preconceived pattern. The attention they paid to detail is clearly shown by the fact that the houses in the quadrants at Trelleborg deviated only 0.2 metres from an average length of 29.42 metres. It would have been natural enough to expect these master builders to ensure that the grid system of roads within the ramparts comformed to certain principles. It has been taken for granted that the fortresses were orientated towards the four cardinal directions.

The south direction might have been important for the Norsemen. At this northern latitude of the fortresses, the sun barely comes above the horizon in winter. At Trelleborg it reaches a maximum height of only eleven degrees in the south at local noon at the winter solstice. The south was also the direction in which Valhalla according to Norse mythology was located. The three famous ship burials at Oseberg, Gokstad and Tune had their prows pointing towards the south. At Ladby on the Danish island of Funen, the interred ship was also facing south (Brøndsted 1965).

The east direction could have had a relation with the sunrise. The sun rises exactly due east on two occasions in the year, at the equinoxes. In summer the sun rises north of east and in winter south of east. On a certain date, the sun rises every year in the same direction. It was the rule during the Middle Ages that churches should preferably be orientated towards the east. By studying the orientation of medieval churches in the Carpathian Basin, it was proved that the date of the vernal equinox in the Julian calendar had been used more often than the proper establishment of true east. It was also found that a good deal of the churches had been orientated towards the sunrise on the saint's day to whom the church had been devoted (Guzsik 1986).

SUGGESTIONS FOR ORIENTATIONS

In order to find how closely the road grid corresponds with the cardinal points, the azimuth of the east-west axis was measured with a precision theodolite with reference to the sun. The result is shown in Table 1 for the three existing Danish ring-fortresses and is surprising. The fortresses differ considerably from each other in orientation and from the cardinal directions. The usual picture of comparison of the ground plans for the fortresses aligned with the cardinal directions is misleading - upper part of Figure 1 - and should be replaced with one showing the true orientations of the fortresses - lower part of Figure 1.

TABLE 1. *Julian dates for sunrises and sunsets through gates to Danish geometrical Viking fortresses.*

FORTRESSES	TRELLEBORG	AGGERSBORG	FYRKAT
Azimuth of east gate	100° 58′	83° 09′	86° 47′
Elevation of horizon	1° 16′	0° 00′	2° 00′
Declination of the Sun	-5° 41′	+3° 01′	+2° 58′
Date of sunrise (first light)	Mar 01	Mar 23	Mar 23
	Oct 02	Sep 10	Sep 10
Azimuth of west gate	280° 58′	263° 09′	266° 47′
Elevation of horizon	0° 18′	0° 00′	0° 45′
Declination of the sun	+5° 49′	-4° 26′	-1° 44′
Date of sunset (last night)	Mar 30	Mar 03	Mar 10
	Sep 03	Sep 29	Sep 22

The disparity in orientation could be the effect of a random scatter around the cardinal points due to the builders lack of concern in making the orientations precise. The mean deviation is no more than eight degrees. This explanation goes contrary to the care with which the ground plans were laid out.

One reason for the observed deviation from the cardinal points could have been that the builders never intended to include these in their plans. Instead of directing the east-west axis towards the sunrise or sunset at the eqinoxes, they might for one reason or other have decided on other dates. The sunrise on March 23 in Table 1 seen through the east gate at both Aggersborg and Fyrkat is interesting as this date is close to both the ecclesiastical date in the Julian calendar for the vernal eqinox on March 21 and to the feast of the Annunciation of the Virgin Mary on March 25. The latter date commenced the official year in England until much later (Hutton 1996: 8). The date for the sunrise at Trelleborg through its east gate on March 1 does not agree with those at Aggersborg and Fyrkat, but is still interesting because March 1 was counted as the formal beginning of the year by the Franks.

The Easter full moon could also have played a role in the newly christianised Denmark. Table 2 shows the rise of this moon through the east gate at Trelleborg for four years prior to the winter 980-81 when the last trees for the construction of the fortress were cut down. There is a close agreement in orientation for the year 977 when the Easter full moon appeared on Good Friday. The agreement could be coincidental, as long as we have no knowledge of the exact year when the plan was laid out.

TABLE 2. *Azimuths of the rising points of the Easter full moon (upper limb) through the east gate at Trelleborg.*

Year AD	977	978	979	980
Azimuth of east gate	100° 58′	100° 58′	100° 58′	100° 58′
Rising point of full moon	101° 03′	98° 21′	113° 47′	104° 57′
Julian date of full moon	Apr 06	Mar 27	Apr 15	Apr 03
Julian date of Easter Sunday	Apr 08	Mar 31	Apr 20	Apr 11

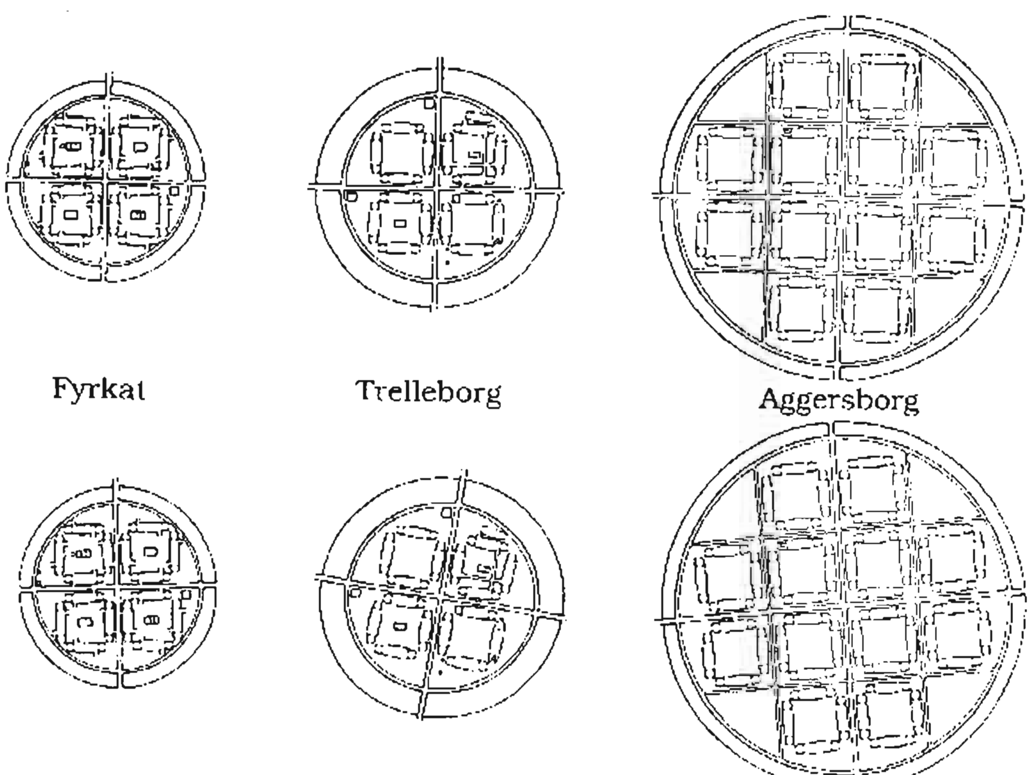


Figure 1. The upper row shows how the ground plans of Danish ring-fortresses generally are depicted and the lower row how they should be shown to include their true orientations.

CONCLUSIONS

There is no doubt that the Danish ring-fortresses were built in accordance with advanced geometrical and metrological rules. However, this does not at first had seem to apply to the orientations, although it is conceivable that the orientations could have been set out after formulas we do not know about.

REFERENCES

H. H. ANDERSEN, *Jyllands vold* (Århus, 1977).

N. BONDE and K. KRISTENSEN, "The Age of Trelleborg. Dendrochronological Dating", *Aarbøger for Nordisk Oldkyndighed og Historie 1982* (1984), 139-152.

J. BRØNDSTED, *The Vikings* (Harmondsworth, 1965).

N. FETTICH, "Der Schildbuckel von Herpaly", *Acta Archaeologica 1* (Copenhagen, 1930).

P. GELLING, and H. E. DAVIDSON, *The Chariot of the Sun and other Rites and Symbols of the Northern Bronze Age* (London, 1969).

M. GREEN, *The Sun-Gods of Ancient Europe* (London, 1991).

T. GUZSIK, "Sol Aquinoctialis - zur Frage der äquinoktialen Ostung in Mittelalter", *Periodica Politechnica* 22 (Budapest, 1987), 3-4, 191-213.

R. HUTTON, *The Stations of the Sun* (Oxford, 1996).

B. JACOBSSON, "Den arkeologiska undersökningen av Trelleborg", in *Trelleborgen* by B. Jacobson, E. Arén and K. A. Blom (Lund, 1995).

K. J. KROGH, "The Royal Viking-Age Monuments at Jelling in the light of recent archaeological excavations", *Acta Archaeologica* 53 (1982), 183-216.

M. P. MALMER, *A Chorological Study of North European Rock Art* (Stockholm, 1981).

P. NØRLUND, "Trelleborg", *Nordiske Fortidsminder* 4:1 (1948).

O. OLSEN, H. SCHMIDT, and E. ROESDAHL, *Fyrkat. En jysk vikingeborg* I-II (Copenhagen, 1977).

P. PAULSEN, *Axt und Kreuz bei den Nordgermanen* (Berlin, 1939).

B. PÓSTA, *Régészeti tanulmányok Oroszföldön* III (Budapest, 1930).

T. RAMSKOU, "Vikingetidsbroen over Vejle å-dal". *Nationalmuseets Arbejdsmark 1980* (1980), 25-32.

H. REINERTH, *Vorgeschichte der Deutschen Stamme* III (Berlin, 1941).

E. ROESDAHL, "Aggersborg in the Viking Age", in *Proceedings of the Eighth Viking Congress*, ed. by H Bekker-Nielsen *et al.* (Odense, 1981).

K. SÁGI, "Árpádkori varázslás régészeti emlékei", *Veszprém Megyei Múzeumok Közleményei* (Veszprém, 1965), 57-81.

H. THRANE, T. NYBERG, F. GRANDT-NIELSEN, and H. VENGE, *Fra boplads til bispeby. Odense til 1559* (Odense, 1982).

J. A. TRIMPE BURGER, "The geometrical fortress of Oost-Souburg (Zeeland)", *Chateau Gaillard 7* (1975).

ARCHEOASTRONOMICAL OBJECT OF THE ENEOLITHIC EPOCH IN RUSSIA

Tamila Potyomkina
Institute of Archaeology, Moscow, Russia

One of the earliest archaeoastronomical object researched in Russia is the *Sanctuary Savin* (BC 3000- 2500) at the Tobol river in the *Trans-Ural region* (in latitude 55,4° North). It is the only analogous to European henges and rondelles in Russia at present.

RESULTS OF THE ARCHAEOLOGICAL EXCAVATIONS

The site is placed on rising ground (350x60 m) in wide flood-lands. The most elevated (up to four metres) west part of the site was excavated in an area 1300 square metres in 1982-85 and 1997 years.

The constructions of *two joining circles* with diameters of fourteen and sixteen metres outlined by ditches were discovered by excavations. Two passages with parallel palings four metres long and more than one metre wide directed to the first circle on the west-east line (Fig. 1). In the second circle the passage in the form of gap in the ditch was on the north-east direction. There were a right-angled-shaped hollows like dug-outs (7x6 m and 9x6 m) in the centre of the both circles. Main finds were concentrated there.

Two concentric rings *with post-holes* and bonfire-pits were discovered at the bottom of the circular ditches and around them on the outside with 1.5-2.5 m intervals (more than 100 in all). Some post-holes were in hollows at the centre of the circles. Sacrificial animal bones (about 4000 pieces) *accumulations* including *vessel crocks* (more than 6000) and *stone tools* (1700 patterns) were discovered around many holes, in the ditch and in centre of the circles. Prevalent part of *bones* (80%) belongs *to horses* (169 individuals), the rest of them to roes (72), elks (25), wild boars (9). Bones of wolf and bear are single. A pit with adult and child human skulls inside the first circle and the skeletal remains two adult men and a girl in the ditch of the second circle were discovered (Potyomkina 1998: 310- 6).

Detected accumulations *were corresponded* to the certain *Solar and Lunar reference-points*. More than 70% of them were near the central posts and posts directed to the east and north-south-east from the centre. These directions coincide with the sunrise equinox and solstice days for the latitude of the site location. Detected accumulations near the posts in the west and north-south-west directions coinciding with the sunset in these days were less considerable.

THE MAIN ASTRONOMICAL REFERENCE POINTS AND THEIR FIXING

The astronomical computation made by the candidate of the physical-mathematical sciences Valentin Yurevitch confirmed the archaeological observations: *all main astronomical directions were marked* out at the Savin site (Potyomkina and Jurevitch 1998: 29-34).

Thus there was a thick post (marked with1 in figure 1) in the south part central ground of the first circle of the sanctuary. The next post (18) just like this was in the ditch strictly to the north of the first one. So there was exactly defined astronomical directions in the first circle of the construction. The east-west direction was marked by two passages, the north-south one by two posts (1, 18) or by four posts (18-1-35-36). Observing a sunrise and a sunset through the passages one could determine beforehand the days of the vernal and autumnal equinoxes.

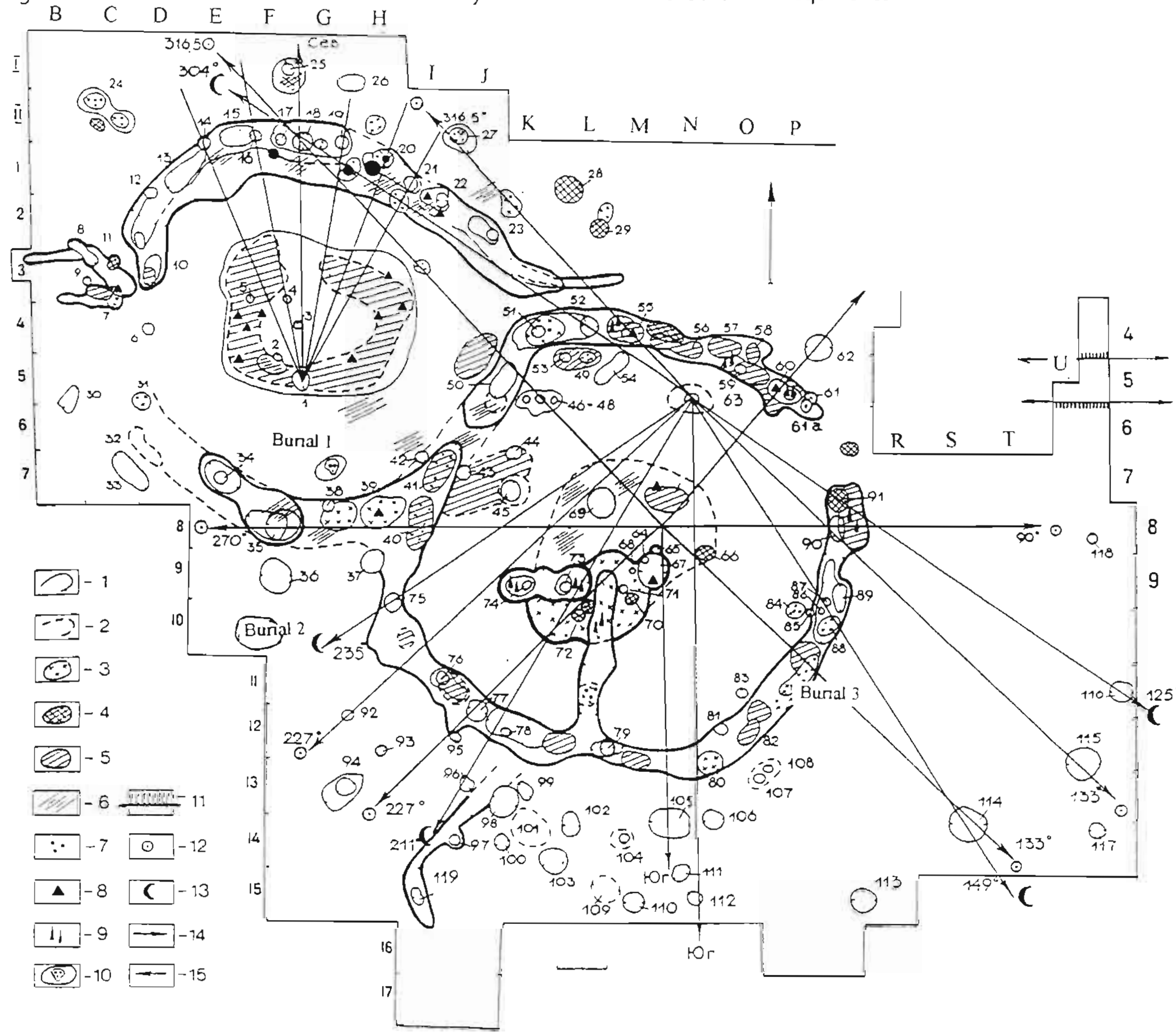


Figure 1. The Sanctuary Savin Plan
1- outlines of the trenches and pits; 2- illegible outlines, 3- carbonized layer; 4- annealed layer; 5- pits filled with bones; 6- accumulations of bones in trenches and on the horizon of buried soil; 7- ochre spots; 8- broken pot's; 9- an accumulation of pottery; 10- a pit filled with men's skulls; 11- the border of the Minor bank in the excavated part; 12- the Sun; 13- the Moon; 14- the direction of rising; 15- the direction of setting.

Also in the north part of the circle six posts were disposed more or less symmetrically relative to the middle mid-day one-four posts (19-22) to their right, two ones (14, 16) to their left. It was possible that these posts in the ditch fixed the position of the shadow of the central post (Potyomkina 1998: 12). During some time about mid-day it was like a *gnomon* (a kind of sundial). The sundial of Savin might divide time into different intervals in different days of the year. In equinoctial days the shadow is displaced from one post to another during 34±3.5 minutes, in the summer solstice day during 25±3 minutes. In the south part and the edge of the ditch 5-6 posts form the semicircle. They are on a straight line with the central one and the other described posts of the north semicircle (22-1-34, 19-1-35, 16-1-38, 14-1-37). Small deflections are normal. We must remember that such an ancient construction of 4000 years ago remained only in the form of spots and deepenings of different colour and intensity of the ground colouring. This creates some mistakes in fixing the time of the remains.

By the archaeological data the second circle was constructed later than the first one. During the excavation a point near the circle centre was not marked, but was found out by the method of reverse directions. Seven holes of the thick posts were accurately fixed in the ditch and outside it. They placed six directions from that point. They mark *six sun azimuths*: the sunrises (60, 62 - 43°; 90, 118 - 90°; 114 - 133°) and sunsets (77, 95 - 227°; 93, 94 - 226°; 35 - 270°, 18 - 317) in the equinox and solstice days. Sunset in the summer solstice was marked by already known middle post (18) in the north part of the first circle. The azimuth is calculated according to the phenomena of the appearance of the upper edge of the sun at the skyline in the year 2000 BC. Each of six sun directions is accompanied by many archaeological findings. It makes astronomical research more convincing. It is interesting that the ditch of the common part of two circles is roughly directed toward the sunrise of the summer solstice day.

Solar azimuths connect also *two banks* located outside circles. Their sections confirmed their man-made origin and connections with the circular buildings (Potyomkina 1998a: 13- 14). The banks and ring structures with pots by designs entered into a uniform architectural complex of the Sanctuary (Fig. 2).

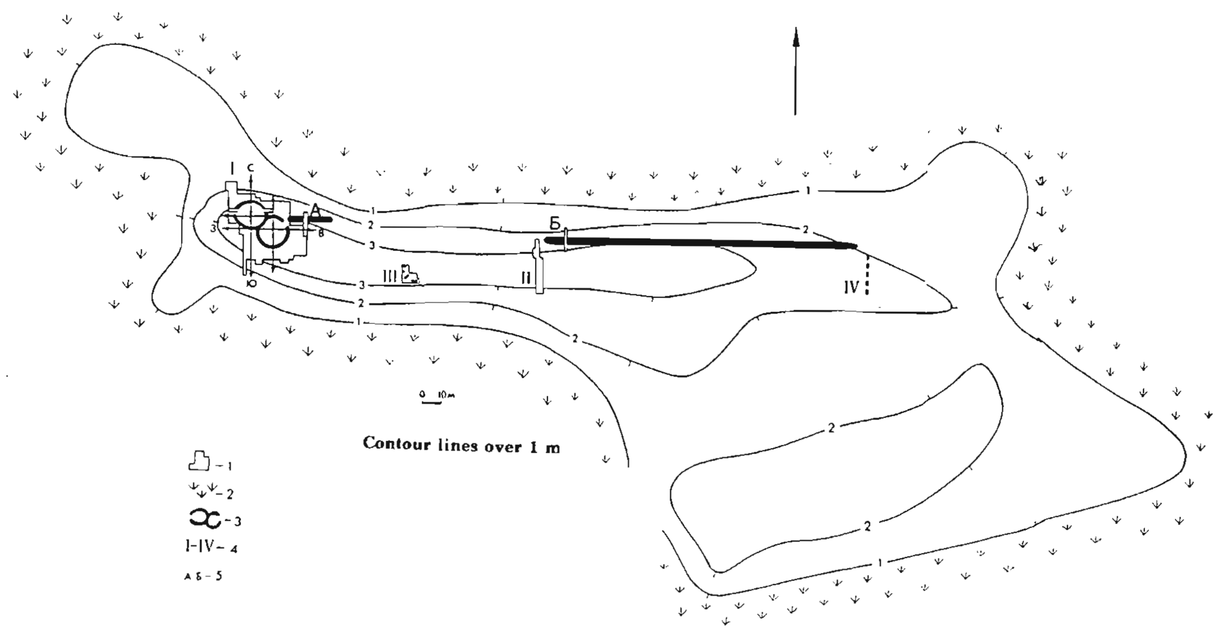


Figure 2.. The Sanctuary Savin. Total plan.
1- excavated parts; 2- old swamped river-bed; 3– circular buildings outlined by the ditches; 4- excavated parts numbers; 5- Minor and Major banks.

The first (Minor) bank 30 m long and 0.5 m height extended from the eastern entrance to east direction. Its axis, the post (1) in the centre of the first circle and other posts (50,60) in the ditch with thick animal bones and other finds accumulation near it are on one west-east line. The second (Major) bank 100 m long, 0.4- 0.9 m height located in 150 m distance to the east from the centre of the second circle (Fig. 3). On both sides of the bank small ditches were discovered. The Axis of the bank coincides exactly with the west-east line, the central post of the second circle, two posts in the ditch to the east (90) and to the west (35) from it, one post (118) outside (Fig. 4). Under embankments of both banks some post-holes, arboreal decay, traces of bonfires, pieces of coal were discovered (Fig. 5). The banks were constructed to have more exact and visible sight lines at the most important for the Savin builders (or priests) east direction pointed to the sunrise in equinox days.

These astronomical reference-points illustrate the fact that the Transuralian Aeneolithic population knew the orientation of the sun and used it in their cult centres. It is really to suppose an existence of the sun calendar.

Figure 3. The Sanctuary Savin. A view on the Major bank from northwest.

There are also *moon reference-points* at the sanctuary. The post-holes wide arc outlining the second circle from the south is especially interesting from this point of view (Fig. 1). One can think of the post-hole (63) in the north part of the circle between the centre and the ditch as the relative centre of the arc. At least the thickest posts of the arc are roughly at the same distance (about 20 m) from it. Directions from this relative centre to the most visible posts in the south-east coïncide with three astronomical reference-points: 63 - 114- high moonrise (azimuth 150°); 63 - 115 - sunrise in winter solstice (133°); 63 - 116 - low moonrise (125°). The moon azimuths are calculated for the centre of the moon disk.

Figure 4. The Sanctuary Savin. A view on the the Major bank from the centre of the second circle. On an axis of the bank there are poles put on a place of the post- holes 90, 118 and in trench under the bank.

The south-west directions are marked too: 63 - 96 - high moonset (210°); 63 - 92 - sunset in the winter solstice (227°); 63 - 75 - low moonset (235°). One of these posts is in the ditch (75). As to the north-west direction we can mention for the third time the midday post of the first circle (18). It is directed towards the low moonset (304°). The post (112) outside the ditch is place exactly to the south from the central post-hole. The last post (63) is on the east-west line marked by the post-holes both inside the second circle, in the ditch of it, and in the ditch and outside of the first circle (63 - 61a; 63 - 46 - 48 - 30 - 31).

Illustrations of the lunar calendar (bone plate with signs, vessel with the corresponding ornamental sign system and etc.) were discovered. These artefacts can have the effect of the moon phases and moon symbolism (Potyomkina 1998: 320, fig. 7, 8).

STAGES OF FUNCTIONING SANCTUARY

Stratigraphic and planigraphic data are evidence of *three stages of the sanctuary active period*. The most early one is connected with the first circle and two passages entrance - sights. At the second stage the second circle and nearby bank were constructed. The central pole of the first circle was moved from an axis of entrances on an axis of the nearby Minor bank and axis of a line of poles on a place of connection of two circles. At the third stage the Major bank was built. It has became the main sight line. At the same time the centre of ritual actions was moved to the second circle. At all stages old posts - markers, pointed to the main astronomical directions were used too. Posts were moved, changed for new ones. It is evidence of correction the main solar direction during rebuilding. Total time of the sanctuary activity was in period of some ten years.

Figure 5. The Sanctuary Savin. A trench cut across the Minor bank (square V-4,7; east wall). The light- colored lens in its wall is the Stone Age bank. Dark stripe from above lens is ancient a sod surface of the bank. The layers are higher- traces of repeated floods Tobol- river in the period and after functioning the sanctuary. Under the ancient bank is a layer from the rests of a tree, cane, herb, cools; below- white sand.

Active life was stopped at the sanctuary for reason of regular floods: all its buildings including banks were covered by alluvial layer 0.6 m thick (Fig. 5). According to results of palinological analysis of soil from the site in 2500 year BC there was a sharp damping of climate in this region.

New ritual centre like the Savin (Slobodchiki 1) was built at 1 km exactly to the west from "big" bank on a higher place. The period of its activity was BC 2500- 2100.

THE EUROPEAN ANALOGIES

The nearest analogies to the Transuralian round-planned monuments are known in enough removed territory at present. There are the *rondelles* in the Central Europe (Podborsky 1998: 175- 238, .270, fig. 174; Neugebauer, Neugebauer- Maresh, Winkler, Wilfing 1984: 100- 1, fig. 2, 3) and the henges in the British Islands. The special similarity with the Transuralian sanctuaries have *the early henges* with the constructions made from the wooden posts (Earth Woodhenge Monuments) (Wood 1981: 45- 6; Hawkins and White l984: 63, fig. 3; 109-12).

The specified similarity is shown in a lot of general features: I- near latitude of the site place (44°- 56° North) in conditions of the steppe and forest steppe landscapes; 2- similar topographical placing on the risings of the plains and of the wide river flood plain; 3- circular lay-out; 4- small square limited by ditches or ditches and banks without compact inner building; 5- placing and orientation of entrances; 6- presence of the supporting holes for posts directed to the heavenly bodies rises and sets in the equinox and the solstice; 7- presence of accumulations of a pottery, tools, animal bones, cult items; traces of fire, ochre; man skeletons in ditches; 8- presence at a complex of banks for astronomical purpose; 9- planned building these objects, marked on the land preliminarily; 10- some stages of the complexes construction; 11- times and character of functioning as the centers with primitive astronomical, cult- social and calendar meaning.

It the similarity of the Transuralian circular sanctuaries with the analogous sites of the Europe shows that these constructions realised *similar functions* in the system of ideological conceptions of primitive society. They presented different cultural formations far from one another in space but close to each other at the spiritual culture level. As in the Europe, so in the Trans-Ural, all marked above attributes of the structures with circular architecture were a basis of design features of the concrete models of organisation of sacral space. Simultaneously they had represented of the Models of the Universe according to the lifestyle and world wiew of the certain groups of the population. In the field of symbolic these Models are closest to one of the early forms Mandala- to the circle with the square inside.

As European, so Transuralian monuments with similar information system have appeared in the Neolithic-Eneolithic Epoch (4000- 3000 BC). The connection of occurrence of the structures with astronomical meaning in the marked regions with the *process of the formation of the productive economy* is doubtless. From the observations for the heavenly stars reflecting changes of natural conditions, the economic activity was depended. The especially important value this fact had in the conditions of a moderate and continental climate. At this breadth exactly have arisen and have received the widest distribution monuments of a considered type.

Savin undoubtedly was used by relatively well- organised tribes of the hunters, for whom the horse was coveted object. Knowledge of the animal's behaviour and biological rhythms, relying on the existing calendar, helped those tribes to domesticate the horse. The forest steppes across the Ural mountains, Southern Russia and Kazakhstan were part of the vast territory where the process of the domestication of wild horses ran in B.C. 4000- 3000.

CONCLUSION

The studies have shown that Savin sanctuary had its *functions* mainly associated with the *hunting rites* reflected in the year by cycle of the alternation of the season in a hunting calendar. The main stages, rhythm and the way of life of hunting groups were based on such a calendar. A calendar was of especial significance *in connection with hunting a horse* and the domestication of it. The performance of some other rituals which concerned other aspects of the life of society also took place. The main forms of a cult performance were collective sacrifices, accompanied by magic rituals (Potyomkina 1998: 319-24).

We have reason to suppose that the people who visited the Savin site had already used a calendar in the form of the Moon and Sun. In this situation it should be supposed that all ritual acts were strictly regulated by people who determined the time and the process of its performance by playing attention to heavenly bodies.

Sanctuaries like the Savin one were in their way *a kind of center which organized society life* according to the natural environment and a level of socio-economic development. They directly served a practical aspect of the life of a society and performed definite administrative, religious, economic and unifying functions.

REFERENCES

G. HAWKINS and J. WHITE, *Stonehenge decoded* (Moscow, 1984), 63, 109- 12 *(in Russian)*.

J. W. NEUGEBAUER, Ch. NEUGEBAUER - MARESH, E-M. WINKLER und H. WILFING, "Die doppelte mittelneolithische Kreis- grabenanlage von Friebritz NO. Vorbericht Uber die Rettungsgrabungen der Abteilung fur Bodendenkmale des Bundesdenkmalamtes in den Jahren 1979, 1981- 1983", *Fundberichte Aus Osterreich. Herausgegeben vom Bundesdenkmalamt*, 22, 1983 (Wien,1984), 88- 112.

V. PODBORSKY, *Tesetice - Kyiovice. Rondel osady lidu s moravskou malovanou keramikou* (Brno,1988),175- 238,270.

T. M. POTYOMKINA, "The Trans- Ural "Stonehenge" (the Stone Age Sanctuary with astronomic reference points)", *Astronomical and Astrophisical Transactions*, 15, (1998), 307- 24.

T. M. POTYOMKINA, "A Stonehenge beyond the Urals", *Science in Russia*, 4, (1998), 8-15.

T. M. POTYOMKINA and V. A. JUREVITCH, *From the experience of archaeoastronomical research of archaeological monuments (the methodic aspect)* (Moscow, 1998), 29- 34, *(in Russian)*.

J. E. WOOD, *Sun, Moon and Standing Stones* (Moskow, 1981), 45- 46 *(in Russian)*.

ON ANCIENT ASTRONOMY IN ARMENIA

Elma S. Parsamian
Byurakan Astrophysical Observatory, Armenia
eparsam@bao.sci.am

The Armenian highland is one of the ancient cradles of civilisation. Many investigators of the history of astronomy , having no facts to hand, mainly by logical approach came to the conclusion that the ancient inhabitants of Armenia not only knew, but also took part in the formation of ancient astronomy (Maunder, 1906, Olcott, 1914) .

Thus Olcott (1914) wrote : "Astronomical facts correspond with historical and archaeological investigations and prove that people who have invented the ancient figures of constellations probably lived in the valley of the Euphrates , as well as in the region near the mountain Ararat"

Maunder (1906), investigating the question of the origin of the constellations, wrote:

"People, who divided the sky into constellations, most probably lived between 36 and 42 degrees of the northern latitude, so neither Egypt nor Babylon could be the motherland of creation of constellations. Calculating in what place the centre of this empty region coincides with the North Pole, we got the figure 2800 BC, which is probably the date during which the naming of the constellations were completed. It was observed that such animals as the elephant, camel, hippopotamus, crocodile and tiger were not amongst the figures representing the constellations, therefore we can assert India, Arabia and Egypt could not have been the place where the idea of firmament originated.

We can exclude Greece, Italy and Spain on the basis of the fact that the figure of tiger is present in the figures of constellations.

Thus, purely by logical thinking we can assert that the motherland of celestial figures must be Minor Asia and Armenia, that is to say a region limited by the Black, the Mediterranean, the Caspian and the Aegean Seas..."

The above statements had to be confirmed.

The discoveries made during the last decades in Armenia , have enriched our knowledge of the ancient civilisation and ancient astronomy in this region.

On Armenian territory , a belt calendar and geocentric model of the universe were discovered from the Bronze Era, dating back to the XI century BC (Tumanian, Mnazakanian, 1965). Furthermore , rock carvings of astronomical representations of the Sagittarius, Lion and Scorpio constellations, along with symbols of the Sun and the Moon, were discovered on fragments

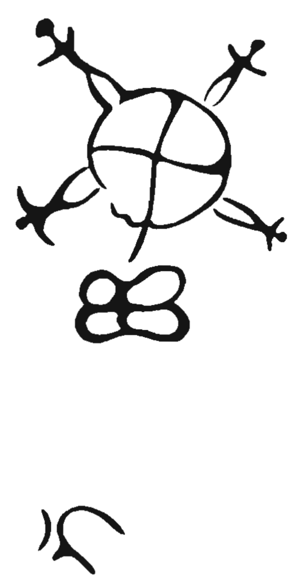


Figure 1. Image of Earth with the antipodes found on rocks

of rocks older than 3000 years. The diameters of the pictures are different from each other , indicating the relative brightness of the stars. On one fragment the Sun, Moon, and five planets, as seen with the naked eye are pictured, and on another two fragments there are circles with short and 29 long rays. The rays carved on the rocks probably depict the period of repetition of the Lunar phases.

A carved circle found on one of the rocks created a great deal of interest. This circle is divided into orthogonal lines, in which (on opposing sides) are also carved human figures. These symbols represent the Earth and antipodes (Figure1). Such symbolism is used in modern astronomy (Tumanian, Petrosian, 1970).

Figure 2. The first platform with four stellar symbols on the east side.

THE ANCIENT "OBSERVATORY" OF MEZAMOR

The important discovery, which enriched our knowledge of ancient astronomy in Armenia, were the complex of platforms for astronomical observations on the Small Hill of Mezamor, which may be called an ancient "observatory" . Investigations on that Hill show that the ancient inhabitants of the Armenian Highlands have left us not only pictures of celestial bodies, but a very ancient complex of platforms for observing the sky.

On the bank of the river Mezamor, some 30 km west of Yerevan, a metal-producing centre was found , dating back to the third millennium BC . The life here dated from V millennium BC till to XVIII century AD.

Here on the Small Hill of Mezamor in 1966 the platforms for astronomical observations were discovered, which form a peculiar complex - an ancient "observatory" (Parsamian and Mkrtchian, 1969, Parsamian ,1985, 1988).

Of the platforms , three are particularly well preserved.

The first is triangular in shape, with its smallest angle facing the South. The bisector of that angle coincides with the North-South direction (to an accuracy 2 degrees). On the rock surfaces a number of symbols are carved. These symbols and images are sometimes also repeated on the other rocks as well.

On the east side of the first platform there are four identical stellar symbols surrounded by a trapezium measuring 55x40 cm. Of these four symbols, three are particularly well preserved. This trapezium is drawn narrower in the south-east; a choice of geometry which is not accidental , as will be revealed later..

One might assume that the centre of the platform might be a good place to place the symbols. However , the positioning of the trapezium and the symbols may be the key to its secrets. The fact that the trapezium with the star symbols is carved on the eastern side suggests the idea that it is connected with the rising of some star or the Sun. The Sun however can be excluded , as it used to have its own unique symbol in ancient times. The question now is which heavenly body was the trapezium pointing to?

Let's continue mentally the altitude of the trapezium till the horizon and see, with the rising of what heavenly bodies this direction is connected. We measured the azimuth of the trapezium with a compass and made some calculations. Let A - be the azimuth of the carved altitude of the trapezium dividing it into two equal parts (the line of the altitude is preserved but it is drawn roughly , so an error of measurements of the azimuth of the trapezium gave the value $A = 298^\circ$. The value of declination was found to be -21°, the value of hour angle $t = 71^\circ$. From these data it is not difficult to establish what bright stars had the above mentioned declination and when. According to 5000 year star catalogue (Hawkins and Rosental, 1967) table 1 gives the name of four brightest stars, their brightness, as well as the epochs when declination was equal to - 21° there are four candidates: Sirius, Rigel, Antares, ß C.Ma.

TABLE 1

STAR	MAGNITUDE	EPOCH
Sirius	-1.58	-2.600
Rigel	0.34	-2.100
Antares	1.22	400
ß C.Ma	1.99	-1000

Figure 3. The third platform with seven steps.

Most probably Sirius was observed and worshipped by the ancient inhabitants of Mezamor and the information they left is about this star.

Table 2 below gives the results of calculations for the rising of Sirius in Mezamor at summer Solstice; we indicate the epoch for three different values of azimuth (A = 298° being the most probable value) .

The table 2 shows how strongly the epoch changes with a change in declination of two degrees.

TABLE 2

AZIMUTH (°)	DECLINATION (°)	LOCAL TIME	EPOCH
300	-22.20	4h 39m	-2800
298	-22.55	4h 43m	-2600
296	-19.00	5h 03m	-1900

It was shown that in the years between 2800-2600 BC Sirius could have been observed at Solstice in the morning, in the rays of the rising Sun, this being the so-called helical rising of Sirius. It is obvious from the data that Sirius, the brightest star in our hemisphere could have been the object of worship by the inhabitants of Mezamor. It is possible that, like the ancient Egyptians, the inhabitants of Mezamor related the first appearance of Sirius with the opening of the year.

The occurrence of the symbol for Sirius four times in the trapezium can be explained by the fact that as in the Egyptian calendar, where the year had 365 days, after each 4 years the rising of Sirius was shifted from the first day to the second day of the month, and after another 4 years from the 3rd day to the 4th and so on. If these suppositions are correct, then the findings on the first platform prove that the inhabitants of Armenia were well acquainted with the sky, and could have used the periodical appearance for measuring time.

The second platform is situated 2.5m above the first one. It is also triangular and in the plane of meridian. The sign of the Sun and other signs are there.

Of special interest is the third platform . It differs from the other two in having seven steps carved in the rock, which lead in from a North-South direction. These steps are positioned roughly in the plane of the meridian. If the stairs leading to the platform were in the East-West direction, then one might assume that the platform was being used for religious ceremonies. The stairs however were positioned in the North-South direction, which provided an optimum position for carrying out astronomical observations. On the last step leading to the platform, a carved directional indicator (compass) was made which shows North-South-East directions. The presence of the compass suggests that the platform was not positioned exactly on the meridian plane and this compass had to be use to correct the position of the observer. The other carved signs found on the hills and the platforms also lead us to understand that the platforms , as well as serving as astronomical observation platforms, could also be used for religious rituals.

But for religious rituals on the Main Hill of Mezamor was found Pagan Altar situated in the plane east-west from the first millennium BC.

MEGALITHIC MONUMENT ZORAZ KAR

Among the ancient monuments in Armenia there is a megalithic monument, probably, being connected with astronomy. 250km south-east of Yerevan there is a structure Zoraz Kar dating back to II millennium BC. Vertical megaliths many of which are more than two meters of height form stone rings resembling to ancient stone monuments -henges in Great Britain and Brittany (Parsamian,1985, Khunkikian, 1985, Parsamian and Barsegian, 1987, Geruni, 1999).

The diameter of the main stone ring of Zoraz Kar is more than 30m and it is notable that on some stones found in the eastern part there are well polished round holes, which could have been used for the observation of the Sun in the days of equinox and solstice. The main ring is connected with megaliths in S-E direction by gate of two megaliths the distance between which more than between other stones. The first observations of the sunrise the days of solstice shows that the middle line of gate has direction East-West. On the direction N-E from the gate there is a range of nine megaliths. Sunrise observations on June 22, 1985 shows that at the moment of sunrise Sun appearance on the top of highest megalith from the gate. In the same moment it was possible to see Sun in the holes of two megaliths N 39 and N 44. Numeration was begin from north end of stone avenue which lead to main stone ring in the N-S direction. After short time during sunrise Sun was seen trough first megaliths hole from the gate.

Figure 4. A carved directional indicator (compass) is on the top of the third platform. It indicates north-south-east directions.

During the observations of sunrise on 21 September , 1985 before appearance of Sun in the middle of gate we observed Venus.

We suggested that the place of gate was chosen for observations of periodic events (Parsamian, 1985, Parsamian and Barsegian, 1987).

In the same region about 40 km from Zoraz Kar there is a village the name of Karahunge which give us some information to meditate.

Figure 5. Zoraz Kar.

Karahunge is a complicate word : "Kara"- means stone, "hunge" may be means bouquet, in Armenian dictionary there is not that word (Parsamian, 1985).

According to hypothesis of Gamkrelidze and Ivanov (1990) Indo-European languages were originated on the eastern Anatolia which is historical homeland of Armenians.

Figure 6. The Sunrise Observation in the summer solstice, 1985.

MEDIEVAL OBSERVATIONS OF COMETS AND NOVAE BY DATA IN ANCIENT ARMENIAN MANUSCRIPTS

In the collection of ancient Armenian manuscripts (Matenadaran) in Yerevan there are many manuscripts with information about observations of astronomical events as: solar and lunar eclipses, comets and novae, bolids and meteorites etc. in medieval Armenia.

In particularly there are interesting information about observations of supernovae in 1006 , 1054, possible supernova in 716, two novae in 762 , (Astapovich, 1974 , Tumanian, 1964, 1967, Barseghian, Parsamian, 1990).

Till to now 75 information about appearances of 60 comets are found in Armenian medieval sources (Vsekhsvjatskij and Tumanian, 1970, Tumananian, 1968, Barsegian and Epremian, 1989). In particularly Halley's comet were observed from Armenia in 684, 989, 1066, 1222, 1145 and 1531 (Brutian, 1988, Barseghian, Epremian, 1989, Barseghian, Parsamian, 1998).

REFERENCES

I. S. ASTAPOVICH, Astron. Zirk. ANSSSR, 826, 1974.

A. J. BARSEGHIAN and R. A. EPREMIAN, Soobsch. Byurakan Obs., 61, 1989.

A. J. BARSEGUIAN and E. S. PARSAMIAN, Soobsch. Byurakan Obs., 63,92,1990.

A. J. BARSEGUIAN, E. S. PARSAMIAN, Proceed. of Armpedinst., 49, 1998.

G. H. BRUTIAN, 1998, private communication.

A. J. BARSEGUIAN and E. S. PARSAMIAN, 1998, private communication.

T. V. GAMKRELIDZE and V. Vs. IVANOV, V. Mire Nauki, 5, 66, 1990.

P. GERUNI, Dokl. NAN of Armenia, v.98, 307, 1998.

E. MAUNDER, Astronomy without Telescopes, London, 1906.

W. OLCOTT, *Legends of Stellar Universe*, Petersburg, 1914.

E. S. PARSAMIAN and K. A. MKRTCHIAN, Historic-Astronomical Investigations, v.X, 35, 1969, Moscow.

E. S. PARSAMIAN, Soobsch. Byurakan Observatory, 57, 92, 1985a.

E. S. PARSAMIAN, Soobsch. Byurakan Observatory, 57,101, 1985b.

E. S. PARSAMIAN and A. J. BARSEGIAN, Some Questions of Experimental

Physics, Proceedings of Armpedinstitut, 58,1987, Yerevan .

E. S. PARSAMIAN, Historic and Astronomical Investigations, v.XX, 139, Moscow, 1988.

B. E. TUMANIAN, History of Armenian Astronomy, v.1, 141, 1964.

B. E. TUMANIAN and A. O. MNAZAKANIAN, Belt Calendar of the Bronze Age, Yerevan.

B. E. TUMANIAN and S. B.PETROSIAN, Uchen.Zapis. of Yerevan Univ., 1, 16, 1970.

S. K. VSEKHSVYATSKIJ and B. E. TUMANIAN, Uchen. Zapis. of Yerevan Univ., 3, 52, 1970.

CONSIDERATIONS CONCERNING POSSIBLE MODALITIES TO ESTABLISH THE ASTRONOMICAL DIRECTIONS IN DACIAN SANCTUARIES

The problem of the apparent and mathematical horizons at Sarmizegetusa-Regia

Florin Stanescu
University "Lucian Blaga", Sibiu, Romania

1. INTRODUCTION

Since the beginning, the dependence of the human being towards the sun and moon motions, the periodicity of the seasons, certain moments of stars, planets, sunset or sunrise, had a strong influence on his whole life, marking his activity (the agricultural cycle, navigation), his religions rituals, his customs and his myths. A lot of these are maintained also nowadays. The vestiges of this influence are still found in large areas, even in different continents, Europa, Asia, Africa or America. For example, in Romania, in 1967, a Neolithic cemetery, dated 4400 - 4200 B.C., was discovered at Cernica, near the capital Bucuresti, From the 327 tombs analised, a number of 314 (96%), are rigorously oriented between the limits of the yearly oscillation of the sunrise azimuth (Cantacuzino, 1963). On the other hand, the medieval cemetery (XIth century) of Alba-Iulia, Romania, 167 tombs of 181 are oriented within the limits of the annual oscillation of sunrise azimuth (Oproiu and Blajan, 1990). In the following, we will see that the Dacians have not made exception from these long traditions and customs.

2. THE DACIANS, HISTORICAL-SOCIAL COMPLEX

The Dacians (Daces) mentioned with this name by the Latin writers, or Getics (Getes) by the Greeks, formed the northern branch of the Tracians. The ancient capital of the Dacians, Sarmizegetusa - Regia, lies in the Orastie Mountains, Romania (Fig. 1).

The last Dacian king Decebalus (87 - 106 A.D.) waged four great wars against the Romans until the emperor Trajan defeated him at 106 A.D. After this victory, which was immortalized in stone by the Romans on the Trajan's Column erected in Rome - Italy (Fig. 2), and on the Adam-Clisi monument at Dobrogea, the Dacian country was transformed in a Roman province (Glodariu,1988).

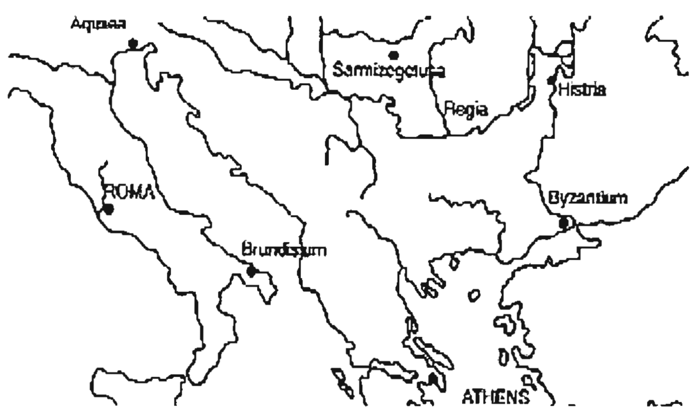


Fig.1 The ancient capital of the Dacians, Sarmizegetusa - Regia, in the European ancient world

Figure 2 The Trajan's Column , with 155 pictures, erected at Rome. The Dacian - Roman wars, this is the picture LXXII

3. ASTRONOMICAL KNOWLEDGE OF THE DACIANS

Several ancient sources mention some astronomical activities carried out by the Dacians. The beginning of the astronomical sciences at Dacia is tied to Zamolxis (or Zalmoxe), reformer of the religion, legislator and a big king, who was divinised. The first accounts about him can be hear from Herodotus, in the "Histories IV", Strabo was the author who, after Herodotus, offers us more data (Geography, VII, 3,5): "He tell us that one of the Getes named Zamolxis was the slave of Pythagoras and with this occasion, he had learned from the philosopher some sciences of the sky as well as other knowledge he had assimilated from the Egyptians,..." Origene in "Philosophumena" also tells us about the important "scientifical" knowledge of Zamolxis. After this, Porphyrios, in "The Life of Pythagoras" tells us:"... Pythagoras teached Zamolxis how to investigate the celestial phenomena..." The most conclusive account about the Dacian astronomy can be found however in Iordanes (Getica, 67-70), an author from the IIIth century. Deceneus, supposedly instructed the Dacians, "demonstrating the theory of the twelve signs of the zodiac, he showed them the motion of the planets (...), the waxing and waning of the lunar orbit (...) and the names and signs under which the 346 stars pass..."

4. DATA AND ARCHAEOLOGICAL MEASUREMENTS

Sarmizegetusa - Regia, the former capital city of the Dacian kingdom, was protected by a series of fortresses, such those at Costesti, Blidaru, Piatra Rosie or Tilisca (Glodariu,1988). In the sacred precinct of Sarmizegetusa Regia, in the vicinity of the fortress' walls, 11 round and rectangular sanctuaries were discovered. Erected on Xth and XIth terraces we can find the following monuments: the Great Limestone Sanctuary (with 4 rows of 15 plinths), the Small Limestone Sanctuary (with 3 rows of 6 plinths), the Great Round Sanctuary, with a diameter of almost 30m and oriented to the winter solstice sunrise, the Small Round Sanctuary with a diameter almost 13m, two other rectangular andesite sanctuaries with north-south orientation, the Great Rectangular Andesite Sanctuary (with 6 rows of 10 elements each, oriented to the rising of Sirius) built on top of an older limestone sanctuary and, last but not least, the altar-sundial know as "The Andesite Sun". The measurements show that the Small Rectangular Sanctuary considered "destroyed", has a curious arrangement of the components, including remains of round and rectangular pillars in its perimeter, that could constitute a mark of the extreme points of the Sun movement. Sanctuaries are also present at Costesti, (two Great Limestone sanctuaries and three Small Limestone sanctuaries, fig. 4), Racos (Great Round Sanctuary, fig.5a, Glodariu and Costea,1992,), Pustiosu, Meleia, Rudele, Fetele Albe, Dolinean - Moldavia Republic, Brad, Barbosi - Galati, Batca Doamnei. A large part of these cultic buildings have certain astronomical orientations (Schlösser, 1996; Iwaniszewski, 1998).

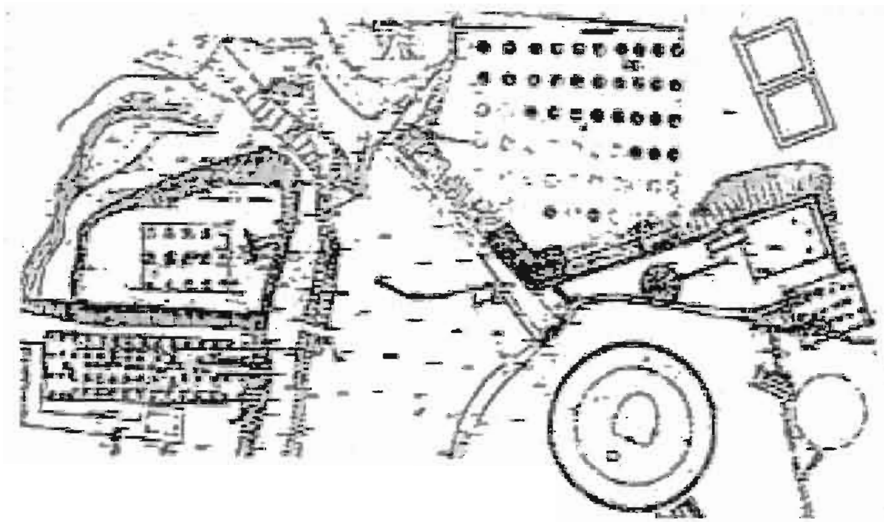
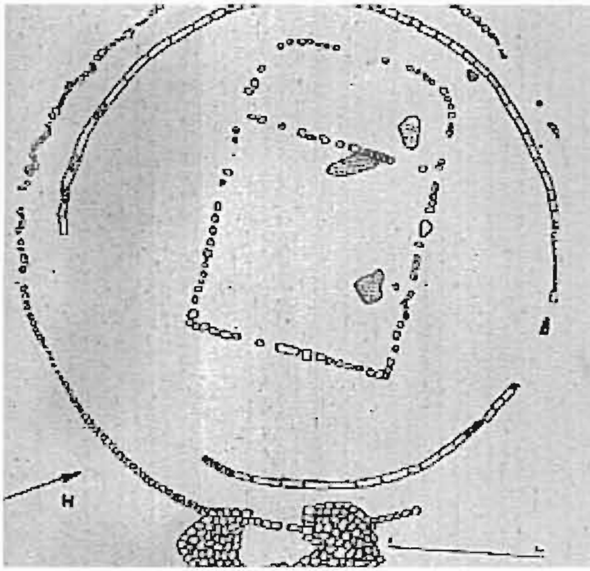


Figure 3. Map of the zone of the sanctuaries at Sarmizegetusa-Regia, Romania

Figure 4. Costesti. a)The great Rectangular Sanctuary «destroyed», «intra vallum». Dimension: 42,20 m x 11,50 m; 15 x 4 pillars. The astronomical orientated element: Moon rising at the winter solstice. b) The Great Rectangular Sanctuary. Dimension: 34,60 m x 11,30; 15 x 4 pillars. The astronomical orientated element: sun rising at the winter solstice.

5. THE PROBLEM OF THE *APPARENT* HORIZON

Lying below the level of the surrounding hills, the sacred terrace of Sarmizegetusa-Regia, where the sanctuaries are, does not have the visibility conditions of a mathematical horizon (Fig. 5b)



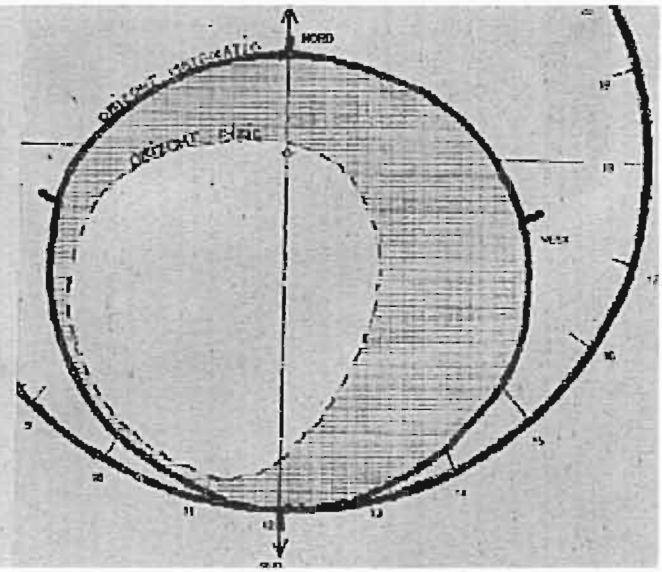


Fig. 5a: Racos. Great Round Sanctuary, with a diameter of almost 20m. Central Apsis is oriented on solstitial direction SE - NW
Fig. 5b: Sarmizegetusa-Regia. The stereographical projection of the horizon of the place seen from the 10th terrace, respectively from the east side of the Great Rectangular Andesite Sanctuary. The mathematical horizont is closed in any direction.

Nevertheless the surveys show that the astronomical orientations of the sanctuaries have been made towards the points where the stars appeared at this horizon. This contradiction can be solved only in the following ways:

- Either there is the possibility to observe the mathematical horizon from a point situated very close to the terrace of the sanctuaries. In this situation we must admit that the ancient builders knew one or more geometrical-topographical methods to translate (move) the observed direction down to the terrace.

- Or we admit they possessed the necessary knowledge and the astronomical "apparatus"- gnomon, sundial, etc.- in order to determine these directions directly at the terrace.

- Or, mathematically speaking, to admit that the orientations determined in the field are accidental.

In the following, we will analyse in detail, the first and the third possibility, while the second, has already been the subject of a larger analysis (Stanescu, 1985).

6. THE HYPOTHESIS OF A DIRECT OBSERVATION OF THE EXTREME POINTS OF THE STARS

For those who live at the mountain or hill, it is well known that the physical horizon changes rapidly when changing the point of observation. This makes that for two observers who are at a small distance from each other, the moment of observing the rising or setting of a star differs sensibly in time, depending on the difference of the height and on each one's aspect of physical horizon.

In the hypothesis that in the big cultural centre that we consider to be here, certain moments (solstice, heliacal rising and setting, etc) were marked by ceremonies or other cultural manifestations, which were being transmitted to the entire community, the determination of these moments could not have been based on some observations at the physical horizon of the terrace. This moment could have been invalidated by any observer being in a more advantageous position than the priests at the terrace of the sanctuaries. We think that this fact would compromise the whole ceremony only in a few years. Therefore, in this hypothesis, it was necessary to know a method to determine these moments, either using astronomical apparatus, or independent of visual observations made at the terrace of the sanctuaries (terraces X and XI)

Therefore we will analyse the possibility to see a free horizon from a place near the terrace. Such a position can be found on a knoll near the walls of the fortress (we remind that the complex of Sarmisegetuza-Regia is formed by a large human settlement, a fortress, and the sacred terrace with the sanctuaries). This knoll is in a place surrounded by the Dacian walls of the fortress, whose height is 1058 m.

Figure 6. a) Topographical map of the Sarmizegetusa - Regia area region, Costesti, and Luncani with the points of the compass and some of the main extreme directions of the Sun and Sirius star movement. b)The ancient instrument for tracing known under the name of "groma"

For an observer at this height, the situation changes radically. The physical horizon is, on some of the directions of interest in the discussion, as follows:

a) The direction *"height 1058m* (peak of the knoll) - *West cardinal point"*, so on the point of the sunset at equinoxes. On this direction the mathematical horizon is completely free. This fact could be sufficient in order to establish the cardinal point (the peak of the knoll establishing, together with the west equinoctial point of the sun, the east-west direction). Any perpendicular line to this direction determines the north-south direction. And, those who lined up the tambours and the plinths of the sanctuaries in a network of perpendicular directions knew, for sure, to do this thing too.

b) The direction "*height 1058m* (peak of the knoll) – *point of the sunset at winter solstice*. On this direction the mathematical horizon is completely free

c) The direction *"heigh 1058m* (peak of the knoll) - *setting of Sirius"* . On this direction the mathematical horizon is completely free.

Once established, the transfer of these directions down on the terrace could be done, possibly, with an "apparatus" (device) as the *"groma"*. A cross with perpendicular arms forms it, at the end of each arm 4 plummets are fixed (fig. 6b). These 4 plummets form 2 vertical planes perpendicular on each other (between them). This, materialized in the field through a marble block marked the crossing of the 2 fundamental directions named *"decumanus maximus"* and *"kardo maximus"*. The viewfinder was used near an arm of the cross. As the cross can rotate, the marking on to the field to any direction was possible.

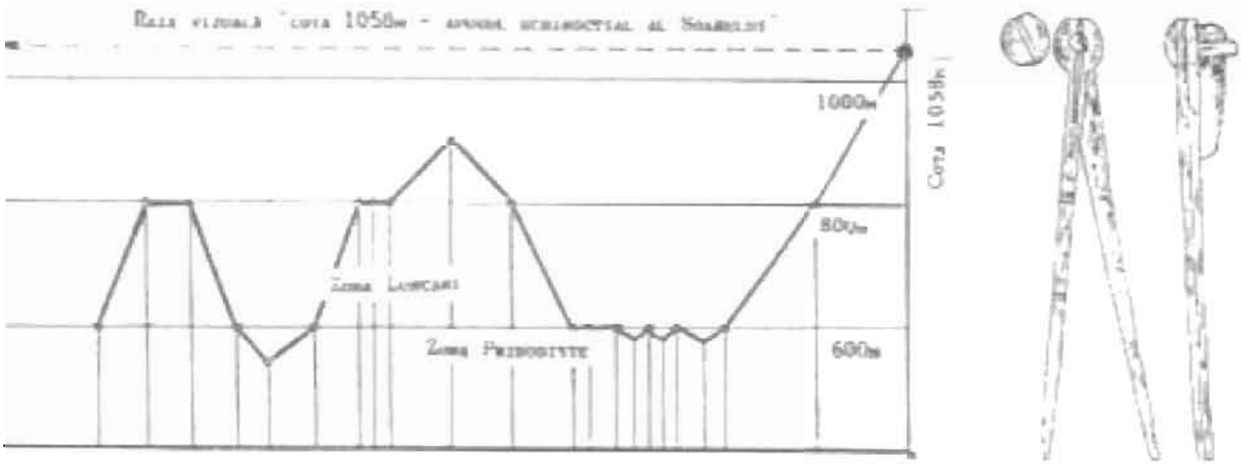


Figure 7: a) The simplified profile for the determination of the visibility on the profile line beetwen the height 1058m - the top of the knoll - inside the Dacian walls at Sarmizegetusa - Regia and the west equinoctial point. The horizon is free. b) Dacian compass type "A"

7. ESTABLISHING THE ORIENTATION OF THE SANCTUARIES WITH THE HELP OF ANCIENT ASTRONOMICAL METHODS

A strong argument supporting that the Dacians possessed some methods in their astronomical practices is also the existence, at the terrace, of 2 rectangular sanctuaries as well as some component parts of a third one, rigorously oriented in the north-south direction. Without considering that the north-south direction is in ancient astronomy, more "modern" than the solstitial directions, this direction could not be established then without the help of the following methods:

a) Knowing exactly the equinoctial days, the only days of the year when the sunrise or sunset occurs exactly in the east or west cardinal points.

b) By using the gnomon, knowing that at the days of the equinoxes, the top of the any gnomon's shadow, describes a rigorous straight line oriented exactly on the east-west direction.

Both points a) and b) lead to evident astronomy knowledge. Besides, we must take into consideration the impossibility to establish the north-south direction, by using the pole star, at those moment. Just because 2000 year ago, and due to precession, no star brighter than 4 magnitude played the role of the pole star, as the *Alpha* star of Ursa Minor plays nowadays. The nearest star to the point where the "world's axis" meets the heavenly sphere and which could be considered a pole star was *Kochab*, at Ursa Minor, but the use of this one would have led to orientation errors which can not be encountered in the sanctuaries, which are oriented very exactly (Stanescu, 1989).

8. THE PROBLEM OF THE ASTRONOMICAL ORIENTATIONS. A PROBABILISTIC ANALYSIS

The measurements show that a large part of the sanctuaries of the "sacred terrace" at Sarmizegetusa – Regia, as well as the sanctuaries at Costesti are astronomically oriented towards the extreme points of the apparent movement of the sun, moon or some bright stars. This has been found in contemporary temples and sanctuaries of other civilizations in other parts of the world. In the following we will analyse the last of the 3 possibilities stated in section 5, so we will look the answer for the question: *Which are the chances for these orientations, established at Sarmizegetusa - Regia, to be fortuitous*? We obtain 97.22% probability to *have in the same places 2 sanctuary deliberately oriented towards one of the 30 points of astronomical interest.*

For the case of the "sacred terrace" at Sarmizegetusa - Regia, where up to present 3 independent astronomical direction have been discovered, its results a 99% chance in the favor of the hypothesis that the 3 sanctuaries have been oriented astronomically deliberately, and a 1% chance for these to have been oriented astronomically accidentally. We can extend the calculus to the sanctuaries, situated at a smaller distance (Costesti) or larger (Racos). The chance draws nearer to certainty in the favor of the deliberate orientations. Otherwise, we remind that the archaeological research had pointed out, long time ago, that all the apses of the Dacian constructions were oriented approximately in the same direction and solstitially.

9. CONCLUSIONS

1. The existence of some sanctuaries oriented towards the extreme moonrise at the solstices, for the first time for the Dacians. The existence of this orientations in different places of the country (Sarmizegetusa - Regia, Costesti, Racos, Pustiosu, Meleia, Fetele Albe) as well in differently types of sanctuaries, demonstrate in our opinion, the purposely of this orientation, in the plans of the ancient builders.

2. The fact that some of these directions are not evidently obtained, by directly endorse, because the mathematical horizon nor the celestial north pole, can not be observed because of the surrounding hills, lead us to suggest that they possessed some kind of "apparatus" or methods to carry out such determinations. One of these possible astronomical "apparatus" of the epoch, seems to be the "altar-sundial" known under the name of the "Andesite Sun" (Stanescu,1989).

3. In conclusion, even though it had not existed the sundial "Andesit Sun", there is still one possibility for orienting the sanctuaries through the direct observation of the horizon from the peak of the knoll close to the Dacian walls of the fortress of Sarmizegetusa - Regia.

REFERENCES

G. CANTACUZINO and S. MORINZ, "Die jungsteinzeitlichen Funde in Cernica", *Dacia*, N.S. 7, (Bucuresti 1967), 76-89

T. OPROIU and T. BLAJAN, "Some results concerning the orientation of graves in Romanian prehistoric and ancient cemeteries", in *Archaeometry in Romania, 2*, ed. by P. Frangopol and V.V. Morariu (Cluj, 1990), 35-40

I. GIODARIU, E. IAROSLAVSCHI and A. RUSU, "*Cetati si asezari dacice in Muntii Orastiei*", (Bucuresti 1988), 48-55

I. GLODARIU, F. COSTEA, "Sanctuarul dela Racos", *Efemeride* (Cluj-Napoca, 1992) 34

W. SCHLÖSSER and J. CIERNY, *Sterne und Steine* (Dortmund, 1996) 101-102

S. IWANISZEWSKI, "The development of a regional archaeoastronomy : the case of central-eastern Europe" in *Atti Dei Convegni Lincei*, 141, (Roma 1998) 177-201

HERODOTUS, "*Istorii*", vol.IV, 94-96

STRABO, "*Geografia*", VII,3,5

ORIGENE, *Philosophumena*, I, 2-22

PORPHIRIOS, XII, 59

JORDANES, "*Getica*", XI, 69 - 72

F. STANESCU, "Astronomical significances of the sacred precinct at Sarmizegetusa Regia",in *Archaeoemetry in Romania*, vol.2, (Cluj Napoca, 1989) 2-31

F. STANESCU, "Archaeoastronomical Researches at Sarmizegetusa - Regia, Romania" in *PACT- 45 - VIII.1*, (Bruxelles, 1993) 510-524

"MUSTACHED" BARROWS AS THE HORIZON SOLAR CALENDARS OF EARLY NOMADS OF KAZAKHSTAN

Nyssanbai M. Bekbassar
Astrophysical Institute, National Academy of Sciences
of the Republic of Kazakhstan, Altamy, Kazakhstan

WHAT ARE "MUSTACHED" BARROWS?

At a huge area of a Steppe zone of Eurasia, from Volga region in the west, through Altai in the east, from Semirechje in the south, and through South Ural in the north during the period of Early Iron Age (VII BC to V AD), constructions special by design had started to appear. These are barrows (i.e. kurgan in Turkish) with stone ridges, best known in the archeological literature under the name "mustached" barrows (MB). By appearance, they represent a horseshoe-shaped construction. From both sides at a small distance from a single or a group of stone barrows, in diameters from 5 and more meters in the eastern direction (seldom also in the south one) slightly expanding, two stone ridges from 1 to 2 m wide in a crescent-shaped form are extended. As a rule the height of barrows and ridges is small - they raise above the surface of ground only for some ten centimeters. Only in rare cases the height of the principal barrow reaches 2-3 m, and ridges 0.5 m. The length of ridges or «mustaches» varies from 20 to 200 m and more. The beginning and the end of «mustaches» has the form of small kurgan or ring cairn, or marked by standing stones - stela. Sometimes axis of the «mustached» kurgans is marked by a stone rows, or more frequently by a single cairn being located in the eastern side of kurgan complex between the ends of ridges.

Being remained similar in design, these kurgan complexes have variations by number and placement of additional kurgans regarding the principal one, as well as the structure of ridges. The number of kurgans in certain cases reaches seven, but the majority of «mustached» kurgans consist of one large one or two ones - large and small located on the direction of north-south or east-west. On the principal kurgans-cairns stones are sometime in the form of the ring or in the form of spiral branch. More often «mustaches» represent entire ridges, its stones are located in the continental surface irregularly, thick in few layers without any system. In some of them, some specifics are marked both in the form of separate or adjoining to each other round cairns-links constituting a chain (1), and in the form of a stone corridor or furrow with stones that are installed crossly and overlapped by stone plates (2).

THE PROBLEMS OF INTERPRETATION

Though these monuments were studied during a long period of time, since 1932 (3,4), the issues of purpose, architectural peculiarities and semantic are not still solved. Until now, complex researches were not conducted on any of the MB. Excavations have a fragmentary nature. An absolute dating has not been identified. Dating on comparative analysis of things out from the MB themselves, as well as neighbouring burial mounds admits a large scatter in identifying their age. According to the comprehensive literature, MB are considered as: a) an over grave construction; b) a cult or ritual place; c) a commemoration construction; d) an astronomical site.

"MUSTACHED" BARROWS AND WORLD VIEW OF EURASIAN STEPPE ZONE NOMADS

Traces of many offerings and ritual fires can be found on the sites of 'mustached' barrows. These special archaeological structures, perhaps, contain certain information about the cult, religion and worldview of the people that lived in this vast steppe 2500 years ago. The offering of horse, crescent-shaped form and the eastward orientation of the ridges suggest the horse cult and horse sacrifice to the solar god, which was widely spread in Eurasian Steppe belt in the previous and subsequent epochs. As Herodotus wrote about Scythian tribes, *"Of all the gods only the Sun is worshipped and to whom the horse is sacrificed. The meaning of this sacrifice is only the fastest animal befits the fastest of all gods"* (5). The zoomorphic form of the horse, possessing a cosmographical function was the most adequate for the myths and religious system of the people of the Great Steppe; for them horse breeding was the principal activity. This fact is reflected in ancient Indian mythology where the zoomorphic symbolism of cosmos is represented by the various parts of the body of the sacrificial horse and functions of its organism:

Dawn - that is truly the head of a sacrificial horse, Sun - eyes, Wind - breathe, mouth - Fire of Vaishvanara, Year - carcass of the sacrificial horse, Sky - hill, Air Space - stomach, Earth - hoofs, Cardinal points - sides, Intermediate Countries of the World - ribs, Seasons of the Year - limbs, Months and Half-months - joints, Days and Nights - feet, Stars - bones, Clouds - flesh, Sand - food in the stomach, Rivers -veins, Mountains - liver and lungs, Plants and Trees -mare, Rising Sun - front part, setting Sun - back part.' ("Brikhadaranyaka-Upanishada") (6).

Horse burials were a characteristic ritual feature of horse-breeder nomadic tribes. It was thought that they played escort functions in funeral rites. E.E. Kuzmina believes that a horse being co-buried with the died, is a sacrifice and considers this horse as a mediator between the world of alive and heavenly dwelling-place of ancestors, as well as a power providing a man with revival in another world to the new, immortal life (7).

At the same time, two ridges have a form of a young, new born Moon in the west (right or south ridge), and old, dying Moon in the east (left or north ridge). Thus, if we distract from some variation of their types, "mustached" barrows symbolizes the Sun and the Moon: a round disk of the principal kurgan - the Sun that does not change its face and two crescent-shaped ridges - faces of the Moon at the moments of their "birth" and "death", symbolizing a revival after the death.

We should emphasize also the fact that "mustached" kurgans represent a man with out-stretched forward arms to the direction of rising Sun. If we look at him from the top, i.e. from the heavens, then a man's head standing in the pose of a prayer, is projected to the principal kurgan, and arms - to the two ridges with the final cairns depicting shoulders and hands. We can also find a comparison in the following Mithra hymn verse (8):

We worship Mithra, His lifted hands,
To whom the ruler of the country prays,
Calling to him for help, To him we lift our hands,
To whom the leaders of the tribe call,
Calling to him for help.

In addition, an obvious orientation exist to heavenly fire - Sun: all the ridges of kurgans, without exception, by their open ends are located to the direction of rising Sun, some of them to the direction of the south - to the direction of culminating Sun. The faces of Ancient Turk sculptures are also oriented to the East, rows of stelas from commemoration fences are aligned mainly also to the east. East - is not only a place of the Sunrise, but also a side in which Ulgen, Turkic supreme divine and his blessed kingdom inhabits. Correspondingly, Yerlik and his dark kingdom - in the west, where Sun and the life of a man disappears.

A four corner country of ancient nomads is the reflection of an idea about the organized Universe. In such a space-ordered world, according to archaic conception, *the center of the world* has a maximum of sacral features, through which an axis of the world passes, and where at the beginning of the world the act of creation had been implemented that led to the creation of organized cosmos. A sacred attribute of the world's center is defined, first of all by the fact, that the shortest way is passing namely through it, connecting a man with the Heavens and Creator. Since to perform ritual ceremonies, in addition to the choice of a place, it was required to precisely fix the time of their conduct, i.e. formation of the calendar. Sacrifices would reach a goal if they have been done in the given place and specific time. Therefore, there are grounds to assume that "mustached" barrows were a ritual place or temples, where not only a worship rite to the Sun has been performing but also a service of observation over heavenly bodies, service of the identification of sacral marked days and periods has been maintained.

"MUSTACHED BARROWS AS A HORIZONTAL CALENDAR"

For a purpose to verify this hypothesis, during a number of years in 1989-1991 and 1997-1998, I have investigated 25 "MB" in the composition of the Central Kazakhstani Expedition of the Archeological Institute of the Academy of Sciences of the Republic of Kazakhstan. Basically, researches had a preliminary nature. Some of the MB were studied in detail from astronomical and geodesic perspectives. Part of the materials containing charts of astronomically significant directions, pictures of rises of the Sun and the Moon over the elements of "MB" on 7 "MB" are published (9,10, 11, 12).

The basic findings to which we are approaching while considering "mustached" kurgans from astronomical perspective, is that it is apparent their functional role - a horizontal calendar, being oriented to the points of Sunrise in its cardinal positions. The extreme marks of ridges are the markers of the position of the Sun and the Moon on the horizon in extreme points. In addition, they constraint limits of swing of vibrating movement of points of Sunrises and Sunsets within the period of the whole year or part of it, as well as the Moon during the month in the minor and major standstill period.

Most of the investigated sites contain the collection of directions to the points of Sunrise and Sunset in the days of solstice and equinoxes, as well as during middle dates between them. This allows to divide a year, with the help of observations over the Sun movements that were made in the kurgans with ridges, into approximately equal parts - into two, four and eight. In addition, directions to the extreme points of rises and sets of the Moon were discovered. Fixation of the Moon's directions, probably allowed to determine regularities in its movement, and on the basis of this to predict eclipses of the Moon.

On Stonehenge, 15 out of the 18 special positions of the sun and the moon provided 22 reference points that accounted for a total of 462 directions of alignment. On 'mustached' barrows, the same issue is optimally solved using only 5-8 reference points (kurgans and end marks of ridges) accounting for a total of 20-56 possible alignments. And in most of the 'mustached' barrows studied almost half of the directions contained on its design are of astronomical significance.

Each element of the "mustached" barrow has some astronomical meaning. They could be both a site for observation, and serve as marker indicating to the points of Sunrises and Sunsets. It is possible to assume various options of ways

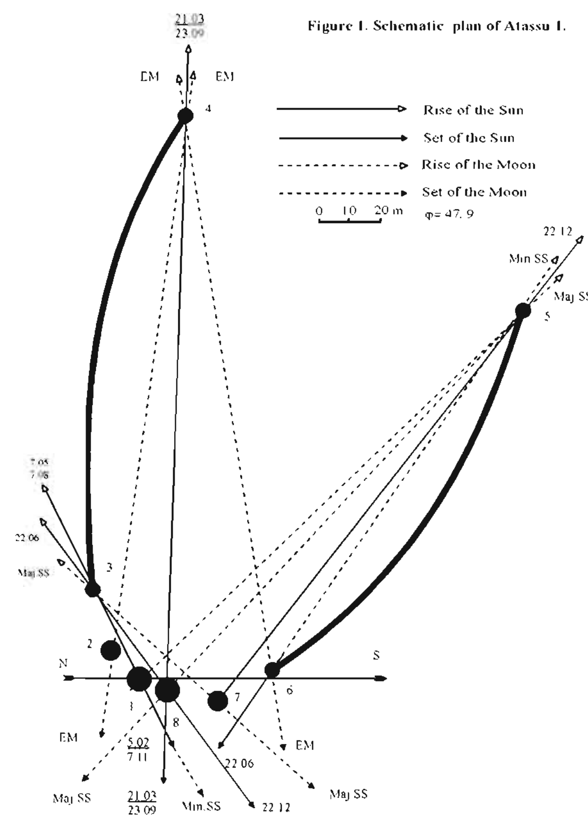


Figure 1

of the use of elements of the "MB" for a purpose to create a calendar. Below I will provide with some examples of the use of the "MB" as a horizontal calendar.

On Atassu-1 site (Fig.1) during the year while observing from the central barrow-8, the end mark of the right ridge aligns with sunrise on the days of the equinoxes, whereas the start mark aligns with the sunrise on the summer solstice. Consequently, from barrow-8, it is possible to easily observe the daily sunrises from the spring equinox to the autumn equinox. During the interval between these dates, the sunrise points moves over the northern ridge from the end mark to the start one and back, reaching the start point on the day of the summer solstice. To determine the middle dates between the equinoxes and summer solstice in that half of the year (which occurs on 07.05 and 07.08) there is the need to cross over to the neighboring supplementary barrow-1 and observe Sunrise over the start mark of that ridge. During the second half of the year, the observer moved daily from end mark of the ridge to the start one and back with such speed, at that Sunset was constantly fixed over kurgan-8. When observer in this manner reaches the start mark the day of winter solstice will occur. The middle date between the equinoxes and winter solstices (which occurs on 07.11 and 05.02) is determined by observing Sunset over barrow-1 from the start mark of the ridge.

FIGURE 2. SCHEMATIC PLAN OF ATASSU 3.

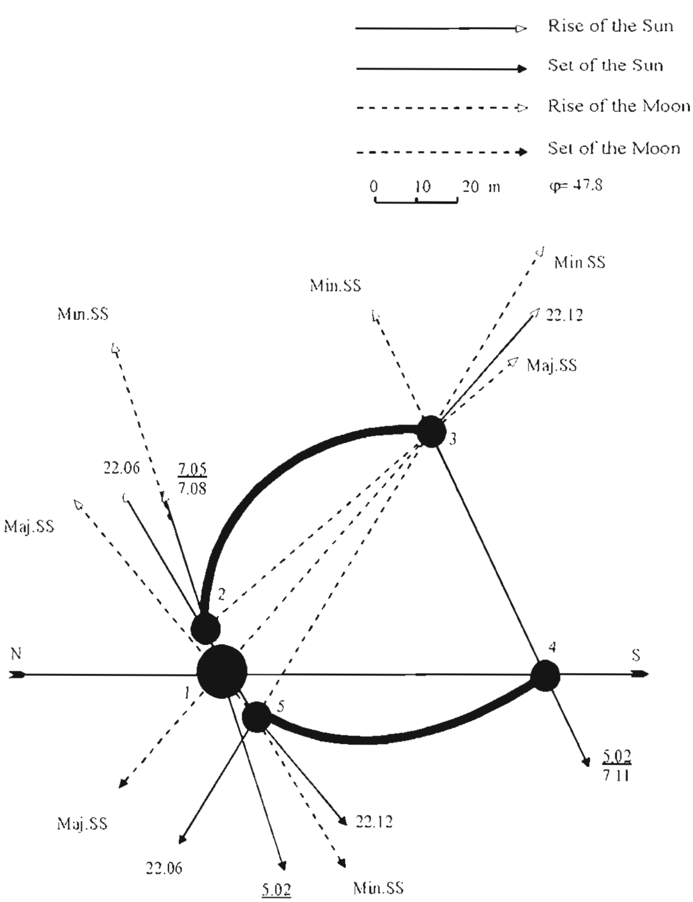


Figure 2

One of the possible options to carry out observations in the Saga site (Fig.2) is as follows. An observer locating on the principle kurgan-1 on the date spring equinox, observes the Sunrise over the end mark of the right (south) ridge (cairn-4), indicating to the top of the nearest hill. During "the first month" the points of rises move to the north approaching to the eastern supplementary kurgan-8. The Sunrise over 8 would testify to the onset of the beginning of the "second month" (on 07.05). In the next days, when an observer moves from 1 to 4 with an appropriate speed, the Sun constantly will rise over the same kurgan-8. When an observer reaches the end mark of the right ridge, the day of summer solstice will occur. Moving every day in the back direction from 4 to 1, it is possible again to constantly observe Sunrise over cairn-8. When an observer reaches the principal kurgan-1, the middle date between the summer solstice and autumn equinox (on 07.08) will occur. In the future, when there is a repeated Sunrise over the end mark of the right ridge, the day of autumn equinox will occur. In subsequent days, during the "fifth month", positions of the rising Sun will be within the horizon area, being restricted by the right ridge. When there is the Sunrise over the start mark of the ridge, a middle date between the autumn equinox and winter solstice (on 07.11) will occur. In the evening of the same day, the Sun sets over the start mark of this ridge (cairn-5), if we observe from cairn-8. Then, starting from this middle date till the day of the winter solstice, the Sun will set over the same right ridge having reached on this date by its position, the point of the horizon over the end mark cairn-4. After the winter solstice, the position of the Sun in the western horizon will start the back movement, and will be over the start mark-5 in the middle date between the winter solstice and the spring equinox (on 05.02). It is necessary to move from kurgan-8 to kurgan-1 on the day of the beginning of the last "month". Starting from this date, points of Sunrises will move along the right ridge from the start mark to the end mark, having reached it on the day of the spring equinox.

Both ridges could be used on Atassu-3 shows that here (Fig.3). So, when an observer is located on the start point of the right ridge and the central barrow, the points of the Sunrise during the whole year and Moon during the month will be within the sector being formed by the left ridge - the Sun during solstices and the full Moon rises over the start and end points of this ridge. The path of the Sun from 05.02 till 07.11 when observed from the end mark-4 of the left ridge moved across the horizon marked by the right ridge reaching the start point on the summer solstice. The Sun on the summer solstice rises and sets over the start points of the ridges, and during the winter solstice rises over the end point of the left and sets in direction with the start point of the right ridge.

Figure 3. Schematic plan of Saga.

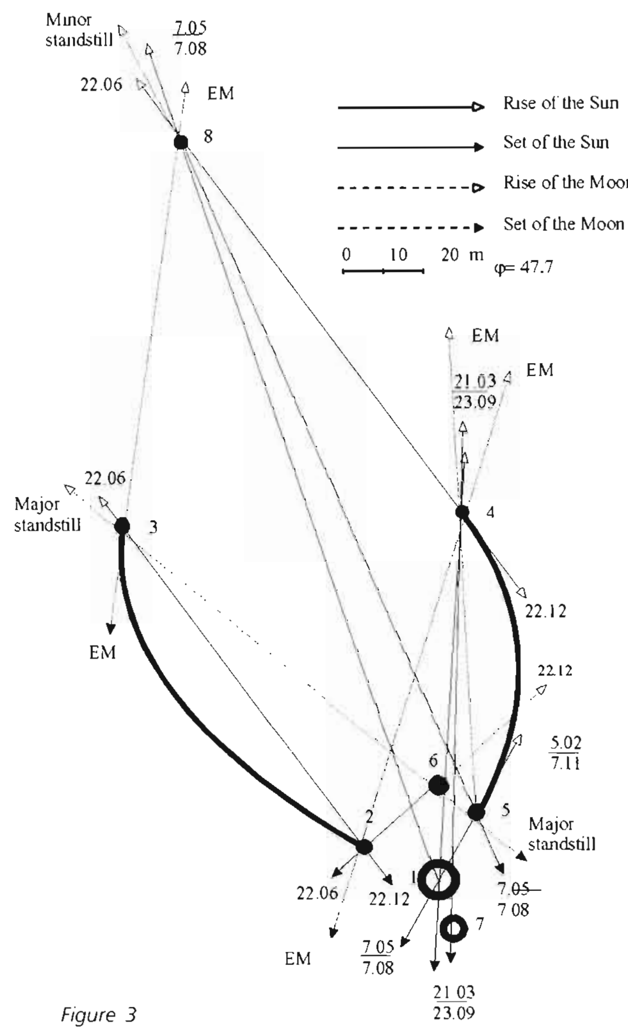


Figure 3

The most probable date of the beginning of the year for that region may be the spring equinox corresponding to Nowruz, one of the oldest festivals that existed in Central Asia even before Zoroaster. Other dates being determined with the help of orientation elements erected on the mustached barrows to the rising and setting points of the Sun, may also correspond to some festivals of herdsmen and farmers. As we know, Zoroaster obliged its followers to annually celebrate seven big festivals dedicated to Ahur-Mazda, six Amesha-Spenta and their seven creations. That also includes "mid-spring", "mid-summer", "harvest", "return of herd from the summer pastures", "mid-winter", and finally Nowruz festivals distributed in accordance with the seasons of the year. Celebration of Nowruz is distinguished among the others, since the seventh creation -fire being a vital energy, pierces all the creations. As the last out of seven, this festival reminds about the Last Day of the world, where finally Asha will triumph, and the Last day will be at the same time a New Day of eternal life (13).

Researches carried out by D. Raevskiy (14) on the basis of the study of Skithian animal style monuments in the art as the text containing coded information about mythological plots, and comparisons of "texts" reflected in them with the texts of ancient authors (Herodotus, Diodorius, Valerius Flaccus and others) allowed, from the researcher's point of view, to proceed in the reconstruction of Skithian mythology as a whole system, that were considered before to be entirely lost. The results of our investigations comply very well with the findings of D. Raevskiy, who interprets events of mythological biography of Kolaksai, the first king of Skiths, being the personification of the Sun, as specific cardinal points of solar cycle. Below I provide a slightly modified chart from the mentioned book reflecting the comparison of Skithian religious and mythological ideas with the Solar calendar:

MARCH 21	JUNE 22	SEPTEMBER 23	DECEMBER 22
Birth	Wedding	Posterity	Death
Birth of tree sons with Targitaos that personifies three zones of physical world: water and earthly depth, mountains and sky (Sun).	Possession by Kolaxais of tree gold combustible things - marriage with Godness Tabiti embodied in golden relics.	Social split-off the society-from Kolaxais military aristocracy-kings, from Lypoxais-pagan priest, from Apoxais-tillers and cattle-breeders.	Elder brothers of Kolaxas insulted by preference given to him, decide to destroy him. They starting to struggle with him and kill him.

From our perspective, studying "mustached" barrows as an alternative source and applying an astronomical method of its interpretation, we find an independent confirmation to this assumption. Namely, Sunrises and Sunsets over the end mark cairns of ridges or their principal kurgan taken place (occur) mostly on these dates.

INSTEAD OF FINDINGS

Consideration of the "MB" as objects containing information about astronomical knowledge of their constructors that was coded by a special way, from our perspective is one of the possible means to learn the world view notion of pre-historic people inhabited in that time Steppe zone of Eurasia. This approach is not a new one, but frequently researchers are constrained by the reconstruction of such concepts as the World Mountain, the World Tree, Three-tier vertical and four-corner horizontal models of the Universe. Next in turn, identification of the role that the Sky and heavenly bodies played in the culture of nomad people, how astronomical notions in the religion and ideology of nomad people are revealed, the role of astronomical practice in their religious and mythological system.

Our researches show, even taking into account that we restricted all our attention by studying only of one type of site out of their diversity, nomad people of Eurasia Steppe in the epoch of Early Iron Age had to a certain extent an astronomical knowledge. They were able to obtain, keep and transfer an astronomical information to the subsequent generations. We are empowered, from our point of view, to consider that some scraps of astronomical knowledge of the peoples of ancient Turk and subsequent epochs that reached us, had been developed during the period of Early Iron Age, during the times of a mass construction of "MB", as well as, possibly, even earlier - in the epoch of bronze.

The issue of determining whether these mustached barrows were of astronomical significance is a matter of principle, since the crux of the matter is about the rightful use of these monuments in important reconstruction in the field of spiritual culture of the ancient people of the Great Steppe.

ACKNOWLEDGMENTS

I would like to express my sincere gratitude to all people thanks to whom it was possible to conduct my researches of "MB". These are - Doctor Z. Kurmankulov, he granted me a possibility to participate in the archeological expeditions to the "MB", my former colleagues in the Astrophysical Institute, Doctors A. Mailybaev and M. Minglibaev, classmates in the physical faculty of the Kazakh University, N. Sakhipov, S. Seitzhanov, K. Ramankulov and also the SOROS Fund-Kazakhstan for their moral support and financial support in attending the international conference Oxford-6, and to my wife, G. Dzhumabaeva who provided interpretation of my report in the Conference and this article.

REFERENCES

1. S.M. AKHINZHANOV. *"Mustached" Barrows in the south-west slopes of Karatau,* Archeologicol researches in Otrar, (Almaty, 1977), 72-81.

2. A.M. ORAZBAEV. *"Mustached" Barrows in the Dzhanaidar burial cemetery as an archeological site, in* Culture of oncient cattle-breeder and tillers of Kazakhstan, (Almaty. 1969), 175-191

3. Archeological works of the Academy of Sciences of the USSR in the new building projects in 1932-33. IGAIMK, 110, (1935), 49.

4. M. K. KADYRBAEV. *"The monuments of Tasmolian culture of Central Kazakhstan", in* Ancient culture of Central Kazakhstan, *(Alma-Ata, 1966), 303-433.*

5. HERODOTUS, History, V1, (Moscow, 1972), 212.

6. *"Brikhadaranyaka-Upanishada", I, 1 - cited from* The Ancient Indian Philosophy, *(Moscow,1972),138.*

7. E.E. KUZMINA. Spreading of horse breeding and cult of the horse of Iran tribes of Central Asia and other people of the Old World" in the Central Asia in ancient times and middle ages, (Moscow, 1977), 41.

8. *"Avesta",* Selected hymns from Videvdata, (Moscow, 1993), 97.

9. N.M. BEKBASSAR. *Astronomical orientation of the "mustached" barrow (Saga river), in* Problems of physics of stars and the exstragalactic astronomy, *(Almaty, 1993), 207-231.*

10. N.M. BEKBASSAR. "Mustached" Barrow on the river Saga: astronomical content of an arrangement of its elements, in The issues of archeology of Kazakhstan. (Almaty, Moscow, 1998), 163-170.

11. N.M. BEKBASSAR. *Archaeoastronomical researches of "mustached" barrows on Atassu, in* Ancient astronomy: the Sky and the Man. Reports of the International Scientific - Methodical Conference, Moscow, 1997, 19-24 Nov., (Moscow, 1998), 32-37.

12. N.M. BEKBASSAR, ZH. KURMANKULOV. *Demystifying the "mustached" barrows,* Didar Kazahstan, *15*(1999), 38-45.

13. M.BOYCE. Zoroastrians, Moscow, 1988), 44-45.

14. D.S. RAEVSKIY. *Essays on ideology of Skithian and Saka tribes. Attempt of reconstruction of Skithian mythology,* (Moscow, 1977), 110-118.

IN ENGLISH TRANSCRIPTION

1. S.M. AKINJANOV. *Kurgan s usami na uygo-zapadnyh sklonah Karatau,* in Arheologicheskie issledovania v Otrare, (Alm-Ata, 1977), 72-81.

2. A.M. ORAZBAEV. *Kurgany s usami v mogilnike Zhanaidar kak arhitekturnyi pamiatnik,* in Kultura drevnih skotovodov i zemledelcev Kazakhstana, (Alm-Ata, 1969), 175-191.

3. Arheologicheskie raboty AN SSSR na novostroikah v 1932-33 g., IGAIMK, 110, (1935), 49.

4. M.K. KADYRBAEV. *Pamiatniki Tasmolinskoi kultury Centralnogo Kazakhstana,* in Drevnaia kultura Centralnogo Kazakhstana, (Alma-Ata, 1966), 303-433.

5. GEREDOT. Istoria, V1, (Moskva, 1972), 212.

6. Drevneindiskaia filosofia, (Moskva,1972),138.

7. *E.E. KUZMINA. Rasprostranenie konevodstva i kulta konia u iranoiazycheskih plemen Srednei Azii i drugih narodov Starogo Sveta v drevnosti i srednevekovie,* (Moskva, 1977), 41.

8. Avesta, *Izbrannye gimny iz Videvdata,* (Moskva, 1993), 97.

9. N. M. BEKBASAROV. *Astronomicheskaia orientacia kurgana s usami (r. Saga), in* Problemy fiziki zvezd i vnegalakticheskoi astronomii, (Almaty, 1993), 207-231.

10. N. M. BEKBASAROV, *Archeoastronomicheskie issledovania kurganov s usami na Atasu, in* Drevnaia astronomia: nebo i chelovek, (Moskva, 1998), 32-37.

11. N. M. BEKBASAROV. *Kurgana s usami na reke Saga: astronomicheskoe soderjanie raspolojenia ego elementov*, in Voprosy archeologii Kazahstana, (Almaty, Moskva, 1998), 163-170.

12. N. M. BEKBASSAR, ZH. KURMANKULOV. *Demystifying the "mustached" barrows,* Didar Kazahstan, 15 (1999), 38-45.

13. M. BOYCE. *Zoroastricy*, (Moskva, 1988), 44-45

14. D. S. RAEVSKII, *Issledovania po ideologii skifskih i sakskih plemen. Popytka rekonstrukcii skifskoi mifologii*, (Moskva, 1977), 110-118.

SACRED LANDSCAPES AND COSMIC GEOMETRIES: A STUDY OF HOLY PLACES OF NORTH INDIA

Rana P. B. Singh
Department of Geography, Banaras Hindu University
Varanasi, UP 221005, India
rana@banaras.ernet.in
J. McKim Malville
Department of Astrophysical and Planetary Sciences
University of Colorado
Campus Box 391
Boulder CO 80309-0391, USA
malville@spot.colorado.edu

ABSTRACT

The disciplines of geography and astronomy can be mutually employed to investigate the inherent power of sacred places by searching for cosmic geometries embedded in ritual landscapes. Our studies of major pilgrimage centers of north India (Chitrakut, Varanasi, Gaya, and Khajuraho) reveal that each can be considered to be a microcosm that geometrically links the celestial realms of the macrocosm with the human realms of text, tradition, and ritual. Through the use of the Global Positioning System (GPS) we demonstrate with high precision how natural topography, ritual movement, and festival calendars combine to establish large scale cosmic geometries.

1. INTRODUCTION

This paper, authored by a geographer and an astronomer, reflects our own profession orientations by exploring the astronomical dimensions of holy places and documenting their spatial structures. We summarize the main findings of six years of mapping utilizing GPS and theodolite measurements at major pilgrimage centers in the middle Ganga valley of north India: Chitrakut, Kashi (Varanasi), Gaya, and Khajuraho.

The *tirthas* of India provide examples of self-amplifying interactions between people and their landscapes, both terrestrial and celestial. Tirthas are "crossing-over" places with complex levels of meaning and often rich historicity. The four pilgrimage centers that we study here were initially places for travelers to pause while fording a river. In each case the particular river flows from south to north, into the realm of birth and life, out of the realm of death: the Madakani, a tributary of the Ganga at Chitrakut; the Ganga itself at Varanasi; the Phalgu at Gaya, and the Khudar at Khajuraho.

Repetition and amplification of simple actions of pilgrims, travelers, and traders combined with countless mythohistorical events have led to the significance of the great pan-Indian pilgrimage centers of Chitrakut, Kashi, and Gaya. Khajuraho was originally developed as an imperial center, chosen for its sacred topography, and has remained today a regional place of pilgrimage.

2. CHITRAKUT

An important pilgrimage destination of Hindu pilgrims for millennia, Chitrakut has been empowered by its association with Lord Rama, who with his wife, Sita, and brother, Lakshmana, spent the first stage of their exile in its forests. Today, the area contains an extensive network of pilgrimage shrines or "sub-tirthas" involving both constructed sites and features of the natural landscape such as caves, hills, springs, and forest glades. Three cardinal points are marked by Siddhashram in the east, Atri Ashram in the south, and Bharatakupa in the west (Figure 1). Embedded in the natural landscape are three sets of nested sub-tirthas, each establishing an isosceles triangle. Textual references to triangular patterns of the tirthas inspired our initial GPS mapping of the area (Dubey and Singh, 1994; Dubey, Singh, and Malville 1999). Because of the special relationship between Rama and Chitrakut, these triangles may represent the arrow and bow that are the icons of Rama and Lakshmana. Support for this interpretation is further provided by the hill near Hanumandhara known at Samkarshana, meaning "fully developed bending of a bow".

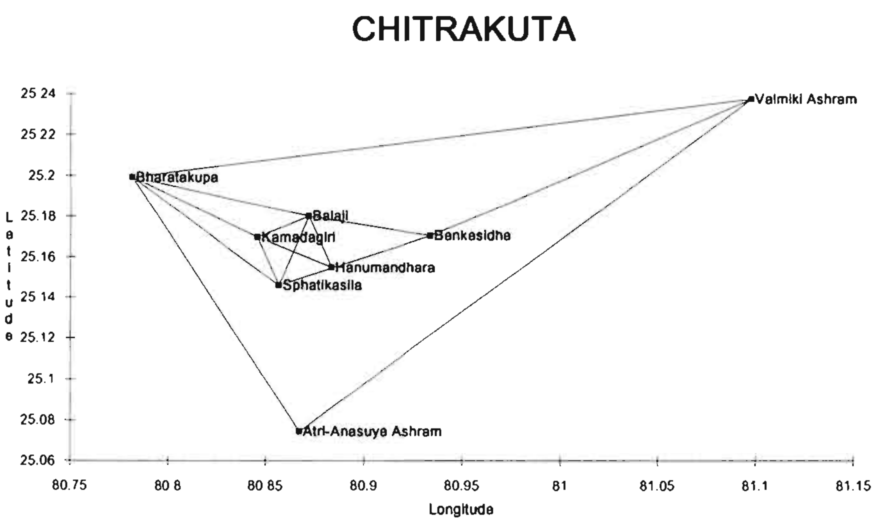


Figure 1. Map of Chitrakut

The precision with which these three interlocking triangles have been established is remarkable and raises important questions about the origin of patterns in pilgrimage landscapes. The line that bisects the largest triangle is established by nine sites, extending some 34 km between Valmiki Ashrama and Gupta Godavari (Figure 2a). Linear regression of the GPS measurements gives an azimuth of 63.5° for the line extending northeastward to Valmiki Ashrma. Although these are primarily natural sites, established by various topographic features, the probability that the alignment of tirthas is coincidental has a probability of less than one in ten thousand. There are clearly other natural features in the vicinity that could have been chosen, but they have note been marked in the landscape by repeated pilgrimage visitations, apparently in favor of the linear alignment. The line toward Valmiki Ashrama aligns approximately with the direction of

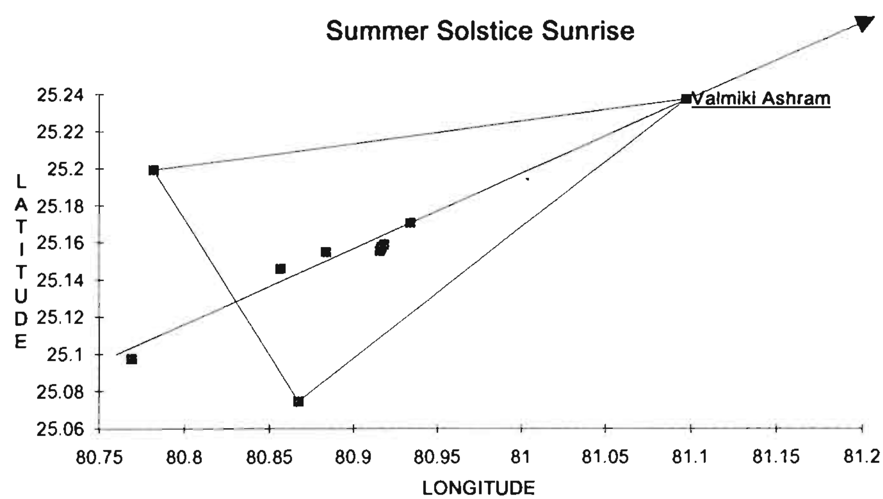


Figure 2a. Sub-tirthas associated with summer solstice sunrise.

sunrise on June 21, which on a flat horizon in the Chitrakut area occurs at an azimuth close to 64°. If the sunrise is viewed from the summit of the hill containing Hanumandhara, the summit of the hill containing Valmiki Ashrama has an elevation close to 0°. Other symmetries include the bisection of the angle at Valmiki Ashrama into 13.9° and 14.4° as well as the two long sides of the triangle, which are 29.4 km and 32.15 km.

The line of regression from Hanumandhara to Bharatakupa (Figure 2b) has an azimuth of 296.2°; at summer solstice on a flat horizon summer solstice sunset occurs at 296°. The two sides of the second isosceles triangle have lengths of 9.3 and 9.6 km; the angle at Bharatakupa is bisected into angles of 11.7° and 11.4°.

In each of these geometric patterns, we suspect that in the development of the tirtha certain sites had greater perceived sacredness and hence had greater lasting power. Namely, those sixteen sub-tirthas that fitted into the symbolism of Rama's triangles were revisited and maintained while others were neglected. Whether such geometric distinctions were made intentionally by Brahmin pundits or intuitively by pilgrims is not clear. In any case, the use GPS in our field work enables us to discuss geometric symbolism in the landscape without being limited by imprecision of measurements.

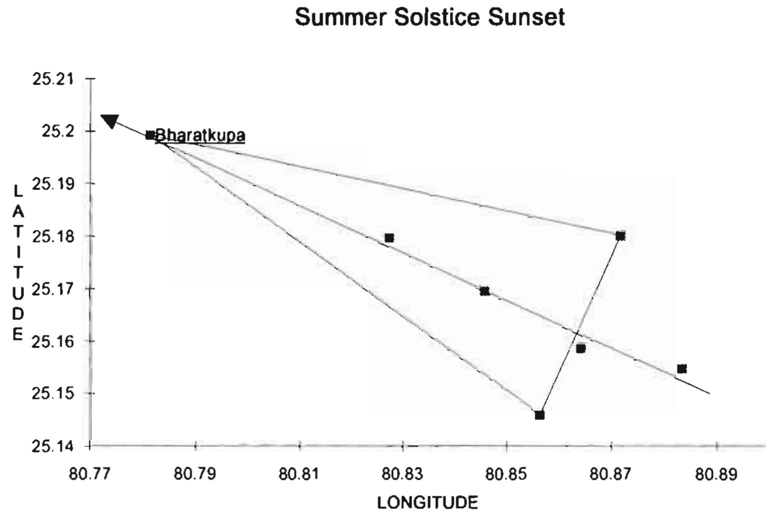


Figure 2b. Sub-tirthas associated with summer solstice sunset.

3. KASHI-VARANASI

Like many old and sacred cities in the Oriental world, a metaphysics based upon cosmological principles has been a dominant force in shaping the cultural landscape of Kashi, one of India's oldest and most sacred cities (Singh 1993, 1994). A prime example of a self-organized pilgrimage center, Kashi contains multiple pilgrimage circuits of great complexity and variety. Movement along these pathways draw upon the energies of the center of Kashi and establish a complex of natural and symbolic cycles which reinforce and articulate the meaning of the city. Among the many routes and territories defined by the movement of pilgrims, five have special significance in terms of cosmogony and sacred geometry. The five sacred territories that are marked by these routes of pilgrims' movement are mythologized as the combined manifestation of the macrocosm (represented by the gross elements: sky, air, fire, water, and earth), the mesocosm (represented by the five routes), and the microcosm (associated with the cosmic man, Purusha: heart, blood, face, legs, and head).

Although sun worship is not as prominent in the ritual landscape of Kashi as it was once, shrines of the sun god are regularly visited by pilgrims. Historical evidence indicates that during the 5th century Gupta period sun worship was common, and that by the beginning of the 12th century it was well established. However, near the end of that century all the sun temple and shrines, together with most other temples in the city, were demolished by the Mughal invaders. Fragments of the temples and sun images exist and today are visited by pilgrims, so great has been the spirit of place and the power of the sun. The 14th century text, the Kashi Khanda lists 14 sun images (Adityas) and shrines in Varanasi, each of which is expressive of one or more of the multiple qualities and meanings of the sun (Singh and Malville 1995).

Of the 14 Aditya shrines, 10 lie along the sides of an isosceles triangle (Figure 3). The longest side is established by Karna and Uttaraka and lies 1.1° east of true north. The two opposite sides have lengths of 2001 m and 1997 m, differing from each other by .2%.The shrine of Madhyameshvara lies inside the triangle only 45 m from the middle of its 2.5 km long base. Prior to the Muslim occupation of the city, Madhyameshvara was the site of one of the oldest and

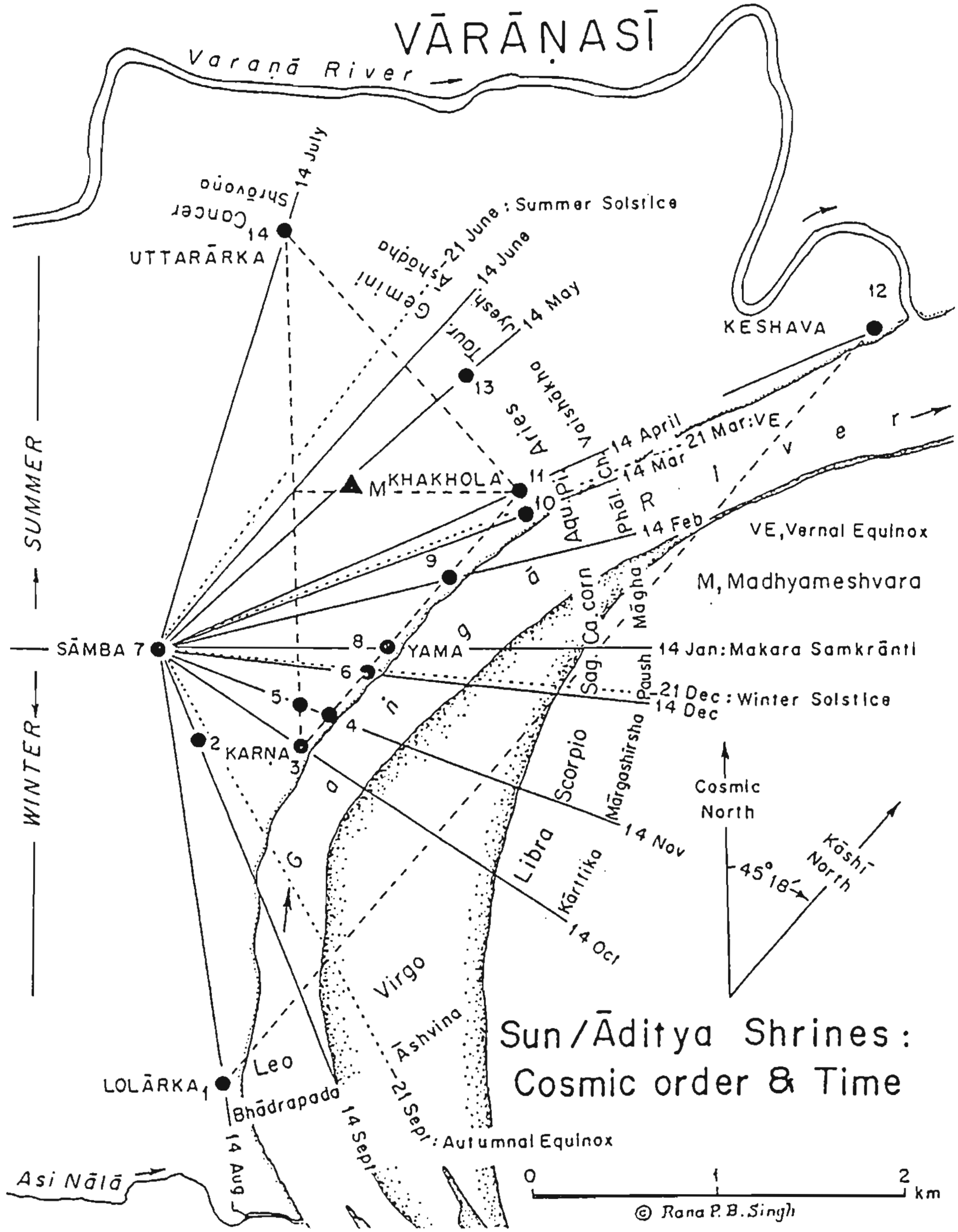


Figure 3. Aditya shrines of Varanasi. The associated dates have been determined by interviews with priests and devotees at the shrines.

greatest temples of the city. Symbolic of the centricity of Lord Shiva, it was the original center of Kashi, and as such it would have been surrounded and symbolically protected by the various forms of the sun as represented by the Aditya temples. The geometric regularity of the Adityas combined with our discovery that the center of the Aditya triangle coincides with Madhyameshvara encourages us to believe that the fragments of Surya images, lotus petals, and other representations of the sun god that mark sites along the Aditya pilgrimage circuit actually do establish the places of the original Aditya temples.

A number of the Adityas appear to be associated with specific astronomical events and solar symbolism. Khakhola Aditya is identified with an extraordinary story involving two sisters, Vinita, the mother of birds, and Kadru, the mother of snakes, the Nagas, which may refer to a major outbreak of naked eye sunspots starting around 1077 and intense meteor showers in 1060-1090 (Malville and Singh 1995). To the south of Khakhola Aditya, Mayukha Aditya is associated with a story of a time when the sun departed from the heavens, leaving only his rays, which may refer to the total solar eclipse visible in Varanasi in 1054.

4 .GAYA

Mythologically described as one of the three pillars of the "holy bridge to heaven" (the other two pillars are Allahabad-Prayag and Varanasi-Kashi), the city of Gaya and its larger territory, which includes Bodhgaya, have attracted pilgrims intent upon performing ancestral rites since at least the 8th century (Asher 1989; Vidharthi 1978) (Figure 4). We suggest that Gaya may have first developed into a major pilgrimage center because of its association with the Vedic sun god Vishnu whose three strides span the universe of earth, atmosphere, and heavens (Paul 1983). The three steps of Vishnu also symbolize the three positions of the sun through out the day. The single foot print of Visnupada suggests to devotees that Vishnu, moving sun-like across the cosmos, placed his foot momentarily on the head of the demon Gaya, who once dominated the place. Surya worship, inspired by the footprint may have paralleled the ancestral ceremonies from the earliest times and both may have been present when the Buddha first arrived in the area (Paul *op cit*).

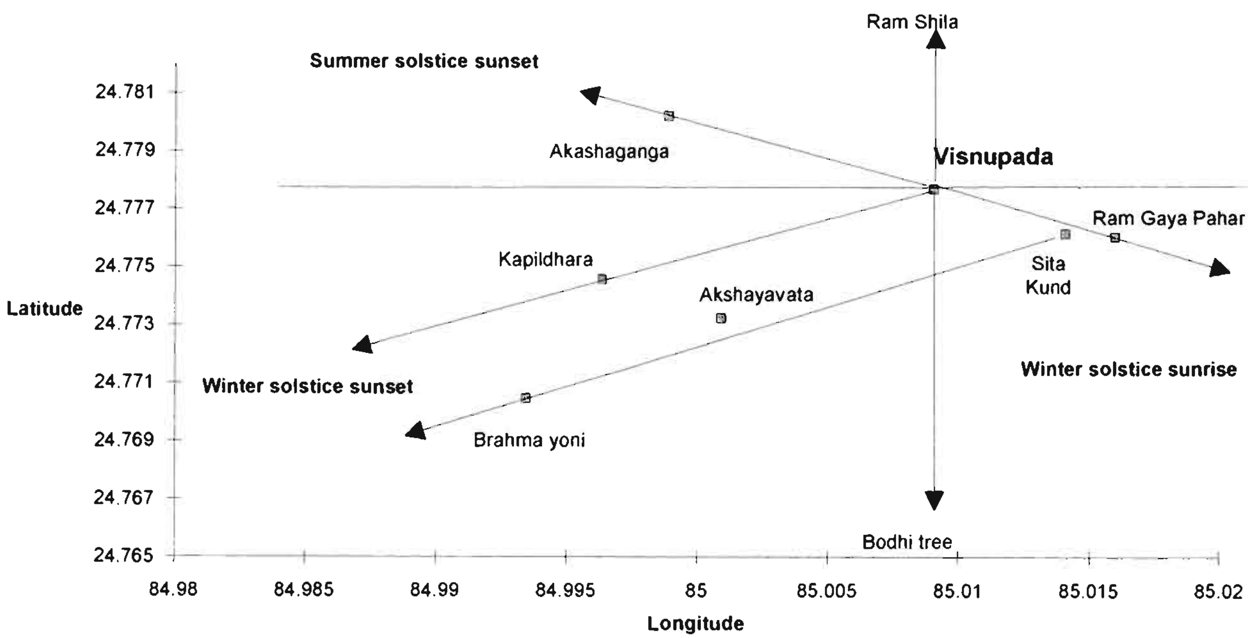


Figure 4. Solar alignments at Gaya.

Cosmic trees, such as the Bodi tree of Bodhgaya and the "imperishable" Banyan tree of Akshayavata at Gaya, may have been elements of an ancient cult that venerated trees and pillars. Each of these symbolic cosmic axes (as well as the up-stretched hand of Dasaratha at Sita Kund) represented a center of the universe, where the earth and sky were "pillared apart" and creation began (Irwin 1983). Paul *op.cit* has suggested that Gaya may have been the original site for the well-known but enigmatic iron pillar of Qutub Minar now at Delhi.

An early cosmic geometry at Gaya may have been a solar mandala with Vishnupad at its center. If the ancient function of the tirtha of Gaya included sun worship, we expect that in the vicinity of Vishnupad there should have existed opportunities for darshan of the sun at important times of the year. A suitable viewpoint for such solar phenomena, with a better horizon than at Vishnupad itself, is the rocky spur that lies just west of the temple. From that point the setting sun at summer solstice sets approximately over Akasha Ganga (the ecliptic) (26.09° north of west) (Figure 5). In the opposite direction, the sun rises at winter solstice approximately over Ramgaya Pahar (25.3° south of east). Also visible from the spur symmetrical with Akasha Ganga, the sun at winter solstice sets over Kapildhara (26.09° south of west). The solar symbolism of these sites is notable: the Akasha Ganga is the ecliptic, the path of the sun the sky; the actual village of Kapildhara is located where the Ganga "dies" flowing into the Bay of Bengal; and Ramgaya Pahar is just adjacent to Sita Kund where the hand of Dasaratha, the deceased father of Rama is rising from the earth to greet Sita, a fitting symbolism for the rising of the dying but reborn winter sun.

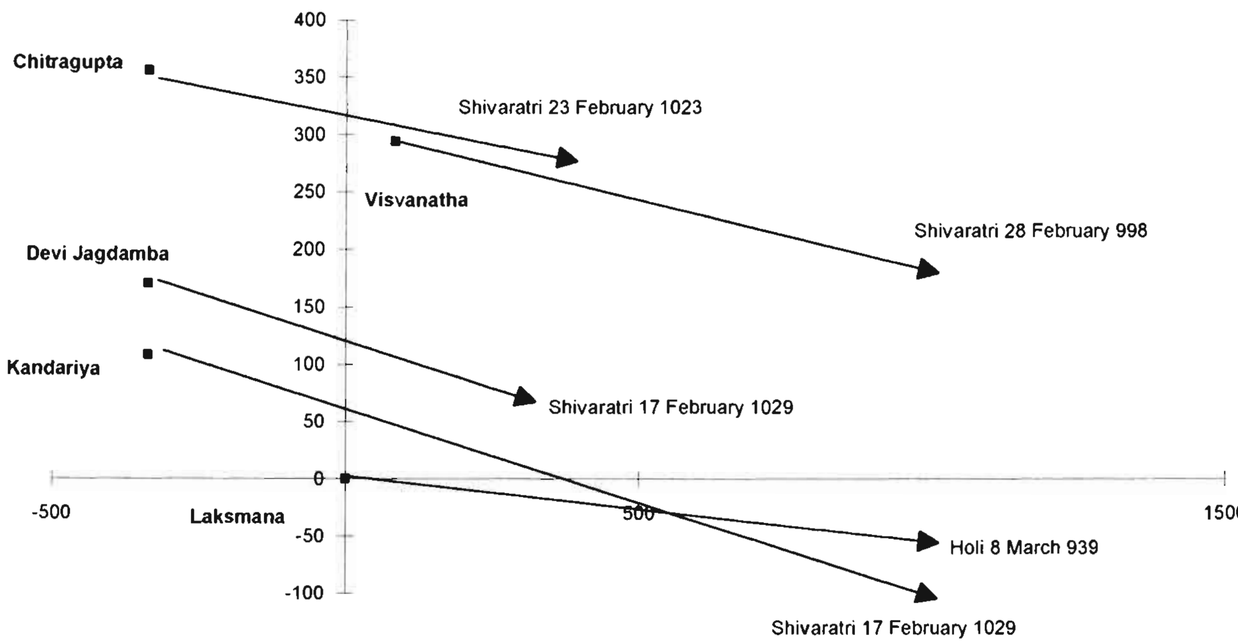


Figure 5. Solar alignments at Khajuraho.

5. KHAJURAHO

Khajuraho (Figure 6) is the location of a series of elegant temples built by the Chandela kings during an burst of construction activity between 950 and 1050 AD. The remoteness of the place has protected its temples from desecration by Moslem invaders.

According to tradition there were originally 84 temples, of which only 24 remain. Many of the temples have been built on raised platforms, about 4-5 m in height, presumably as a precaution against flooding, but which also provides unobstructed views of the eastern horizon. Except for one (Chaturbhuja) all the temples face the eastern horizon. The exquisite architectural designs of the temples, with carefully rendered symmetries, establish well-defined axes. Sun sights were obtained with a theodolite at each of the eastern entrances of the five major temples of the western group. Hindu temples built upon the ground plan of the *vastupurusha* mandala are typically aligned along cardinal directions, and we had anticipated that these carefully constructed structures would demonstrate the precision with which cardinality could be established by the architects of the Chandelas. We discovered, however, that all of the axes of symmetry that we measured were rotated by 3° to 11° south of east.

The temples of Khajuraho have served as popular local pilgrimage centers throughout the centuries, especially during the two major festivals in the spring: Holi, a Vaishnavite festival, which occurs on the full moon of Caitra (March/April) and Shivaratri which occurs 16-17 days earlier, some two days before the new moon of Phalguna (February/March) (Desai 1996). Of the two festivals, Holi is closer to equinox and a temple aligned to sunrise on the morning of that Vaishnavite festival should be closer to east-west than one aligned to sunrise on the morning of Shivaratri. The major Vaishnavite temple for which we measured the axial orientation, Lakshmana, has the smallest departure from true-east west, suggesting to us that it and the other temples might be aligned toward sunrise on the days of either Holi or Shivaratri.

From epigraphic inscriptions on the temples, we know the approximate dates of their consecration and/or construction (Desai *op. cit.*). We have searched for agreement between sunrise positions on the morning of Holi and/or Shivaratri and temple alignment during years closest to these dates. The results of our calculations, suggest that a combined solar-lunar calendar was used for establishing the dates and alignments of the temples. While the exact date of the festival is established by the lunar phase, the orientation of the associated temple appears to have been established by the position of the rising sun on the horizon.

REFERENCES

F. M. ASHER, 1989. "Gaya: Monuments of the Pilgrimage Town", *Marg* 40 (1989) 45-60.

D. DESAI, *The Religious Imagery of Khajuraho* (Mumbai, 1996).

D. P. DUBEY and R. P. B. SINGH, "Chitrakut: The Fame and Network of the Faithscape and Sacred Geometry of a Hindu Tirtha", in *The spirit and Power of Place*, ed. by Rana P. B. Singh (Varanasi, 1994), 307-332.

D. P. DUBEY, R. P. B. SINGH, and J. M. MALVILLE, "Chitrakut: a Hindu Tirtha and its Cosmic Geometry", in *Ancient Cities, Sacred Skies: Cosmic Geometry and City Planning in India*, ed. by J. M. Malville and L. Gujral, (New Delhi 1999) 36-51.

M. ELIADE, *Patterns in Comparative Religion* (London, 1958).

J. IRWIN, "The Ancient Pillar-cult at Prayag (Allahabad): Its pre-Asokan Origins", *Journal of the Royal Asiatic Society* (1983).

J. M. MALVILLE, "The Symbolic Landscape of Vijayanagara", *The Pennsylvania Geographer* XXXVI (1998) 30-54: Sacred Geography Confronts the Cosmos" National Geographical Journal of India, 40, 171-188.

J. M. MALVILLE and R. P. B. SINGH, "Visual Astronomy in the Mythology and Rituals of India: The Sun temples of Varanasi" *Vistas in Astronomy* 39 (1995) 431-449.

D. PAUL, "Antiquity of the Vishnupad at Gaya" *East and West*, N. S., 35 (1983) 103-141.

R. P. B. SINGH, *Cosmic Order, Sacred City, Hindu Traditions* ed. by R. P. B. Singh (Varanasi, 1993).

R. P. P. SINGH, "The Sacred Geometry of India's Holy City, Varanasi: Kashi as Cosmogram", *National Geographical Journal of India*, 40 (1994), 189-216.

R. P. B. SINGH and J. M. MALVILLE, "Cosmic Order and Cityscape of Varanasi (Kashi): Sun Images and Cultural Astronomy" *National Geographical Journal of India*, 41 (1995), 69-88.

L. P. VIDYARTHI, *The Sacred Complex in Hindu Gaya* (New Delhi, 1978). : Concept Publ. Co.

M. WILLIAMS, "Sraddha Ceremonies at Gaya", *The Indian Antiquary*, 5 (1876) 200-204.

ARCHITECTURAL ALIGNMENTS AND OBSERVATIONAL CALENDARS IN PREHISPANIC CENTRAL MEXICO

Ivan Šprajc
Instituto Nacional de Antropología e Historia, México, D.F., Mexico
Scientific Research Center of the Slovenian Academy of Sciences and Arts, Ljubljana, Slovenia

INTRODUCTION

Systematic archaeoastronomical research carried out during the last few decades has revealed that architectural orientations in Mesoamerica exhibit a clearly non-random distribution and that civic and ceremonial buildings were mostly oriented on the basis of astronomical considerations, particularly to the Sun's positions on the horizon on certain dates of the tropical year (Aveni 1975; 1991; Aveni and Gibbs 1976; Aveni and Hartung 1986; Tichy 1991). Various hypotheses forwarded so far interpret the dates recorded by orientations in terms of their relevance in the agricultural cycle and in computations related to the calendrical system. Tichy (1991) proposed the most elaborate models of this type, contending that these dates mark intervals of 13 and 20 days and multiples thereof; he also suggested that the orientations were laid out in accordance with a geometrical system based on a 4.5° angular measurement unit. Some authors have reconstructed possible horizon calendars for particular sites, on the assumption that prominent peaks of the local horizon served as natural markers of sunrises and sunsets on relevant dates (Aveni *et al.* 1988; Broda 1993; Galindo 1994; Iwaniszewski 1994; Morante 1993; 1996; Ponce de León 1982; Tichy 1991).

Since both the accumulated fieldwork experiences and the feedback information generated by interpretational attempts revealed that the available alignment data were neither sufficient nor accurate enough for testing such specific hypotheses, I undertook precise measurements of alignments at 37 Preclassic, Classic and Postclassic archaeological sites in central Mexico, taking into account a variety of facts and circumstances whose relevance had not been recognized before. Not only the orientations of civic-ceremonial structures but also the alignments to prominent peaks on the local horizon, placed within the angle of annual movement of the Sun, have been measured. The interpretations of the alignment data and the supporting evidence, as well as the methodological procedures concerning the measurements, selection of the alignments and analysis of the field data, are exhaustively presented in my Ph.D. dissertation (Šprajc 1997). Following is only a brief summary of the results of this research.

ASTRONOMICAL ALIGNMENTS AND OBSERVATIONAL CALENDARS

In order to analyze the alignment data corresponding to both architectural orientations and prominent mountains on the local horizon of central Mexican archaeological sites, I elaborated a number of histograms which show the distribution of azimuths, declinations and solar dates, and intervals between these dates (Figures 1and 2).[1] The distribution of azimuths is clearly non-random, but it does not confirm Tichy's (1981: 225; 1990: 187f; 1991: 106ff) hypothesis about the underlying geometrical scheme based on a 4.5° angular unit (Šprajc 1997: 39ff; Figs. 4.1-4.4). Various structures have been found to be oriented to prominent mountain tops on the local horizon (Figure 1). This fact probably reflects the significance of the mountains in the Mesoamerican world view (*cf.* Broda 1982; 1991; 1993), though the peaks to the east and west may also have facilitated astronomical observations.

Figure 1. Distribution of declinations recorded by alignments at central Mexican archaeological sites. Each quadrate represents one declination, corresponding either to a structure or to a horizon prominence; the meaning of signs and letters in the quadrates is explained in the figure. Declination values on the horizontal scale are spaced in 1° intervals; for example, all declinations greater than 15° and smaller than or equal to 16° appear in a single column. The declinations recorded on the eastern/western horizon are plotted upward/downward. For the range of declinations attained by the Sun, the corresponding dates of the year are also shown; winter and spring dates appear above the declination scale and summer and autumn dates below it.

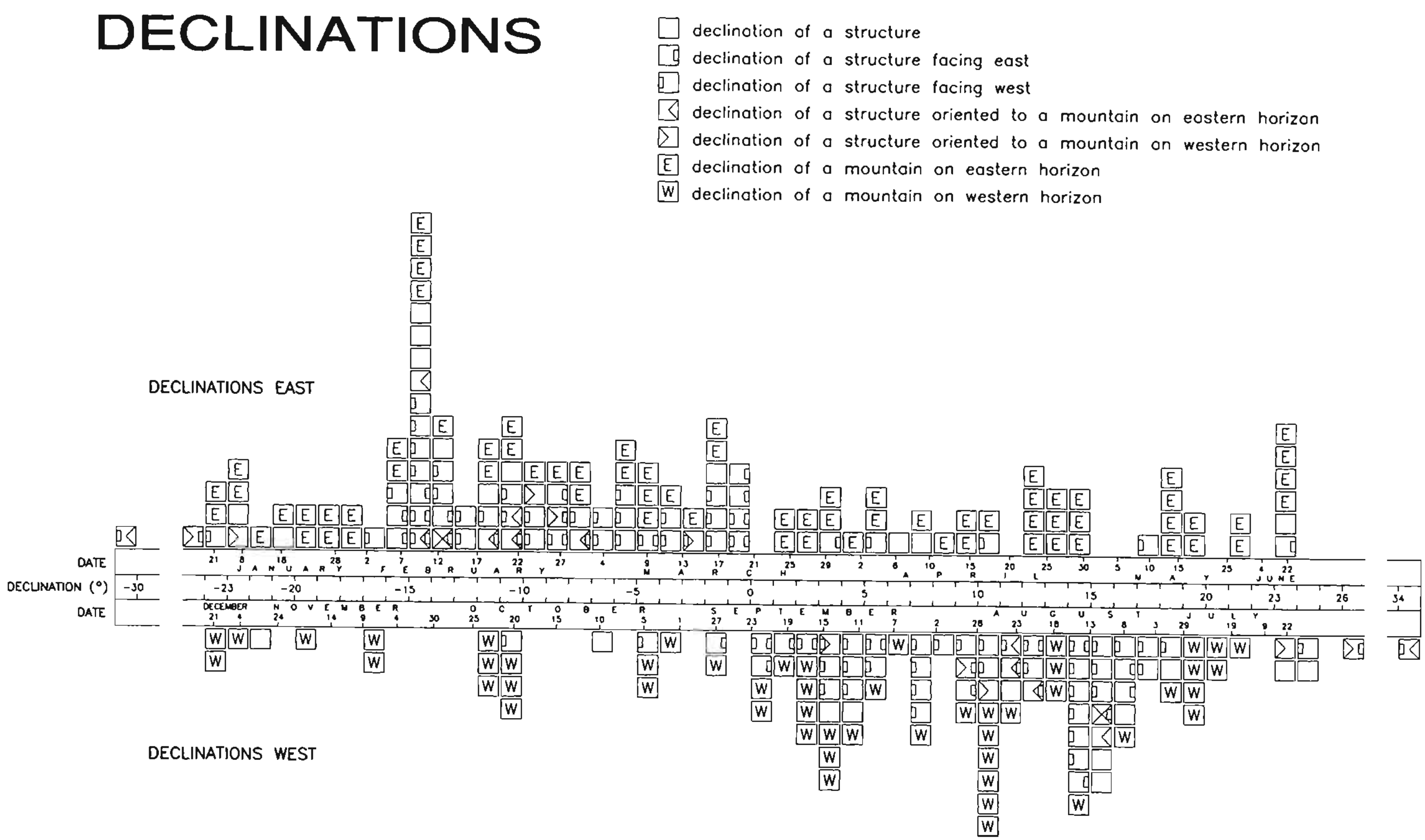
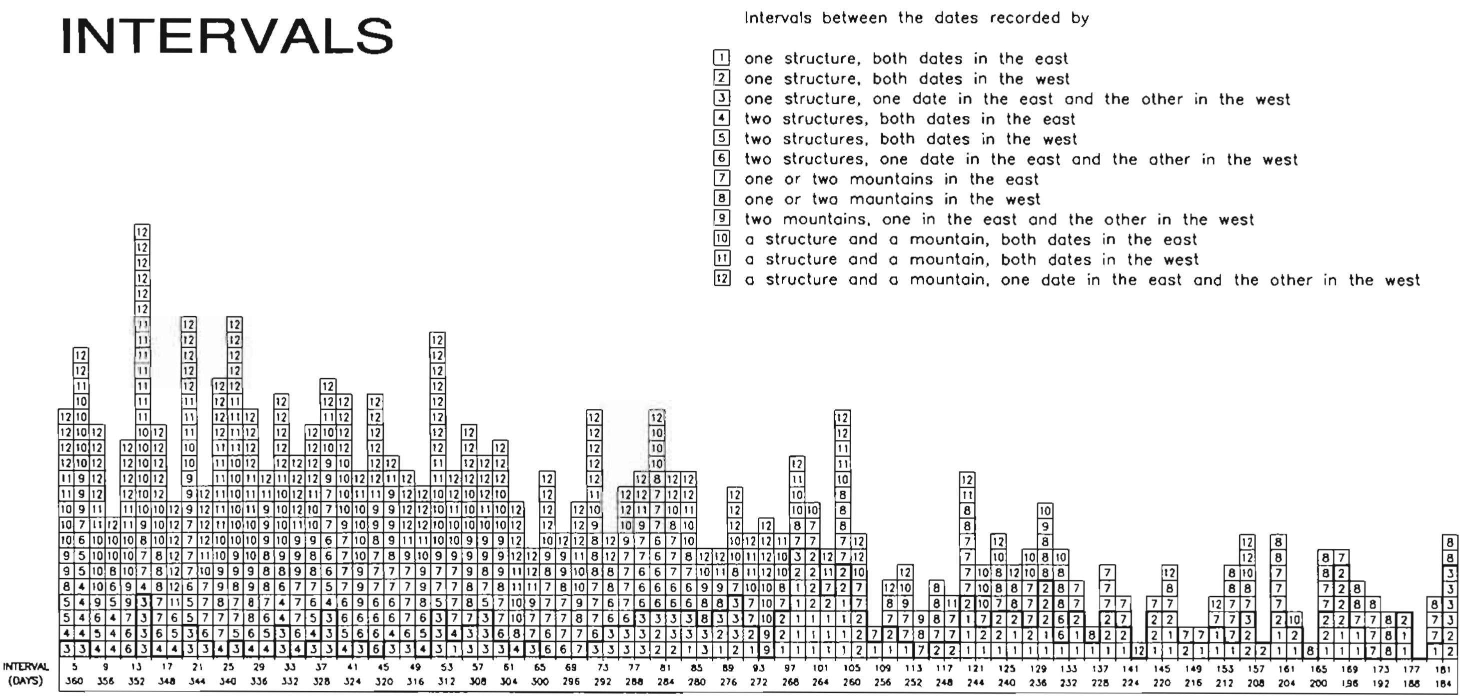


Figure 2. Distribution of intervals between the dates recorded by alignments at central Mexican archaeological sites. The intervals, each represented by a quadrate, are distances, in days, from any one to any one of the dates recorded at any particular site, both by architectural orientations and by prominences on the local horizon; the meaning of numbers in the quadrates is explained in the figure. Since any (except a solstitial) alignment registers in one and the same direction two dates in a year and, therefore, two intervals whose sum is 365 days, both are represented by a single quadrate: in the upper line of the horizontal scale the shorter intervals are listed and in the lower one their complements to the 365-day year. The columns of quadrates are spaced at 2-day intervals: for example, all intervals in excess of 103 and smaller than or equal to 105 days (greater than or equal to 260 and smaller than 262 days) are included in a single column. The thick line divides the intervals produced by a single architectural orientation (quadrates 1, 2 and 3) from others. If an interval separates the dates recorded by two alignments, the latter actually mark four dates which, consequently, delimit two short intervals; since both are necessarily coexistent and similar (though not always exactly equal, due to the variable speed of the Sun's apparent movement), they are represented by a single quadrate, its location in the histogram being determined by their mean value. Since any (except a solstitial) architectural orientation that is functional in both directions records two dates on the eastern and two on the western horizon, two of the six intervals produced necessarily approach 182 days (half a year); such intervals, even if some of them may have been achieved intentionally (their exact lengths depend on horizon altitudes), are not represented in the histogram, because their high frequency would not reflect their real importance (for details see Šprajc 1997:63, 122-124).



Since it can be affirmed that orientations in Mesoamerican civic and ceremonial architecture largely refer to solar positions on the horizon on certain dates (*cf.* Aveni and Hartung 1986: 59f; Tichy 1991: 117; Šprajc 1997: 9f), only the declinations corresponding to the east-west axes of the structures have been calculated and plotted (Figure 1; Šprajc 1997: Figs. 4.5-4.8).[2] The declinations corresponding to both architectural orientations and prominent horizon features (the latter were measured from the main buildings, normally temples, of every site) cluster around certain values, indicating not only that the architectural alignments had a calendrical function but also that the places for the construction of important buildings were carefully selected, so that prominent mountain peaks on the local horizon could be used as markers of horizon calendars.

The distribution of intervals between the dates recorded by alignments (Figure 2; Šprajc 1997: 4.9-4.12) exhibits concentrations around certain values, particularly around multiples of 13 and 20 days, suggesting the existence of observational calendars composed of calendrically significant and, therefore, easily manageable intervals.[3] Both the distribution pattern in Figure 3 and particular observational calendars that have been reconstructed for a number of sites (Šprajc 1997: 119ff; some examples are shown here in Figures 3-7) reveal that the dates recorded by one or more ceremonial structures at a site, as well as by prominent mountain peaks on the local horizon, were commonly included in a single observational scheme.

ALIGNMENT	DATE	INTERVAL (days)	DATE
		120	
Mt. Iztaccihuatl, sunset	Feb 18		Oct 21
		26 23	
Structure E1, sunrise	Mar 16		Sep 28
		13 14	
Structure E1, sunset	Mar 29		Sep 14
		20 19	
Mt. Papayo, sunset	Apr 18		Aug 26
		130	

Figure 3. Possible observational calendar of the Late Preclassic site of Xochitécatl, Tlaxcala, Mexico. Interestingly, Structure E1 registered the same dates as the roughly contemporaneous circular pyramid at Cuicuilco, D.F., Mexico (Šprajc 1997: 125ff, 139ff).

ALIGNMENT	DATE	INTERVAL (days)	DATE
		26	
Mt. Santa Cruz, sunset	Jan 2		Dec 7
		92 91	
pyramid, sunset	Apr 4		Sep 7
		13 13	
Mt. Diolochi, sunset	Apr 17		Aug 25
		130	

Figure 4. Possible observational calendar of the Classic pyramid of Chalcatzingo, Morelos, Mexico (Šprajc 1997: 190ff).

ALIGNMENT	DATE	INTERVAL (days)	DATE
		140	
area D, sunrise	Mar 1		Oct 12
		39 39	
area F, sunrise	Apr 9		Sep 13
		20 21	
area H, sunset	Apr 29		Aug 13
		13 13	
Mt. Pico Tres Padres, sunset	May 12		Jul 31
		40 40	
Mt. Tlamacas, sunrise	Jun21		Jun 21

Figure 5. Possible observational calendar of the Late Postclassic site of Texcotzingo, México, Mexico (Šprajc 1997: 285ff).

ALIGNMENT	DATE	INTERVAL (days)	DATE
		156	
Templo Mayor, sunrise	Mar 9		Oct 4
		26 27	
Templo Mayor, sunset	Apr 4		Sep 7
		26 25	
Mt. Tlamacas, sunrise	Apr 30		Aug 13
		105	

Figure 6. Possible observational calendar of the late phases of the Postclassic Templo Mayor of Tenochtitlan, D.F., Mexico (Šprajc 1997: 299ff).

SCHEME 1

DATE	INTERVAL (days)	DATE
	120	
Feb 12		Oct 31
	80 80	
May 3		Aug 11
	100	

SCHEME 2

DATE	INTERVAL (days)	DATE
	100	
Feb 9		Nov 1
	80 80	
Apr 30		Aug 13
	105	

Figure 7. Two observational calendar schemes reconstructed on the basis of two groups of the 17°-family alignments.

While Tichy (1981; 1982; 1990; 1991) attempts to establish uniform schemes applicable on regional and even supraregional level (exhaustively discussed in Šprajc 1997: 70ff), the results of my study indicate that different communities, even in one and the same region, had different observational calendars: although various dates recorded by alignments are evidently clustered, others are scattered throughout the year (Figure 1), suggesting they were not important *per se*, *i.e.* due to their position in the tropical year, but rather because of their specific computational role in local observational calendars. The conclusion is supported both by pronounced frequencies of certain intervals (Figure 2) and by the fact that observational calendar schemes based on the same principles, though not on the same dates, can be reconstructed for most of the sites (Figures 3-7; Šprajc 1997: 119ff).[4]

It is obvious, however, that some dates did have supraregional importance; the solstices and quarter days of the year, for example (declinations around ±23°30' and +1°, respectively: Figure 1), must have been common references in observational calendars.[5] The most frequently recorded dates, however, correspond to the so-called 17°-family of alignments (azimuths around 17°/107°/197°/287°, *i.e.* 17° clockwise from cardinal directions; declinations around −14° and +15°: Figure 1). It has been known, since the results of the Teotihuacan Mapping Project were published, that the same general orientation of the urban grid pattern of Teotihuacan, where this alignment family is supposed to have originated (Aveni and Gibbs 1976: 510), actually involves two slightly different orientation groups, incorporated into different parts of the city layout (Dow 1967: 326; Millon 1973: 17, 37). The results of my research reveal that this is not a peculiarity of Teotihuacan: the two alignment groups of what has been labeled as the 17° family have been found at various sites from different periods.

The dates corresponding to one group are February 12 and October 30, on the one hand, and April 30 and August 13, on the other, ±1 day. Each of the two pairs of dates divides the year into significant intervals of 105 and 260 days (*cf.* Malmström 1978; 1997; Galindo 1990: S30ff; 1994: 124f, 129ff; Broda 1993: 261f, Fig. 9.1; Morante 1993; 1996; Flores 1995: 131). The determinant of this alignment group must have been the 260-day interval, common multiple of 13 and 20 days and, therefore, calendrical interval *par excellence*: the sunrises or sunsets separated by this period occurred on the *same dates of the sacred count*. The dates recorded by the second group tend to be February 9, May 3, August 11 and November 1. The coexistence of both alignment groups at various sites, among which Teotihuacan and Xochicalco figure prominently (Šprajc 1997: 157ff, 202ff), suggests that their astronomical functions were interrelated. Indeed, the two corresponding series of dates permit reconstruction of two variants of observational calendar that could have been in use simultaneously (Figure 7). Scheme 1 in Figure 7 combines «winter» dates of the first series (February 12 and October 30) with «summer» dates of the second one (May 3 and August 11), while Scheme 2 incorporates «winter» dates of the second series (February 9 and November 1) and «summer» dates of the first one (April 30 and August 13). In both schemes a cycle of 260 days (from February 12 to October 30 in Scheme 1, and from August 13 to April 30 in Scheme 2) is subdivided by multiples of 20 days.

The dates registered by the two alignment groups of the 17° family, although perhaps not all of them were equally important, probably marked four critical moments in the maize cultivation cycle, corresponding to preparatory works in the *milpa* (February), the onset of the rainy season and the time for planting (around May 1), the ripening of the first corn cobs in some areas (August), and the end of the rainy season and the beginning of harvest (around November 1) (*cf.* Iwaniszewski 1989: 29ff; 1991). However, the fact that practically the same declinations (dates) are recorded by alignments at a number of sites, even in ecologically different zones, and that traditional festivities with predominantly agricultural symbolism are still celebrated in various indigenous communities around February 10, May 1, August 10 and November 1 (Broda 1993; Šprajc 1997: 51ff), suggests the existence of a *ritual* or *canonical* agricultural cycle: the dates involved must have been canonized precisely because the intervals separating them were easy to handle by means of the sacred 260-day calendar count. The 17°-family alignments can thus be interpreted as marking ritually important dates that introduced particular stages of the maize cultivation cycle, whereas the determination of exact times appropriate for initiating the corresponding agricultural works depended on a variety of other, mostly practical considerations related to specific environmental circumstances (Šprajc 1997: 51ff, 74ff; *cf.* Zeilik 1985).

While the observational calendar schemes based on the two groups of the 17°-family alignments may have been such as those presented in Figure 7, the motive for their simultaneous use is not readily apparent. Possibly the alignments of the two groups allowed greater reliability in determining the most relevant days with precision: if cloudy weather made impossible to fix a particularly important date by means of direct observations along the corresponding alignment, this date could have been determined by prediction, having the record of dates marked previously by other alignments and knowing the structure of intervals involved in the observational calendar. In general, the distribution of dates corresponding to architectural orientations and prominent mountains on the local horizon at central Mexican archaeological sites seems to reflect precisely this concern for determining significant moments of the year with due anticipation (Šprajc 1997: 114ff). Ethnographic analogies from the U.S. Southwest support these conclusions (Zeilik 1985).

Even if the alignments of the 17° family are widespread all over Mesoamerica, some other dates frequently recorded by alignments (Figure 1) suggest that different versions of ceremonial agricultural cycle were employed, probably as a result of differing environmental circumstances, cultural idiosyncrasies, and even political ambitions of ruling elites.

CONCLUDING REMARKS

Observational calendars, such as have been reconstructed for a number of central Mexican sites, must have had practical uses, allowing an efficient scheduling of agricultural and associated ritual activities in the annual cycle. While some dates recorded by alignments probably marked crucial moments of a canonical or ritualized agricultural cycle, others must have had «auxiliary» functions. Since the intervals composing observational schemes were multiples of basic periods of the calendrical system, it was relatively easy to predict the most important dates, knowing the sequence of intervals involved and the mechanics of the formal calendar. This *anticipatory* aspect of observational calendars must have been of major significance: important dates, supposing they were related to subsistence activities, had to be announced ahead of time, because the ceremonies officially inaugurating certain stages of agricultural cycle had to be prepared with due anticipation; furthermore, direct observations on relevant dates may have been obstructed by cloudy weather. On the other hand, *confirmatory* observations on predicted dates must have also had a significant role, sanctioning the ideology of the ruling class and reinforcing social cohesion (Šprajc 1997: 114ff; *cf.* Iwaniszewski 1989: 30f; Zeilik 1985; 1989).

Future research is expected to shed light on details concerning the structure, function and development of observational calendars. Considering the high degree of Mesoamerican cultural unity, it is probable that diverse societies in the area employed observational calendars with common characteristics, but only detailed studies of alignments at a sufficiently large number of archaeological sites in various parts of Mesoamerica will be able to disclose regional and time-dependent variations in the principles underlying the orientation and location of civic and ceremonial buildings.

NOTES

1. While Figures 1 and 2 show these data for all sites included in my study, histograms presenting them separately for the Preclassic, Classic and Postclassic periods can be found in Šprajc 1997: Figs. 4.1-4.12.

2. Among the orientations measured there are only two that cannot be related to the Sun's positions on the horizon. The substructure of El Circular and its Annex at Huexotla (Šprajc 1997: 246f, Table 5.4.5.1) were probably oriented to the maximum northerly extreme of Venus as evening star (Šprajc 1993a: 48ff; 1993b: 273f; 1996: 179ff, pls. 23 and 24), whereas the orientation of the pyramid of Tepeapulco (or Xihuingo), if astronomical at all, can only be related to the rising or setting points of certain stars (Šprajc 1997: 200ff).

3. Sunrises and sunsets separated by 13-day intervals and their multiples occurred on dates with the same *trecena* numeral, while the events separated by 20-day periods and their multiples fell on dates having the same *veintena* sign of the 260-day count. The importance of intervalic time reckoning is attested both in central Mexican (Siarkiewicz 1995) and in the Maya codices (Aveni *et al.* 1995; 1996). The mechanics of the 260-day count is even nowadays familiar to indigenous calendar-keepers in the Guatemala highlands, who use no written records; the knowledge possessed and the procedures employed by prehispanic full-time specialists were obviously far more sophisticated (Šprajc 1997: 115f).

4. The existence of different observational calendars was proposed also for the Maya area by Aveni and Hartung (1986: 57), who related local versions both to environmental peculiarities and to the autonomy of political entities. It can also be recalled that among the Pueblos of North American Southwest, in spite of their cultural unity, each community has its own Sun watcher and keeps its own agricultural and ceremonial calendar (Zeilik 1985: S2; 1989: 151).

5. Solstitial orientations were more common in the Preclassic than in later periods (Šprajc 1997: 47ff, Figs. 4.6-4.8), which is a fact observed in early Mesoamerican architecture in general (*cf.* Aveni and Hartung 1986: 12, Fig. 2d; Tichy 1991: 55f; Broda 1993: 266). While the equinoxes, as defined in modern astronomy, do not seem to have been known in ancient Mesoamerica, comparable significance may have been attributed to the so-called quarter days (March 22-23 and September 20-21) which, together with the solstices, divide the year into four approximately equal parts (Somerville 1927: 33; Aveni *et al.* 1988: 290, Table 1; Ponce de León 1982: 60, note 33; Tichy 1991: 29ff; Šprajc 1995: 590, 600, note 1; 1997: 48ff).

REFERENCES

A. F. AVENI, 1975. Possible astronomical orientations in ancient Mesoamerica. In: A. F. Aveni, ed., *Archaeoastronomy in Pre-Columbian America*, Austin – London: University of Texas Press, pp. 163-190.

A. F. AVENI, 1991. *Observadores del cielo en el México antiguo*. México: Fondo de Cultura Económica (transl. by J. Ferreiro; orig.: *Skywatchers of ancient Mexico*, Austin: University of Texas Press, 1980).

A. F. AVENI, E. E. CALNEK, and H. HARTUNG, 1988. Myth, environment, and the orientation of the Templo Mayor of Tenochtitlan. *American Antiquity* 53 (2): 287-309.

A. F. AVENI, F. ANTHONY and S. L. GIBBS, 1976. On the orientation of precolumbian buildings in central Mexico. *American Antiquity* 41 (4): 510-517.

A. F. AVENI and HORST HARTUNG, 1986. *Maya city planning and the calendar*. Transactions of the American Philosophical Society vol. 76, part 7, Philadelphia.

A. F. AVENI, S. J. MORANDI and P. A. PETERSON, 1995. The Maya number of time: intervalic time reckoning in the Maya codices, part I. *Archaeoastronomy* no. 20 (*Journal for the History of Astronomy*, supplement to vol. 26): S1-S28.

A. F. AVENI, S. J. MORANDI and P. A. PETERSON, 1996. The Maya number of time: intervalic time reckoning in the Maya codices, part II. *Archaeoastronomy* no. 21 (*Journal for the History of Astronomy*, supplement to vol. 27): S1-S32.

J. BRODA, 1982. El culto mexica de los cerros y del agua. *Multidisciplina* 3 (7): 45-56.

J. BRODA, 1991. Cosmovisión y observación de la naturaleza: el ejemplo del culto de los cerros en Mesoamérica. In: J. Broda, S. Iwaniszewski, and L. Maupomé, eds., *Arqueoastronomía y etnoastronomía en Mesoamérica*, México: Universidad Nacional Autónoma de México, Instituto de Investigaciones Históricas, pp. 461-500.

J. BRODA, 1993. Astronomical knowledge, calendrics, and sacred geography in ancient Mesoamerica. In: C. L. N. Ruggles and N. J. Saunders, eds., *Astronomies and cultures*, Niwot: University Press of Colorado, pp. 253-295.

J. W. DOW, 1967. Astronomical orientotions at Teotihuacán, a case study in astro-archoeology. *American Antiquity* 32 (3): 326-334.

D. FLORES GUTIÉRREZ, 1995. En el problema del inicio del año y el origen del calendario mesoamericano: un punto de vista astronómico. In: D. Flores G., ed., *Coloquio Cantos de Mesoamérica: Metodologías científicas en la búsqueda del conocimiento prehispánico*, México: Universidad Nacional Autónoma de México, Instituto de Astronomía – Facultad de Ciencias, pp. 117-132.

J. GALINDO TREJO, 1990. Solar observations in ancient Mexico: Malinalco. *Archaeoastronomy* no. 15 (*Journol for the History of Astronomy*, supplement to vol. 21): S17-S36.

J. GALINDO TREJO, 1994. *Arqueoastronomía en la América antigua*. México: Consejo Nocionol de Ciencia y Tecnología – Editorial Equipo Sirius.

S. IWANISZEWSKI, 1989. Exploring some anthropological theoretical foundations for archaeoastronomy. In: A. F. Aveni, ed., *World archaeoastronomy*, Cambridge: Cambridge University Press, pp. 27-37.

S. IWANISZEWSKI, 1991. La arqueología y la astronomía en Teotihuacan. In: J. Broda, S. Iwoniszewski, and L. Maupomé, eds., *Arqueoastronomía y etnoastronomía en Mesoamérica*, México: Universidad Nacional Autónoma de México, Instituto de Investigaciones Históricas, pp. 269-290.

S. IWANISZEWSKI, 1994. Archaeology and archaeoastronomy of Mount Tlaloc, Mexico: a reconsideration. *Latin American Antiquity* 5 (2): 158-176.

V. H. MALMSTRÖM, 1978. A reconstruction of the chronology of Mesoamerican calendrical systems. *Journal for the History of Astronomy*

9: 105-116.

V. H. MALMSTRÖM, 1997. *Cycles of the Sun, mysteries of the Moon: The calendar in Mesoamerican civilization*. Austin: University of Texas Press.

R. MILLON, 1973. *The Teotihuacán map. Part one: Text*. In: R. Millon, ed., *Urbanization at Teotihuacán, Mexico*, vol. 1. Austin – London: University of Texas Press.

R. B. MORANTE LÓPEZ, 1993. "Evidencias del conocimiento astronómico en Xochicalco, Morelos", unpublished M.A. thesis. México: Escuela Nacional de Antropología e Historia.

R. B. MORANTE LÓPEZ, 1996. "Evidencias del conocimiento astronómico en Teotihuacan", unpublished Ph.D. dissertation. México: Universidad Nacional Autónoma de México, Facultad de Filosofía y Letras.

A. PONCE DE LEÓN, 1982. *Fechamiento arqueoastronómico en el Altiplano de México*. México: Departamento del Distrito Federal, Dirección General de Planificación.

E. SIARKIEWICZ, 1995. *El tiempo en el tonalámatl*. Warszawa: Uniwersytet Warszawski, Cátedra de Estudios Ibéricos (Monografías 3).

B. SOMERVILLE, 1927. Orientation. *Antiquity* 1: 31-41.

I. ŠPRAJC, 1993a. The Venus-rain-maize complex in the Mesoamerican world view: part I. *Journal for the History of Astronomy* 24: 17-70.

I. ŠPRAJC, 1993b. Venus orientations in ancient Mesoamerican architecture. In: C. L. N. Ruggles, ed., *Archaeoastronomy in the 1990s*, Loughborough: Group D Publications, pp. 270-277.

I. ŠPRAJC, 1995. El Satunsat de Oxkintok y la Estructura 1-sub de Dzibilchaltún: unos apuntes arqueoastronómicos. In: *Memorias del Segundo Congreso Internacional de Mayistas*, México: Universidad Nacional Autónoma de México, Instituto de Investigaciones Filológicas, Centro de Estudios Mayas, pp. 585-600.

I. ŠPRAJC, 1996. *La estrella de Quetzalcóatl: El planeta Venus en Mesoamérica*. México: Editorial Diana.

I. ŠPRAJC, 1997. "Orientaciones en la arquitectura prehispánica del México central: Aspectos de la geografía sagrada en Mesoamérica", unpublished Ph.D. dissertation. México: Universidad Nacional Autónoma de México, Facultad de Filosofía y Letras.

F. TICHY, 1981. Order and relationship of space and time in Mesoamerica: myth or reality? In: E. P. Benson, ed., *Mesoamerican sites and world-views*, Washington: Dumbarton Oaks, pp. 217-245.

F. TICHY, 1982. The axial direction of Mesoamerican ceremonial centers on 17° north of west and their associations to calendar and cosmovision. In: F. Tichy, ed., *Space and time in the cosmovision of Mesoamerica*, Lateinamerika Studien 10, München: Universität Erlangen-Nürnberg – Wilhelm Fink Verlag, pp. 63-83.

F. TICHY, 1990. Orientation calendar in Mesoamerica: hypothesis concerning their structure, use and distribution. *Estudios de Cultura Náhuatl* 20: 183-199.

F. TICHY, 1991. *Die geordnete Welt indianischer Völker: Ein Bespiel von Raumordnung und Zeitordnung im vorkolumbischen Mexiko*. Das Mexiko-Projekt der Deutschen Forschungsgemeinschaft 21, Stuttgart: Franz Steiner Verlag.

M. ZEILINK, 1985. The ethnoastronomy of the historic Pueblos, I: calendrical Sun watching. *Archaeoastronomy* no. 8 (*Journal for the History of Astronomy*, supplement to vol. 16): S1-S24.

M. ZEILINK, 1989. Keeping the sacred and planting calendar: archaeoastronomy in the Pueblo Southwest. In: A. F. Aveni, ed., *World archaeoastronomy*, Cambridge: Cambridge University Press, pp. 143-166.

PROMISING ARCHAEOASTRONOMY INVESTIGATIONS IN CHILE

Maxime Boccas[1,5], *Patricio Bustamante Díaz*[2,5], *Carlos González Vargas*[3,5], *Carlos Monsalve Rodríguez*[4,5]
[1] Cerro Tololo Inter-American Observatory, Chile, mboccas@noao.edu
[2] Comisión Nacional de Energía, Chile, pbustama@cne.cl
[3] Instituto de Estética, Pontificia Universidad Católica de Chile, cgonzale@puc.cl
[4] Instituto de Arte y Comunicación Social, Chile
[5] Intijalsu Ltda., Castor Villarin 35, Chile, http://www.intijalsu.cv.cl

ABSTRACT

Chile is about to become the land hosting the largest concentration of 4 to 8m-class optical telescopes in the world. This preference is due to the well-known very favorable climatic conditions. Keeping in mind the way modern astronomers conduct site-testing campaigns to build observatories we wondered how ancient people of Chile took advantage of these superb skies, what kind of observatories they constructed and where they built them.

In 1994, we formed a research group in archaeoastronomy, called Intijalsu, to investigate the astronomical roots of the Chilean people. We have realized field work in different parts of Chile and present here a brief overview of our results. The Pucará de Chena near Santiago could have been an important religious center for the southern part of the Inca empire. In the Atacama region, the Pucará de Lasana shows construction features probably designed for calendaric use. In the Norte Chico, Cuz-Cuz is a megalithic solsticialy-aligned site. Nearby, Valle de El Encanto is a ceremonial center and presents interesting astronomical evidence of rock art and orientations. Finally, we address the educational and national heritage conservation aspects of our activities, which are the driving goals of our group. World investigators in cultural astronomy have not yet focused very much on the Southern Andes and we want to emphasize the potential of this region.

1. PIONEER WORK

The Andes cordillera, forming a natural wall with an average altitude of 5000 m, and the Pacific Ocean invaded by Humbolt's cold marine current are the two main elements that create a very special climate equilibrium along the Chilean north coast. There, between the latitudes of 18°S and 31°S, away from the humid coastline, the sky remains perfectly clear for 90% of the time, reaching 350 nights per year in the Atacama desert. In 2002, Chile will be the land hosting the largest total surface of optical reflecting mirrors in the world. That criterion of finding a site with special properties to establish an observatory -by observatory, we mean a place where the sky is being watched, not necessarily regularly, and where some evidence of this interaction with the sky was left and can be examined as archaeological material- is one of the main thoughts leading our investigations. Indigenous people were not indifferent in front of these starry skies (Urton 1981), and want to find out what observatories they used (if any), and why they built them where they are. Prehistoric people had some criteria for selecting a place to settle, based on availability of natural resources and also on sacred or ceremonial landscape. Since 1994, our archaeoastronomy group, called Intijalsu, has carried out field work to understand the prehistoric astronomical heritage of Chilean people.

Archaeoastronomy is an intersection of disciplines and can probably surge when each discipline has reached a certain maturity level, which then makes natural the need to look for new investigative tools and also makes beneficial a collaboration. The fantastic growth of astronomy in Chile will surely take archaeoastronomy to a higher status. As pointed out by Berenguer (1999), archaeoastronomical studies could play a fertilizing role for Chilean anthropology, as has been the case with rock art over the last two decades. The situation is somewhat similar in other South American countries, where a few national investigators have realized research in archaeo- and ethno-astronomy, without being actively part of the world community through publications of papers in international refereed journals or participation in specialized conferences. We will mention a few sources of interest that we have consulted. In Brazil, Beltrao (1991) has elaborated several celestial interpretations of rock art and more recently (1998) a correlation between the megalithic site of Monte Alto (near Bahia) and the Pleiades. Langer (1998), in a synthesis of the numerous megalithic sites in Brazil, provides more references to local archaeoastronomical research. In Bolivia, Eyzaguirre (1956) wrote an interesting ethnological work about Aymara names of celestial objects. Rivera (1984) described briefly a peculiar solstice alignment at the Horka del Inca near Copacabana. Urzagasti (1997) has conducted meticulous orientation measurements at Tiwanaku's Kalasasaya temple and explains what phenomena can be observed from it. Pereira (1998) has dedicated several years of ethnoastronomical investigations among indigenous people of Bolivia (Chiriguanos for example).

In Chile, González was the pioneer in looking for astronomical remains of ancient people. His interest started in 1967 when he was given a peculiar set of Mapuche ceramics on which he later identified possible calendarical information (1984). In the late 80s and early 90s, Bustamante and González investigated independently in Chena, an Inca site, reaching similar astronomical interpretations. Bustamante has published preliminary results about Cuz Cuz (1991), a petróglyph site, and Chena (1996) in local newspapers. Grebe, an anthropologist, presented an analysis (1992) of the perception of time among Aymara, Atacameños and Mapuche modern people. In 1992, González published preliminary results about field work conducted in the Pucará de Lasana. Magaña (1995) carried out detailed ethno-astronomical research in the Atacama Region. Vilches (1996) was the first archaeologist to tackle with methodology the subject when analyzing precious rock art in Taira (by the Loa river, II Region). Besides summarizing for the Chilean archaeological community what archaeoastronomy is and how it can be used, she reached interesting conclusions about the relationships existing between engraved stones, the Milky way and its fauna, and peculiar light and shadow effects produced by the sun. Finally, Easter Island, part of the Chilean territory, was extensively investigated by Liller (1989) who demonstrated the solar alignments of some moais and ahus.

2. OVERVIEW OF ARCHAEOASTRONOMICAL SITES

2.1. Pucará de Chena (Metropolitan Region)

The Pucará de Chena (33°36'S ; 70°45'W ; 638 m) is located 30 km south of Santiago. Archaeological work on the site began in 1957 and the ruins were classified as a military fortress (meaning of the Quechua word pucará). Stehberg (1976) published the latest work and described it as a strategic refuge, built not only to support the Inca military conquest at a frontier area but also to protect the presumed large Inca settlement in the valley of modern Santiago. The pucará is built on the top of a hill, surrounded at half-slope by two perimeter walls. Surprisingly, no arms were found but only 2 arrow ends. Besides playing a military role, we wondered whether the construction could have had other functions in the same way Sacsayhuaman was built as a fortress and a sacred place for celebrations. Two main arguments drove our study: the northern horizon (from azimuth 300° to 55°) is hidden by the nearby Cerro Chena culminating at 950m, and the design (as seen in aerial view) has a singular shape: it looks like an animal, with a head, a body and legs. A nighttime long-exposure picture from the summit of Cerro Chena looking downhill to the pucará (properly illuminated) revealed the entire structure was visible and appeared as a giant animal laid down on the hill! The possibility of a zoomorph design immediately led us to the famous puma-shape controversy of Cuzco, the Inca capital. In 1571, Sarmiento compared the city of Cuzco to the body of a mountain lion and the fortress of Sacsahuayman to its head. Rowe (1967) confirmed the same fact but Zuidema has argued that Betanzos's original description is metaphorical (1985). We are tempted to associate Chena's shape to a puma, thus establishing a strong ritual relationship between the Inca capital and one of the fortress established in the major settlement of the Inca southern empire. In fact, the controversy about the intentional zoomorphic town planning of Cuzco might find an important clue in the Pucará de Chena. There, because the site is quite small, all the walls are parts of the mountain lion figure, which simplifies greatly the identification. We interpret Chena's construction as a hermaphrodite animal, with a feminine and a masculine zones. In the same way, the Coricancha solar temple is the puma's sex organs in Cuzco and is depicted in Pachacuti Yamqui's diagram as a dualistic masculine/feminine world (Aveni, 1995). F. and E. Elorrieta (1996) have investigated other stunning examples of zoomorph architectures in Perú. They reveal several sacred landscapes in the region of Ollantaytambo, all associated to astronomical phenomena. Searching for more common features with Cuzco, we investigated any sky watching from Chena. The possible ushnu mentioned by Stehberg (1995) is the best hint. The main concept associated to the ushnu is an opening into the ground, and in terms of temporal idea, it represents the time when the Earth opens up to collect the rain. The ushnu could have been a set of several pieces: a pillar/gnomon made of stone, a sink/basin where the Incas poured chicha and a seat for the Inca or an idol (Zuidema 1989). As a gnomon, the ushnu was used to monitor the passage of the sun (or the full moon) through the zenith. At the latitude of Chena, neither the sun nor the moon ever goes through the zenith, ruling out the importance of the zenith-passage concept. This leads us to state that the astronomical observations made by the Incas at the extremes of their empire were certainly different from the ones made in their capital, and possibly enriched by all the astronomical practices they encountered among the conquered tribes along their territorial expansion. From the HaucayPata ushnu in Hurin Cuzco, observations of the June solstice sunrise were realized. In Chena, as seen from the northeast corner of the platform (where the ushnu is believed to have been), the June solstice sunset occurs at the intersection of the far horizon and the slope of the nearby Cerro Chena, thus forming a natural alignment. Surprisingly, from the gates of the perimeter walls, one can also observe this sunset at the intersection of the far horizon and the corresponding elevations on Cerro Chena. We don't think such a peculiarity can be the product of pure coincidence. On the contrary, the Incas might have observed that natural coincidence, which led them to chose on purpose that hill for building a fortress and ceremonial center. The Incas showed an obvious expertise in searching special sites for satisfying a religious and astronomical purpose. In Cuzco, the December solstice celebrations (which feature the use of puma skin) emphasize the start of the rainy season. In Chena, the rainy (or cold) season goes roughly from June to September. This provides us a logical interpretation for choosing the June solstice as a calendar marker. If calendarical-keeping activities were performed at Chena, it would seem logical to find an alignment to find the second solstice line from the ushnu. We don't have clear evidence of that yet. We did investigate some interesting alignment features in the rooms inside the pucará but couldn't reach a conclusion. Chena was built at about the southernmost limit of all Inca occupation. Building there a site with Cuzco's spiritual influence was a way for the Incas to affirm the greatness of their empire in front of the enemy tribes. Building a local calendar-house to monitor the time and maintain the same rhythm of celebrations as in Cuzco would have given more cohesion and strength to their huge empire. The construction has seriously deteriorated in the past years (mainly due to lack of knowledge and therefore lack of respect on the part of the visitors). We believe that, if well being taken care of, the Pucará de Chena would become an excellent tool for educational and cultural activities and a recommended stop for tourist excursions (a wish already formulated by Stehberg in 1979!).

2.2. Pucará de Lasana (II Region)

The pucará de Lasana (22°18' S, 68°39' W, 2256m) is located in the Loa river canyon in the Atacama region near the town of Calama. This area was inhabited by the Atacameña culture, through successive stages, from 400 B.C. until the Inca conquest in 1471 A.D. The Pucará de Lasana is one of several settlements (Quitor, Turi) built around the XII century, after the collapse of Tiwanaku's empire (Schiapacasse et al. 1997). The pucará architecture is varied: it contains habitation-type rooms (walls are up to 2-3m high), storehouses, tombs and possibly an industrial sector of red ceramics. Outside the pucará, large terraces were organized for agriculture, allowing to feed some 500 to 800 people. The site has been cleaned up and partly reconstructed in the years 1951-53 by Montandón (1950). In recent years, several anthropologists have investigated in this region (see Van Kessel, 1996, who wrote about the Aymara cosmovision, their spatial and temporal division of the world).

All the rooms in the pucará are fitted with rectangular doors and windows, except one. In 1971, González started investigating the interaction of the light in that room whose western wall is opened with two similar cross-shaped windows located 1.5m apart and 2m above the ground. The cross segments are about 30cm long and 10cm wide. During a few days around the 6th of February and the 6th of November (dates half-way between the summer solstice and the equinoxes), both rays of light, entering the room through these windows, hit the ground at the bottom of the northern wall and end their trajectory by ascending the northern wall to die at sunset respectively in two niches. The sunset light spots move about 3cm every day, thus framing fairly well the central date within ± 1 day. The beauty of the effect is reinforced by the presence of two windows and not just one. Six months after these dates, roughly on the 6th of August and the 6th of May (in between the winter solstice and the equinoxes), the beam of light going through the southern cross window ends its path, at the sunset, in the direction of the foot of a square pillar located inside the room toward the eastern wall. Early August, one could think that when the sunlight comes toward the center of the pillar, it indicates time for a celebration related to the call for fertility of the Earth. All these dates frame perfectly the solar annual cycle. The pillar, about 1m high (nowadays), could have served as an altar for sacrifices or adoration of a ritual ornament. The squareness and verticality of the pillar, compared to any other stone structures in the pucará, lead us to suggest the altar was also used as a gnomon for monitoring the zenith passage of the sun, which occurs 18 days before and after the summer solstice. At the time of both solstices, the rays of light enter these windows in a very oblique way and the sun gets to project S-shaped spots of light on the walls, curiously simulating a sliding on the stones snake (any relation to the god Amaru?). Finally, the room exhibits another intentional solar architectural feature. The northern wall is perforated by two windows, about 25cm square and roughly 7m apart, which are not perpendicular to the wall thickness: they are oblique and their respective axes intersect exactly at the opposite doorstep. From there, an observer can actually see walking paths on the ridges of the Loa canyon. Besides that purpose of surveillance, the light of the winter solstice rising sun penetrates the eastern window and dies in the middle of the doorstep! Added to the other calendarical features described previously, it is certainly not the fruit of hazard. Because of the multiple effects orchestrated in a single room, and leading to the determination of specific dates in the solar cycle, we conclude that the social structure of the village probably included a priest or a sun-watcher in charge of organizing temporally the activities of the community.

We intend to investigate more thoroughly the recurrence and meaning of this cross shape in other pucarás of the region, the meaning and the need for such a double alignment, and the date pointed out by the double alignment (in modern calendars of the Aymara people living in the San Pedro area, no specific celebration or activity is held at these dates). Because they could have triggered a deeper adoration or respect to the Sun, and the actual construction of a room dedicated to solar observation, solar eclipses (i.e. total, partial or annular with obscuration >95%) visible from Lasana between 900 and 1400 A.D. were searched for. The combination of the three eclipses of the X century (945: «long» 4 min. totality; 960: partial; 999: «very long» 6 min. totality) rather close in time -44 years- could have been meaningful to the Atacameños.

2.3. Cuz Cuz (IV Region)

The rock art investigated is attributed to the El Molle culture which developed from 100 BC to 700 AD, covering what is called the «Norte Semiárido» of Chile. Most recently, a few authors have published overviews of this interesting culture (Niemeyer et al., 1997). Detailed descriptions of El Molle's rock art sites -several thousands of petroglyphs catalogued- have been made by Niemeyer and Ballereau (1998). Cuz Cuz is the local name for an area (31°39' S, 71°14' W) of about 20km^2, located 6 km before arriving to the city of Illapel. In this site, mostly investigated and documented by Bustamante, more than one hundred of petroglyphs and some 30 cup stones have been found. The rock art can be classified into 88% of geometrical or abstract forms, 10% of human figures and 2% of phytomorphic and zoomorphic shapes. The first clue in our discovery of the major stone structure was the finding of two large upright-standing stones with petroglyph, located some 25m away from each other, one at the bottom of a hill ridge and the other one at the top. In between, there is a set of large stones, arranged to form what we think are the steps of a megalithic stairway. From the upper stone, one dominates the valley over 360° of horizon. The site was discovered in 1985, and at that time the arrangement of the stones (at least the four bottom ones) was still well conserved, making obvious the steps. Unfortunately, natural and human-forced erosion of the ground has caused a slippage of the structure. The stones that are still roughly in place are approximately 2m long, 1m wide, spread along the 25m (length of the stairs) and form an elevation of about 8m between the first and last steps of the stairs (we estimate nine in total). The orientation of the axis of the structure is 115°±3°. We believe this number is not random but is aimed at the summer solstice sunrise whose azimuth is 116°38' (for the 2° height of the local horizon).

All around the stairway, we have found some stones that, coincidentally, seem to be aligned with solar phenomena: toward the northeast, in the direction of the winter solstice sunrise, about 5km from the stairway, there is a small stone with a simple cross and triple cross carved ; toward the northwest, in the direction of the setting sun of the same winter solstice day, we found an isolated stone, with a single cup hole in its upper part ; as seen from the top of the stairway, the winter solstice sun rises exactly in the middle of a deep V-shape, quite unique in the profile of the horizon (this natural marker could have motivated the decision of the indigenous people to build a solar monument right there) ; toward the southeast, following the direction of the stairway axis, the sun rises above a distinguishable M-shaped mountain, about 12km away, at the bottom of which we found more than ten petroglyphs ; toward the east, there is a very large stone forming the hill ridge (4m high) with petroglyphs, plus some other smaller carved stones around ; toward the south, there is a concentration of cup stones. Additional rock art is found in the north-northeast, north-northwest and southwest directions, with azimuth not corresponding to particular solar directions. We are inclined to think that the stairway's builders could have designed a rock art network around it to indicate dates and places important to them. Some of the sites around the stairway present characteristics of ritual places. Southwest of the stairway, one needs to cross the river (purification) to access a rock art area. Right at the edge of the river, there is a very unusual round and polished stone («egg»), with a white and golden color, standing on a large grey stone divided in two parts («legs»), thus representing a mother giving birth or the sun rising behind a mountain with two summits (M-shaped), as it is the case precisely at the summer solstice. Associations of natural elements to feminine identity were a common practice among indigenous tribes. About 50m from the previous site, we observed three nicely preserved petroglyphs, which represent animal evolution (a frog, going from the egg shape to the adult body), thus being a fertility symbol. Several carved rocks show people with appendages on their heads, which could reflect some kind of shamanic activity.

The phosphenic hallucination is explained by the Indians as energies and cosmical forces ruling the Nature and the Universe (Reichel-Dolmatoff, 1985). In Cuz Cuz, the large proportion of geometrical (regular or irregular) petroglyphs would suggest the local shaman ingested drugs to start his communication with the spirits and to materialize on the rocks his vision of the energies ruling the world. The astronomically oriented megalithic stairway is probably the strongest evidence offered in all the El Molle occupation sites of knowledge of the sky from this indigenous culture. It opens the door to more systematic work that could be done to determine whether this knowledge is also present in other sites. The goal of this examination is to motivate more investigations to be carried out at this site, which is in serious danger due to the urban growth in the valley.

2.4. Valle de El Encanto (IV Region)

Valle de El Encanto (71°15' W, 30°35' S, 200m) is a superb archaeological site in the Limari river region characterized by the amazing beauty and variety of its rock art. The place was inhabited by the El Molle culture in the first few centuries A.D. Archaeologists (Ampuero, 1992) have registered 80 blocks with petroglyphs, 83 with cup stones and seven with pictographs. The zone of interest is 2km long with some rocks of huge dimensions (up to 20x20m of base and 12m high) which could have been a first (visual) factor in the selection of the place by the Indigenous people because it certainly looks like a demonstration of power from Mother Nature. The petroglyphs exhibit two artistic techniques: deep carving and pecking. These deeply carved petroglyphs are actually quite unique in Chile: they are usually formed by lines 5 to 15mm deep and often require very special conditions of light (and the shadow left in the grooves) to be seen. The deep carving petroglyphs are located mostly on stones with a dark patina. On the contrary, pecked petroglyphs are always carved on brown/reddish stones: although their readibility is usually improved when the sunlight comes with a grazing angle, they are visible all day long. These statements constitute, on their own, an evidence that the El Molle artists were aware that solar light would often decide whether the pieces of art could be seen or not. This in turn sounds like a logical way to mark a specific time: hour of the day or day of the year. We measured the direction pointed out by petroglyphs and the inclination of the rocks where they are carved. Our initial sampling of 54 petroglyph stones spread over the entire site don't show any significant tendency (all azimuths are faced). The clearer orientation pattern is that most of the rock art is actually looking at the water stream (i.e. the petroglyphs north of the stream face southward and vice-versa): the artists seemed obliged to give the actors of their pieces of art (80% of all petroglyphs have an anthropomorphic style) a visual connection to the water.

By their numbers, the cup stones are the other important characteristics of Valle de El Encanto. These are holes cut in stones, usually located within 15m of the river: they vary from 2 to 16cm in depth and have circular (5 to 16cm in diameter) or elliptical shape (up to 20x40cm). The quantity of cups in the rocks vary from 1 to 44, the most common occurrence being 1 to 3. The fact that some cup stones are located in the riverbed, and consequently are sometimes underwater, tells us that one of their uses was probably to contain water or other liquids. Menghin (1982) has published a rather complete overview of the «cup stones» phenomenon. Among many applications, he mentions the representation of stars. The largest cup stone in Valle de El Encanto is about $3m^2$ and contains 44 holes with, apparently, a random distribution. The second stone of interest is only 15m away from the former. It has about the same area but it contains only 16 holes. At the first sight, we recognized the familiar shape of the Scorpio constellation, like the one printed on any celestial maps and the even more familiar shape of the Southern Cross: 4 holes respecting very closely the asymmetry of the famous constellation. At night in early June, standing right in front of the longer axis of the stone and looking straight across to the sky above the horizon we saw the constellation of Scorpio undergoing its heliacal rising and, some 45° above it, the constellation of the Southern Cross, both groups of stars being almost exactly in the same relative position, as what the cup stone illustrates. It was then easy to recognize two additional cups as the very bright a and b Centauri, still following precise relative orientation.

In the eastern sector of the quebrada, we found a large stone, quite unique in the local scenery because it is easily seen standing off the ground. The rock long axis is roughly north/south. It is about 1.7m wide, 3m high and 4.6m long. Several wide flat surfaces of the rock are the result of natural fractures along the cleavage planes. The northern upper face is carved with two mysterious petroglyphs whose style is not found elsewhere in the site. The technique used is pecking although quite deep (up to 5mm) and requires special grazing light to be seen. The drawings represent a circle with exterior ramifications (a sun rayed with arms and fingers?) and a small body with legs and wings, half-human and half-bird. The stone is located in a unique place for conducting ritual dances, protected by a ring of rocks, allowing entry and exit of people and possessing a superb 360° view of all the Limari valley. Several other natural coincidences occur at that site and we think that the local shaman became aware of them and decided to use the place as an important ritual plaza. Looking at the large stone from the center of the plaza at midday, one has the impression of seeing a huge toad and surprisingly, at sunset, one can hear a loud recital of toads in the river down the hill. The only other group of petroglyphs (showing unique «dancing men») in that sector is found at the bottom of the hill, on the eastern side from where one can perfectly see the «toad stone» in between two triangular rocks forming a pronounced V-shape. There are typical signs of ceremonial landscape all around the plaza: the two highest summits (by far) on the 360° horizon are located north and south and are respectively only 10° off to the east and 3° off to the west of the perfect north-south line. The rest of the horizon is absolutely flat at the exception of a hill in the southwest, which stops the sun's southward journey precisely at the summer solstice sunset. The angle of tilt of the petroglyph surface on the toad stone (and the general angle of the stone) is 36°. It therefore points closely into the direction of the south celestial pole. If the shaman ever conducted ceremonies at night and stood in front of his petroglyph, he would probably have noticed that the celestial vault appears to rotate around a fixed point indicated by the stone. Our discovery gathers many features typically searched for by an archaeo-astronomer! We realize that the concept of «axis mundi» has mostly been associated to the vertical axis among ancient people. The terrestrial axis of rotation is an observable element and we intend to search systematically all the El Molle sites to see if this presumed knowledge of the celestial pole axis and interest in the constellations repeat elsewhere.

3. CULTURAL ASTRONOMY AND ARCHAEOASTRONOMY IN CHILE: PRESENT AND FUTURE

The lack of an archaeologist in our group has been handicap but we have not yet been successful in convincing a professional to join our field work. Recently, we designed and built an itinerant exhibit (sponsored by the Chilean Minister of Education and the Explora program of the National Commission for Science and Technology) which we use to present the discipline in public places and as an educational tool in secondary schools, focusing on learning «hands-on» the basics of ancient naked-eye astronomy, a re-evaluation of the local indigenous people and prehistory, and last but not least respecting the ecological and cultural heritage. We also gave a two-day course on archaeoastronomy at the first Congress of Amateur Astronomers in Chile (Boccas and Bustamante, 1998) in front of some 100 enthusiastic people. Finally we were invited by the Organization of the 19th World Scout Jamboree, held in Chile at the end of 1998, to animate

6 days of archaeoastronomy workshops for more than 400 kids, originating from 180 countries of the world. We are convinced that, as has been the case in astronomy for example, networks of well-taught and reputable amateur archaeo-astronomers can contribute very significantly to the knowledge of the discipline in Chile, providing good database, extracted (passively) from careful field work, to academics interested in studying in depth how the sky contributed to daily life in prehistoric societies. We will work toward implementing such a program with the amateur astronomer community, establishing collaboration bridges with the scientists of the main disciplines involved.

Although there are some new laws under study in the Chilean Parliament for increased protection of archaeological sites, not much progress has been done and destruction, mainly for the sake of urbanization, goes on. The Chilean Council of National Monuments, through the newest edition (1998) of its guide inventories 559 national monuments in the country. We divided these monuments into four groupings, and indicate hereafter the relative quantities: 90.5% of historical sites/architectures (including historical objects), 5.4% of natural sites, and 4.1% of pre-historical -i.e. Pre-Colombian-sites (not including archaeological pieces in museums). This statistic is very sad. Ancient rock art is internationally recognized as part of the world cultural heritage. In the IV Region of Chile only, there are more than 200 petroglyph sites known, amounting several thousands of separate engraved stones, which should be catalogued as national monuments? Intijalsu has certainly set the goal of supporting the archaeological community in protecting archaeological sites and generating more public interest in the knowledge and respect of our cultural indigenous heritage.

4. CONCLUSION

To our minds, looking for astronomical alignments is just one of the methods that the investigator can apply to understand the life of the people who lived in an ancient site. Besides, answering the question: «why are the constructions built in such a particular pattern?» is often an interesting starting clue to be able to reconstitute part of the story, not only architectural but also sociological and spiritual, of a group of people. As «amateur archaeoastronomers», we try to build on an advantage: we bring new and varied insights to the discipline, which can lead to deeper analysis, as long as we apply a methodology in the measurements and analysis, which we are in the process of making systematic. We have started all our investigations from unusual observations in the field that were transformed into serious hints for a further analysis because they could be compared to research made by other scholars elsewhere in the world. In most cases, archaeological excavations would need to be undertaken to keep learning about the sites (ushnu of Chena, stairway of Cuz Cuz, dance plaza of Valle de El Encanto). We have shown that, in most cases, a pattern dictates the decision to build an observatory in a specific place (or dedicate a place to sky watching) and this is, as a matter of fact, the same concept on which modern astronomical site-testing campaigns are based (without the religious aspect!). A long and detailed version of this paper with figures and pictures of each site is available on our web site http://www.intijalsu.cv.cl.

The authors want to express their gratitude to a number of people who have participated in our efforts: J.Berenguer and L.Briones for their encouragement; G.Ampuero for his insistence that we improve our methods; C.Astuhuamán and F.Elorrieta for useful discussions; D.Ballereau, D.Dearborn, E.Krupp, and M.Ziólkowski for their advise and help to find specific documents; J.Araya for lending us the transit surveyor; and R.Probst for improving our English writing. The editor of the Latin American Antiquity journal and a group of anonymous referees have greatly contributed to our more thorough analysis of the Pucará de Chena through their constructive critics. Almost all field work has been financed privately by the authors. We thank the French Embassy in Chile for financing the trip of two of us to Bolivia and Perú to visit major archaeological sites and meet local investigators, and Kodak Chilena S.A. for its sponsorship to complete our itinerant exhibit. The first author wants specially to thank his wife, S.Fernández, for her patience and encouragement.

REFERENCES

G. AMPUERO, 1992, Arte rupestre en el Valle de El Encanto, Museo Arqueológico de La Serena

A. AVENI, 1995, Empires of time (Calendars, clock and cultures), ed. by *Kodansha America*

M. BELTRAO, 1991(October), A astronomia do homem pré-histórico Brasileiro, *Revista Geográfica Universal*

M. BELTRAO, G. AFONSO, 1998, Um calendario das Pleiades na Bahia, *Revista de Iconos-Brasil*, Sao Paulo

J. BERENGUER, 1999, Museo Chileno de Arte PreColombino, Santiago, personal communication

M. BOCCAS, P. BUSTAMANTE, 1998, Arqueoastronomía: un encuentro con los antiguos astrónomos, 2-day course taught at the First National Congress of Amateur Astronomers, Vicuña, Chile, (to be published)

P. BUSTAMANTE, 1991 (5 Sept.), Astrónomos antes de Illapel, *Siglo XXI*, El Mercurio, Santiago

P. BUSTAMANTE, 1996 (January), La huaca del cerro Chena, *revista Cimin*, Santiago

F. ELORRIETA and E., 1996, El valle sagrado de los Incas, mitos y símbolos, *Ed. Sociedad Pacaritampu Hatha*, Cusco

D. EYZAGUIRRE, 1956 (Oct.), Astronomía aymara, *Khana, Arte y letras*, revista municipal, La Paz

C. GONZÁLEZ VARGAS, 1984, Simbolismo en la alfarería mapuche, claves astronómicas, *Instituto de Estética*, Facultad de Filosofía, Pontificia Un. Católica de Chile

C. GONZÁLEZ VARGAS, 1992-93, Un recinto del pucara de Lasana: propuesta de interpretación, *Aisthesis* 25-26, Instituto de Estética, Facultad de Filosofía, Pontificia Un. Católica de Chile

M. E. GREBE VICUÑA, 1992, Concepción del tiempo en las culturas indígenas sur-ándinas, *in Time and astronomy at the meeting of two worlds*, Proceedings of the International Symposium held at Varsaw University, pp.297-313

J. LANGER, 1999, O megalitismo na pré-história Brasileira, to be published

W. LILLER, 1989, The megalithic astronomy of Easter Island: orientations of ahu and moais, *Archaeoastronomy 13*, JHA

E. MAGAÑA, 1995, Informe etnografía I: astronomía, *Proyecto Fondecyt 1940099*

O. MENGHIN, 1982, *Las piedras de tacitas como fenómeno mundial*, Boletin del Museo arqueológico de La Serena

R. MONTANDÓN, 1950, Apuntes sobre el pukara de Lasana, in *Cuadernos del consejo de monumentos de Chile*, n°1, Imprenta Universitaria, Santiago

H. NIEMEYER and D. BALLEREAU, 1998, Los petroglifos del cerro La Silla, Región de Coquimbo, *Chungara*, volumen 28, n°1 y 2, Universidad de Tarapaca, pp 277-317

H. NIEMEYER, M. CERVELLINO, G. CASTILLO, 1997, Los primeros ceramistas del Norte Chico: complejo el Molle, Culturas de Chile: Prehistoria, Ed. *Andrés Bello* (3rd edition), p227-263

G. PEREIRA, 1998, Planetario Max Schreier, UMSA, a Paz, personal communication

G. REICHEL-DOLMATOFF, 1985, *Aspectos chamanísticos y neurofisiológicos del arte indígena*, Estudios en arte rupestre, Museo Chileno de arte Precolombino, pp291-307

O. RIVERA SUNDT, 1984, La harka del Inca, *Arquealogía Boliviana*

J. ROWE, 1967, What kind of settlement was Inca Cuzco?, *Nawpa Pacha* 5:59-77

N. SCHIAPPACASSE, V. CASTRO, H. NIEMEYER, 1997, Los desarrollos regionales en el Norte Grande, Culturas de Chile; Prehistoria, Ed. *Andrés Bello*, Santiago de Chile, (3rd edition), pp181-221

R. STEHBERG, 1976, La fortaleza de Chena y su relación con la acupación incaica de Chile central, *Publicación ocasional* 23:3-37, Museo Nacional de Historia Natural, 1976

R. STEHBERG, 1995, Instalaciones incaicas en el norte y centro semiarido de Chile, *DIBAM*, Santiago

URTON GARY, 1981, At the crossroads of the earth and the sky: an Andean cosmology, *University of Texas press*

D. URZAGASTI, 1997, Astronomical character of Tiwanaku ruins: observation of the solar movement at the Kalasasaya temple, *Instituto de Investigaciones Físicas, U.M.S.A.*, La Paz, Bolivia, personal communication

J. VAN KESSEL, 1996, Lo cosmovisión Aymara, Culturas de Chile: Etnografía, Ed. *A.Bello*, Santiago de Chile, pp169-189

F. VILCHES, 1996, El arte rupestre de Taira, rio Loa, II Región. Espacio y significación, tesis de doctorado, Un. de Chile, Facultad de ciencias sociales, Dpto de antropología

R. T. ZUIDEMA, 1985, The lion in the city: royal symbols of transition in Cuzco, in Gary Urton, ed., *Animal, myths and metaphors in South America*, pp.183-250, Salt Lake city, University of Texas Press

R. T. ZUIDEMA, 1989, El ushnu, in *Reyes y guerreros: ensayos de cultura andina*, Manuel Burga compilador, Fomciencias Lima, pp402-454

POTENTIAL ASTRONOMICAL CALENDARS AND A CULTURAL INTERPRETATION THEREOF ALONG THE PALAT'KWAPI TRAIL OF NORTH CENTRAL ARIZONA

Bryan C. Bates,
Coconino Community College, Flagstaff, AZ, U.S.A.
Leah Coffman,
Flagstaff High School,Flagstaff, AZ, U.S.A.

ABSTRACT

The Palat'kwapi Trail is an ancient (800+ years) migration and trade route used by the Hisatsanom (ancestral Hopi) that stretches from the Hopi Villages in Northern Arizona south to Homol'ovi Ruins State Park then west to the Verde Valley and continuing to the Pacific Ocean extending as far south as Durango, Mexico. This paper will examine five archaeological sites that lie within three kilometers of the Trail that may have been used as solar calendars. Ethnographic documentation will be used to support the interpretation of each site. The sites will be examined in geographic order from Homol'ovi Ruins to the Verde Valley, a distance of 100Km.

INTRODUCTION

The use of solar and lunar calendar systems has been well documented in the ethnology of the Hopi Indians of the Southwest U.S.(1,2,3,4,5,6,7) Several ruins, petroglyphs and artifacts were examined within three kilometers of the Palat'kwapi Trail. It is anticipated that not only were goods exchanged, but also ideas and ways of perceiving the environment. The location of the sites and the pathway of the Palat'kwapi Trail (a reference to the Red Rocks of Sedona) can be observed in figure 1. After plotting the research sites on a map, it was observed that they all lay along the Trail, leading to the hypothesis: Habitation sites along the Palat'kwapi Trail will show a greater occurrence of astronomical calendars than sites not associated with

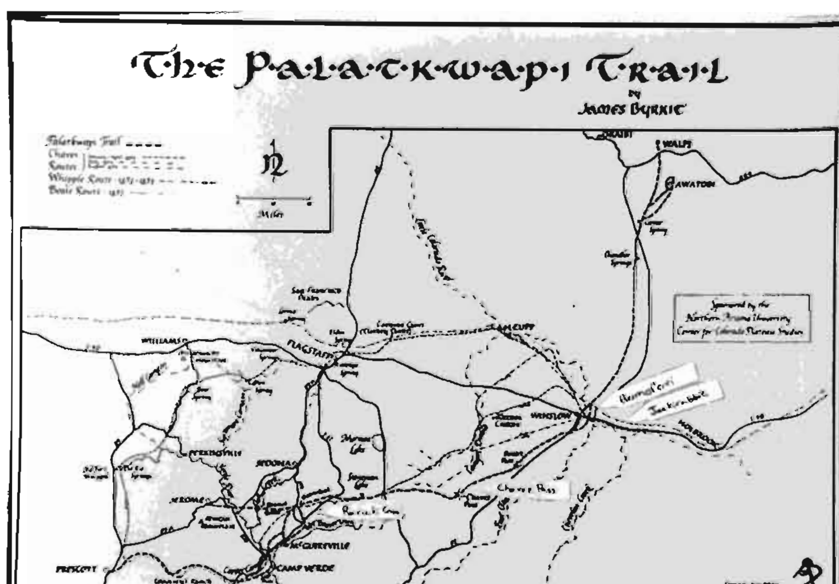
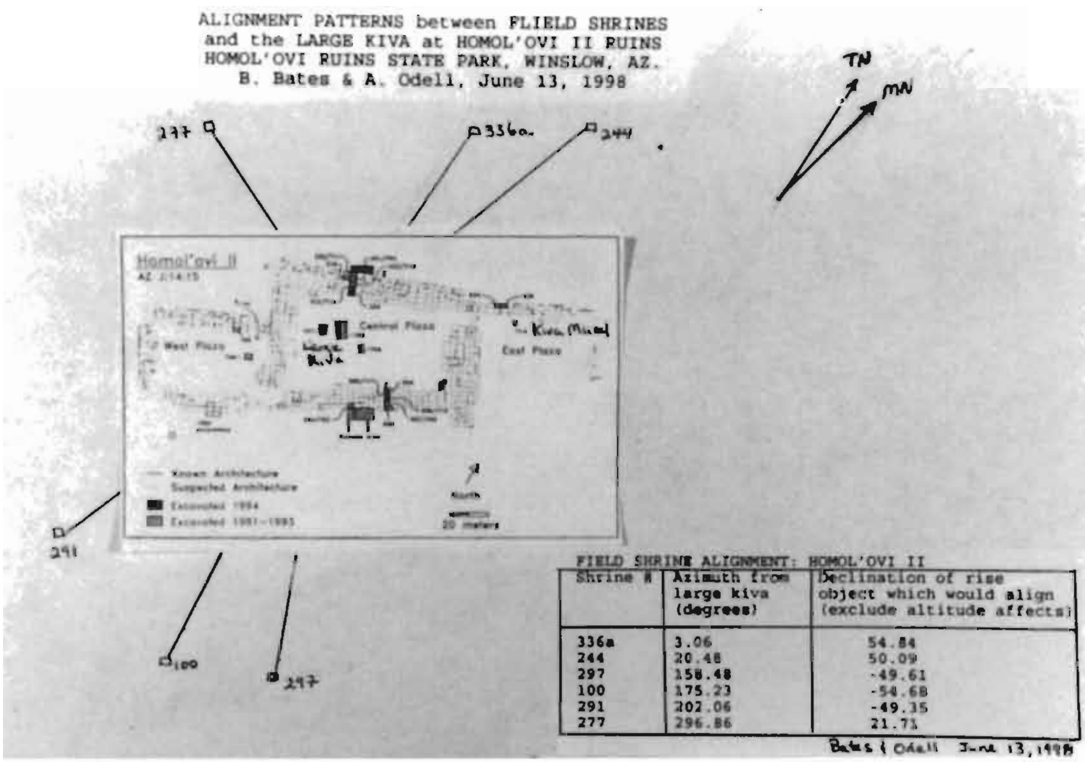


Figure 1. Map of the Palat'kwapi Trail, Northern Arizona, and the location of those sites reviewed herein annotated. Map by Jim Byrkit, used with permission.

the Trail. However (as a work in progress), the database is too small (n=8, with two sites >10km from the Trail) to justify any statement regarding the relationship between calendrical sites and migratory pathways

DISCUSSION

During the 1998 summer, Bryan worked with the Arizona State Museum at Homol'ovi Ruins State Park investigating sites identified by Dr. Chuck Adams as potentially calendric. Dr. Adams identified 1) a series of field shrines, 2) a kiva mural and, 3) a petroglyph panel near Jackrabbit ruin. Located along the Little Colorado River, Homol'ovi, "the place of the little hills", is part of the Great Basin Desertscrub of the Upper Sonoran lifezone. Receiving only 20 cm (8in) precipitation/ year, the ancestors of the Hopi were dependent upon and farmed throughout the Little Colorado River basin. Homlo'ovi was occupied during three different phases: Early 620-890 A.D.; Middle 1000-1225 A.D.; and Late 1260-1400 A.D., with



Shrine #	Azimuth from large kiva (degrees)	Declination of rise object which would align (exclude altitude affects)
336a	3.06	54.84
244	20.48	50.09
297	158.48	-49.61
100	175.23	-54.68
291	202.06	-49.35
277	296.86	21.71

Figure 2. Schematic of Homol'ovi II Ruins with the location of a) the central kiva, b) the field shrines and c) the kiva mural. Drawn by the Homol'ovi Research Project, Dr. E.C. Adams, Director. Used with permission.

most construction occurring during the late period. Agriculture was largely located within the floodplain with elevations for ruins and farmlands ranging from 1200 to 1500 m. (8).

Six field shrines (400-600 cm² subterranean sandstone boxes located in ancient agricultural fields were previously documented by the Homol'ovi Research Program. Fewkes (9) implies that shrines may have been used as astronomical observation stations, leading to the question: Are field shrines (constructed =1100A.D.) situated so as to astronomically align with the large kiva at Homol'ovi II on dates ethnographically identified (10) as culturally significant? (figure 2).

Based upon the data (see Table 1), the hypothesis is rejected. Field shrines at Homol'ovi II are not located in an astronomical relationship with the central kiva. Fewkes (11) and Stephen (12) both state that objects from the kiva and ceremonies (such as spruce boughs, ceremonial water, clay balls, and pahos) may be placed on the field shrines following a ceremony. Exclusion of field shrines does not exclude other shrines, of which there are many different types. For example, the Chief of the Horn Society observed the migration of the sun from summer to winter solstice from the "Buffalo Shrine" (13).

Table 1. Azimuth and Declinations from Central Kiva of Homol'ovi II to Field Shrines
Note the wide dispersal of azimuths, indicating a lack of pattern.

SHRINE SITE NUMBER	AZIMUTH	DECLINATION	ALIGNMENT
336 a	3.1	54.8	None
244	20.5	50.1	None
297	158	- 49.6	None
100	175.2	- 54.7	None
291	202.1	- 49.3	None
277	296.9	21.7	None

Bates & Odell, 13 June 1998. Theodolite survey from high point 3m west of central kiva.

KIVA MURAL

Immediately north of the central kiva is a second smaller kiva (built during the Late Period) that contains a plaster mural of the San Francisco Peaks. The mural was unearthed during excavations in 1994 (14). The San Francisco Peaks, "Nuvatukyaoui", are home to the Katsinas or "spirits of the dead" who bring rain (15,16). They are a sacred place and are used to predict the summer solstice sunset and timing for Niman or Katsina Going Home (to the Peaks) Dance ceremony (17).

Due to the religious nature of this kiva mural, the Hopi Tribe will not allow publication of a research photo taken in 1994. However, the mural replicates the western horizon of the Peaks with the summer solstice sunset (see figure 3) occurring at the same geographic point as the termination of the kiva mural (18). The hypothesis that the kiva mural is calendric is accepted based upon a weekly sunset observations between the spring and fall equinoxes by co-researcher Sue Bomboy and Bryan.

Ethnographic evidence indicates that kiva murals may have been used to symbolically represent solstices. At Awatovi village of the Hopi mesas, a kiva mural depicts an antagonist struggling to return the sun from the winter solstice at Soyal. Room 778 (a different Kiva) symbolizes the "Ahola" katsina returning the sun during Powamu, an earth renewal ceremony celebrated at the February cross-quarters date (19).

Figure 3. Sunset, 18 June 1999 from the kiva mural ruin site. The sun drops below the horizon at the same point that the kiva mural horizon line stops. Photo by Sue Bomboy.

JACKRABBIT SUN-DAGGER

Ten kilometers east of Homol'ovi Ruins, a small outlier ("Jackrabbit") was occupied concurrently (20). In a cave behind the ruin, a four-turn, spiral petroglyph with 25 edge bracts interacts with the setting sun between the May and August cross-quarter dates (21). Between these dates, light enters through a slit in a "cave", is thrown 2.26 m and forms a horizontal light dagger that progresses from the base of the wall upwards until (on the summer solstice) it cuts through the center of the spiral. On 21 June, the light–spiral dagger interaction begins at the spiral base at 4:19pm, migrates unimpressively upward and then ends with a dramatic and rapid extinction of the narrow light dagger from the arrow. (figure 4). Ethnographic evidence supports the interpretation of intentionality with this site (22). Near this solar calendar, a second petroglyph panel shows the Two Horn Katsina Clan symbol, a clan thought to have occupied this region(23) and known to have observed the annual migrations of the sun (24).

Figure 4. The horizontal light dagger at the tip of the arrow at the Jackrabbit summer solstice sunset petroglyph. From this interaction, the light will rapidly proceed to extinction. Photo by Alan Spiegler.

CHAVEZ PASS

Proceeding south 60 Km along the Palat'kwapi Trail lies a large habitation site (approx 180 rooms) that was occupied 1120-1300 A.D. On a basalt ridge overlooking Chavez Pass, a spiral petroglyph marks the changing declination of the sun between the November and February cross-quarter dates, times significant to the Hopi (25). Chavez was the largest habitation between Homol'ovi and the Verde Valley. Additional research needs to be conducted to document the degree of time specificity of this potential solar calendar.

RARICK CANYON

Rarick Canyon lies 60 Km WSW of Chavez Pass (see Figure 1) and contains the remnants of a 500 room, Pueblo III Sinaguan masonry pueblo. This heavily vandalized site once supported a small population of farmers and gathers in Pinyon-Juniper forest (26). Permanent water flows through nearby Red Tank Draw, a major petroglyph site, though no elements appear to have any calendric function.(27).

Along the basalt ledges one-Km north of the ruins, two spiral petroglyphs have been etched into a boulder. The larger spiral is up to the right, contains fourteen symmetrical grooves and has a radius of 45.7cm. A shadow casting nubbin projects overhead at the one o'clock position 1.57 m from the center of the petroglyph and cast the equinox shadow dagger. A small spiral lies to the lower right and has an undulating tail that curves superior to the right and terminates in a crevice in the basalt rock. With the changing altitude/declination of the sun, the overhanging ridge will cast a migrating light shadow line beginning tangent to the top left edge at February cross-quarters and running across the face of the petroglyph until tangent to the right edge at May cross-quarters. The reverse process occurs between the August to November cross-quarter dates. (Figure 5)

While the cross quarter time regions bracket the light-shadow interaction across the spiral, the most dramatic interaction occurs mid-day on the equinox. On the date of equinox, a coupled light dagger and shadow dagger (projected by the nubbin described above) begin a series of syncopated groove interactions at the base of the petroglyph and work their way up the glyph. On the date of the equinox and even specific as to the timing, the shadow dagger will align with the center of the petroglyph (Figure 6). As the alignment proceeds, the light-shadow line comes tangent to the smaller spiral while the shadow dagger intersects another groove. When the light-shadow line bisects the lower spiral, the

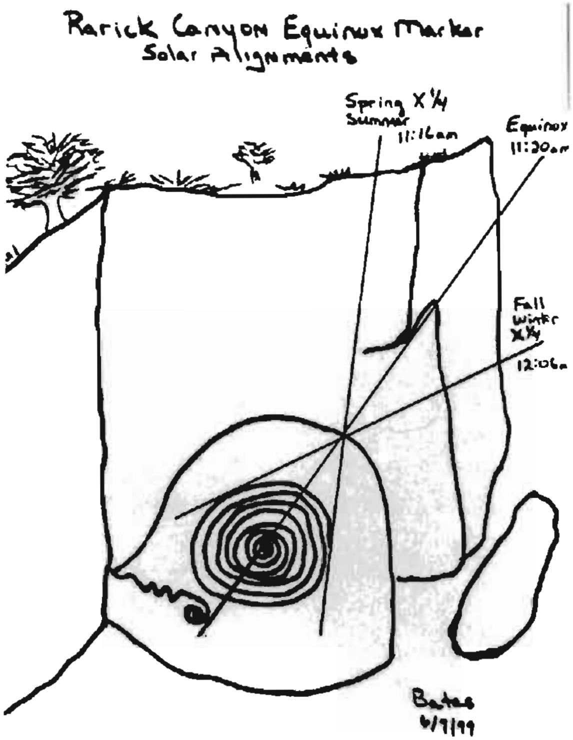


Figure 5. Schematic diagram of the light interaction process on the spiral petroglyph in Rarick Canyon. The lower azimuth of the sun causes a vertically higher light-shadow line across the top of the petroglyph. As one proceeds from February through equinox and onto May, the petroglyph becomes ensconced in dark by a migrating light shadow line that shifts from one shadow casting surface upward to another shadow casting surface. Similarly, the petroglyph surface is slowly unveiled from the shadow in a reverse light motion from the August to November cross-quarter dates. This reversible process may be indicative of Hopi concepts in duality (1)

Hopi ceremonies are predicted by observing the sun and it's corresponding relationship with the moon. With the first crescent of a new moon, the announcement of that season ceremony is made (31).

Mamzrau, a women's society, host the Mamzrauti ceremony held in alternate years in either January/ February (short form) or the September equinox (long form). The timing of Mamzrauti is set by the first crescent moon proceeding equinox. The dance maybe related to the Flute, One-Horn, Two-Horn or Lizard/Sand/Snake clan (32). Mamzrauti should not be confused with the Lalakonti (or Basket Dance) shadow dagger lies in the top-most groove of the larger spiral Finally, the light-shadow line terminates at the confluence of the lower spiral tail with the crevice in the basalt boulder (Figure 7). It is the matrix of interactions that makes this process so convincing (28). The intersection of the light-shadow line with the lower spiral tail at the crevice of the basalt boulder may be symbolic of shamanic/underworld travel (29). The complexity of the interaction sequences and the date specific precision of the shadow daggers' intersection with the center of the large spiral led to the hypothesis that this site was intentionally constructed to mark the equinox and potentially the cross quarter dates.

SIGNIFICANCE OF EQUINOX

Theran Koiyaquaptewa's (30) grandfather (a sun priest in the Pumpkin Clan) teaches that Mamzrauti (Equinox) and all

Figure 6. Shadow dagger intersecting with the center of the Rarick Canyon spiral petroglyph, 11:50am, 22,Sept, 1998. Photo by Bryan Bates.

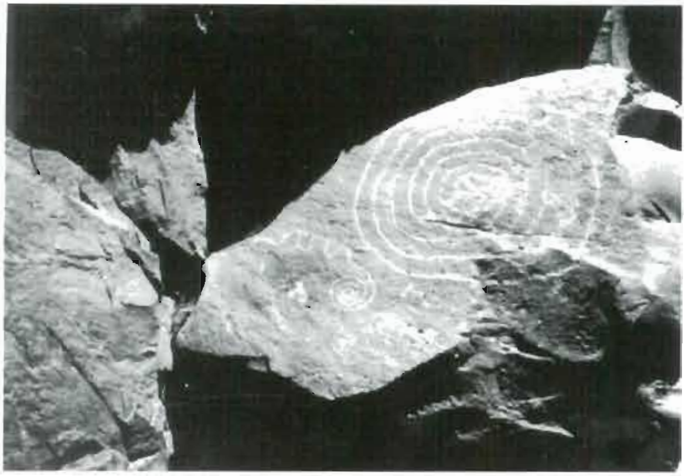


Figure 7. The light shadow line intersecting with the confluence of the basalt crevice and lower spiral tail at 12:12pm, 22 September, 1998. Culturally, this may be significant as it could allow for the movement of spirits from the underworld to interact with the sun's rays through the grooves of the petroglyph. Such light to corner crack interaction maybe significant in shamanic practices. Photo by Bryan Bates.

held during a similar time frame and of a similar or parallel nature (32).

Mamzrauti, a nine day fall Equinox ceremony conducted by women, is intended to 1) promote fertility and germination of all living organisms including humans, 2) cure diseases, 3) bring rain and 4) promote successful organization for war (33, 34, 35, 36). It is associated with the Corn Maidens and Hehea Katcina that encourages reproduction (34). Stephen (37) suggest Mamzrauti maybe a female fertility and passage into womanhood ceremony similar to the male right of passage ceremony of Wuwutsim. The majority of the ceremony is conducted in a kiva and pahos (prayer sticks) are made by the women and placed with corn meal in the direction of the solstices sunrise and sunsets, as well as zenith and nadir (38).

Based upon the physical light shadow interactions across the face of the petroglyph and the depth of ethnographic information, we accept the hypothesis that the Rarick Canyon equinox marker was intentionally created to demarcate the equinox date and Mamzrauti ceremony.

CONCLUSION

An intriguing pattern of ancestral solar calendars that lie along the Palt'kwapi Trail was found; yet it is impossible to determine whether their occurrence is associated primarily with habitation sites or the Trail itself. Due to the small sample size (n=8), no conclusion can be drawn. Judgement on the accuracy of the hypothesis is reserved. In the coming year, site visits and ethnographic research will continue in an effort to determine whether a true association between the location of archaeoastronomical calendars and the Palat'kwapi Trail can be documented.

NOTES AND REFERENCES

1) B.BATES, "A Cultural Interpretation of an Astronomical Calendar at Wupatki National Monument", in *Proceedings of the Fifth International Conference on archaeoastronomy,* Santa Fe, N.M. 1996. In press.

2) J. FEWKES, Sun Worship of the Hopi Indians" in *Smithsonian Report from 1918,* Washington, D.C. pg 493-526.

3) S. McCLUSKEY, "The astronomy of the Hopi Indians", in *Archaeoastronomy* (supp. to *Journal for the History of Astronomy),* No.8 (1977) S174-195.

4) S. McCLUSKEY, "Historical Archaeoastronomy: The Hopi Example" in *Archaeoastronomy in the New World*, ed A.Aveni, Cambridge University Press, England (1982).

5) M. TITIEV, "Old Oraibi: A study in the Hopi Indians of Third Mesa" , in *Papers of the Peaboody Museum,* Vol. 22, Harvard University, Boston, Mass. (1944).

6) M. ZEILIK, "Keeping the Sacred and Planting Calendar: Archaeoastronomy in the Pueblo Southwest, in *Prehistoric Astronomy of the New World: Proceedings of the Second Oxford Conference on Archaeoastronomy*, ed. A.Aveni, (1987a)

7) M. ZEILIK, "Anticipation in Ceremony: The Readiness is All", in *Astronomy and Ceremony in the Prehistoric Southwest*, ed. J. Carlson

and W. Judge, Papers of the Moxwell Museum of Anthropology, No. 2, pg 25-41 (1987b)

8) R.C. LANGE, *Prehistoric Land-Use and Settlement of the Little Colorado River Valley: The Survey of Homol'ovi Ruins State Park, Winslow Az.* Arizona State Museum Archaeological Series 189, University of Arizona Press, 1998.

9) J. FEWKES, "Hopi Shrines near the East Mesa, Arizona", *American Anthropologist,* No. 8, 1906 reprinted, New York, 1962, pg 350.

10) A. STEPHENS, *Hopi Journals*, ed. E.C. Parsons, Columbia University Press, New York, 1936. Pg.1037ff.

11) J. FEWKES, "The Katcina Altars in Hopi Worship", Annual Report of the Smithsonian Institute, U.S. Govt. Printing Office (Washington, D.C.,1927) pg 483.

12) A. STEPHENS, *op.cit.* ref.10, pgs 463, 538, 928.

13) Ibid. pg 928.

14) C. ADAMS, Director, Homol'ovi Research Program, Arizona State Museum. Personal communication, 1998.

15) J.FEWKES, *op.cit.* ref 11. Pg 485.

16) A.STEPHENS, *op.cit.* ref.10, appendix #1

17) IBID. pg 476

18) DR. M. ZEILIK first brought this kiva mural to my attention.

19) W. SMITH, "Mural Decorations from Ancient Hopi Lives", in *Hopi Kachinas: Spirit of Life.* Edt. D Washburn, California Academy of Sciences, U. of Washington Press, 1980. Pg 29-38.

20) C. ADAMS, *op.cit.* ref 14.

21) P. McCREEY & E. MALOTKI, *Tapamveni: The Rock Art Galleries of the Petrified Forest and Beyond*. (Petrified Forest Museum Association, 1994) pg 163. The site was independently noted by Chuck Adams, 1995. This paper is the first formal documentation of the periodicity of the light-shadow interactions across the petroglyph.

22) B. BATES, *op.cit.* ref 1.

23) H. COURLANDER, *Fourth World of the Hopi,* (New York,1971).

24) T. KOIYAQUAPTEWA, a Hopi of the Sparrow Hawk clan and knowledgeable of Hopi astronomy. Personal communication, 1999.

25) B. BATES, *op.cit.* ref #1.

26) E. JACKSON, Field report for Museum of Northern Arizona, Site # 3994, April, 1933

27) B. BATES, unpublished measurement, 1995. Note that Shelby Cody, retired archaeologist with Coconino National Forest first took us to this site.

28) B. BATES, Field notes during multiple observations including three separate equinox events. 1998-99.

29) T. BOSTWICK, City Archaeologist, City of Phoenix, AZ., personal communication, Phoenix, AZ.

30) T. KOIYAQUAPTEWA *op.cit.,* ref 24

31) A. STEPHEN, *op.cit.,* ref 10, pg 155.

32) H.R. VOTH, *The Oraibi Marau Ceremony,* in Field Museum of Natural History, Smithsonian Institute. Vol XI. No.1 (Chicago, 1912) pg 12.

33) A. STEPHEN, *op.cit.,* ref 10, pg 864.

34) H.R. ,VOTH, *op.cit.,* ref 32, pg 43.

35) J. FEWKES & J. OWENS. "The LaLoKonTo: A Tusayan Dance, in *American Anthropologist* Vol 15, (1892). pg 105-130.

36) E. NEQUATEWA, "Hopi Hopiwime: The Ceremonial Calendar " in *Hopi Customs, Folklore and Ceremonies,* Museum of Northern Arizona and Northern Arizona Society of Science and Art, Flagstaff, AZ 1954, Reprint series #4.

37) A. STEPHEN, *op.cit.,* ref 10, pg 864

38) H.R. VOTH, *op.cit.,* ref 32, pg 43, see also STEPHEN, *op.cit.,* ref 10, pg 871.

ROCK ART AND ASTRONOMY IN BAJA CALIFORNIA

Ed C. Krupp
Griffith Observatory, Los Angeles, USA

Although the Smithsonian Institution's authoritative multi-volume reference *Handbook of North American Indians* dedicates an entire book (Heizer 1978) to the California culture area, it completely ignores Baja California, a peninsula that extends eight hundred miles south from the international border between Mexico and United States. The border, of course, accounts for this academic frontier, but the indigenous and prehistoric peoples of Baja California were much closer culturally to the peoples of southern California and the Southwest, in what is now the U.S., and to the peoples of northwest Mexico than to the high Mesoamerican civilizations that dominate the study of archaeology in Mexico. Baja, in fact, is still somewhat isolated culturally, politically, and economically from mainland Mexico. Despite this, none of the surveys of North American rock art treat the rock art of Baja as part of a related or neighboring tradition (Conway 1993, Grant 1967, Grant 1983, Wellmann 1979). Specialized publications of Baja rock art -books and research papers- usually confine themselves to a particular regional style.

Figure 1. Cueva de la Supernova, in the Arroyo del Parral of central Baja's Sierra de la San Francisco, is a shallow, west -facing rock shelter. Most of the paintings on its "ceiling" are large figures in the Great Mural style, and a pair of deer can be discerned here. A much smaller, red painting of a rayed disk accompanied by a bisected, half-colored circle is located about half way toward the far end of the shelter, close to the vertical wall. Interpreted as a record of the 1054 A.D. supernova partnered with the moon, this pictograph inspired this site's name, Cueva de la Supernova. (photograph E.C. Krupp)

Most of the Baja environment is marginal. Dominated by mountains and desert, it offered marine resources to prehistoric coastal peoples and permitted a hunting-and-gathering strategy inland. At the time of European contact, Kumeyaay and Karnia, territories straddled the present international border. Other southern California Yumans, including the Cocopa, the Paipai, the Kiliwa, and the Nakipa, resided just below those areas, about as far south as San Quintín.

Below San Quintín, central Baja was home to the Cochimí, peninsular Yumans who also spoke a Hokan language. The archaeological complex associated with this area is known as Comondú, and most specialists believe the prehistoric people were the ancestors of the historic Cochimí. Their immediate neighbors on the south were the Cadegomeño, the Didiu, the Laymón, and the Monqui, all still members of the Hokan language family. The Guaicura, the Huchiti-Cora, and the Pericu inhabited the southern part of the peninsula, and each of them spoke a non-Yuman language.

The best known rock art in Baja belongs to the rugged canyons of the central mountains, especially the Sierra de San Francisco, where Cueva Pintada, the "Sistine Chapel" of the Baja Great Mural style, is located. The large polychrome paintings of the Great Mural style are usually found in relatively shallow rock shelters. Primarily figurative, they are dominated by representations of animals-deer, pronghorn, bighorn, mountain lion, pinnipeds, some birds, and large anthropomorphic figures, both male and female.

Figure 2. Although it is difficult to discern the red, bisected circle in this black-and-white image of the rock surface in Cueva de la Supernova, the rayed disk, just left of the circle, stands out. (photograph E.C. Krupp)

Elsewhere in the peninsula, the rock art is distinctly different (Grant 1974). The scale is generally smaller. Often more colors are used. Geometric and abstract figures, and generally smaller figures, are the rule. Petroglyphs are found in some areas.

Like most rock art, the rock art of Baja is poorly dated. Some of the Great Mural paintings are certainly centuries old, and some suspect they are much older. They were first brought to the attention of the outside world by the famous mystery writer Erle Stanley Gardner, who organized and financed his own scientific expedition to Cueva Pintada (Gardner 1962, Meighan 1969). Unknown except to the local mountain people, subsistence ranchers who have owned the land for generations, a few of the sites were documented in the Mission period. Most, however, are modem discoveries since Gardner's precedent-setting program.

It still takes a great deal of time and planning, and the fortitude of mules, to see even a few of these spectacular paintings on a trip to central Baja. On my most recent visit to the area, from, 27 December 1998 through 8 January 1999, a small party of us traveled with five guides, 15 mules, and 16 burros to Cuesta del Palmarito, Arroyo del Infierno, and

Arroyo del Parral. It was an exercise in wilderness camping-close encounters with spined plants and little water.

The story of astronomy and rock art in Baja California really begins 1975, when Harry Crosby's pioneering report, *The Cave Paintings of Baja California,* was published. Although very little celestial imagery appears in the Great Mural style, Crosby included a photograph of a rayed disk tangent to a bisected and half-colored circle painted on the ceiling of a small rock shelter in Arroyo del Parral. Referencing William, C. Miller's interpretation of elements at two sites in northern Arizona as eyewitness records of the 1054 A.D. supernova (Miller 1955a, 1955b, 1970), along with more recent study of this issue by John Brandt and others (Brandt *et* al 1975), Crosby suggested the central Baja pictograph he had first seen in 1971 might also be a representation of the supernova. Crosby's interest in this possibility was primarily driven by the desire to date the painting astronomically. Identification of the small but attractive "astronomical" element prompted Crosby to name the shelter Cueva de la Supernova, and the name has stuck.

The supernova interpretation of star/crescent motives in the rock art of the American Southwest attracted a great deal of public interest and is popularly endorsed (Brandt and Williamson 1979). More thoughtful consideration, however, invites skepticism (Krupp 1995, Krupp 1994 in press). The pictograph in Arroyo del Parral has its own difficulties. The shelter is at the bottom of a deep canyon and faces west. No one in the shelter, or even the canyon, would have ever seen the waning crescent moon joined by the Crab supernova in the morning twilight on 5 July 1054 A.D. It would have been necessary to be high up on the mesas. Although this is possible, it means we cannot directly associate the painted shelter with the event. Also, the "supernova" pictograph has to be considered in context. There are lots of other paintings in this shelter, most of them different in content and style. Also, this shelter at some point received a great deal of attention from people carving petroglyphs. These comprise still another completely different style, and it further complicates any kind of systematic analysis. There is, however, at least one rayed disk carved into the soft rock. Further, the part of the "supernova" symbol that corresponds to the moon is not a crescent, but a bisected and half-colored disk. Any supernova/crescent moon we see in this pictograph is arbitrarily identified. The case remains unresolved and unlikely.

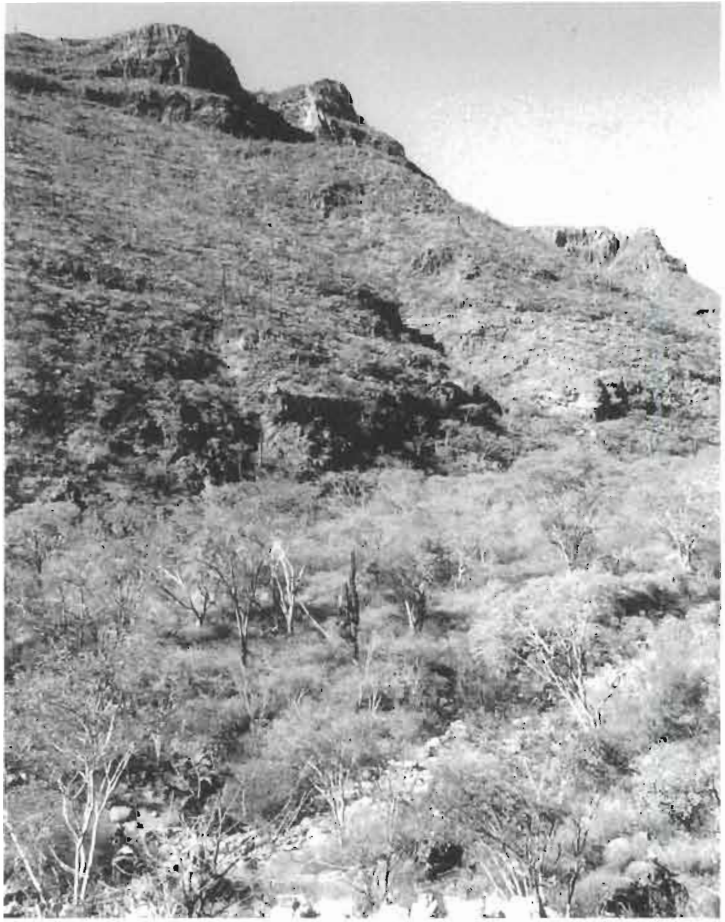


Figure 3. Cueva de la Supernova faces west, and the shelter's view of the sky is restricted by the high profile of the canyon. When the Crab supernova first appeared near the waning crescent moon on the morning of 5 July 1054 A.D., it was low on the eastern horizon, which cannot be seen at all from the shelter. (photograph E.C. Krupp)

Farther down canyon, at the junction with the Cañada del Torotal, petroglyphs in the Arroyo del Parral include a fine rayed disk, pecked on a small boulder on the slope that forms part of the main drainage. From this spot, the ridge to the east offers excellent horizon calendar potential, covering the entire solstitial excursion. Of course, there is no way to prove the petroglyph was intended to function as the marker for a place to stand (or sit), but the rayed disk is suggestive. There is also significant variation in petroglyph style in this location, and some of the petroglyphs downstream are eroded and repatinated. The paintings in the Cañada de Torotal, on the other hand, are in the Great Mural style, but they include some odd departures. Overall, the rock art concentrated in this area suggests the camp was in use over a very long period of time and perhaps by culturally distinct peoples.

No other astronomical elements in Baja rock art were recognized and studied until 1975, when Ken Hedges, Curator of Anthropology at the San Diego Museum of Man, and an expert in rock art styles of southern California and Baja, guessed that a southeast-facing rock shelter at La Rumorosa (known in Mexico as Conjunto El Diablito, at el Vallecito), no more than ten miles south of the international border and about 40 miles east of Tecate, might host an interaction with light from the winter solstice sunrise. His guess was rewarded with one of the most fetching light-and-shadow effects with rock art ever reported (Hedges 1976, Hedges 1986). The horizon of the Sierra de Juarez performs as an admirable horizon calendar, ideal for monitoring the solstice, as California tribes were known to do (Hudson, Lee, and Hedges 1979, Krupp 1991b). Shortly after the sun's first gleam, it rises high enough to penetrate the shelter with a spot of light that grows into a blade and stabs toward a small red anthropomorphic figure with wavy horns and tiny black eyes. The entrance configuration forces the blade of light to stop advancing, and at that point is marked by a painted white bar. As the sun rises higher, another spot of light forms, on the other side of the little red figure and develops into a second luminous blade that again moves toward the little red man. This time the blade continues and cuts directly across the figures two eyes, transforming him into a watcher of the winter sun. Before this painting was vandalized, I scripted and Michael Bober (1996) produced a short commercial video of the effect and its context. Seasonal concerns and solar observations were part of the shaman's portfolio in southern California, and the shelter, the figure, and the winter solstice effect may all be part of shamanic activity in the acquisition of supernatural, celestial power (Krupp 1983, Krupp 1991b, Krupp 1997). Hedges and his associates saw the La Rumorosa winter solstice event as part of a larger picture and identified other solstitial rock art sites in southern California and other celestial imagery (Hudson, Lee, and Hedges 1979).

Another stunning light-and-shadow effect was subsequently discovered by Eve Ewing and Marc: Robin (Ewing 1990, Ewing 1995, Robin and Ewing 1989, Krupp 1991a, Krupp 1998) at Mesa San Carlos, a spectacularly-sited,

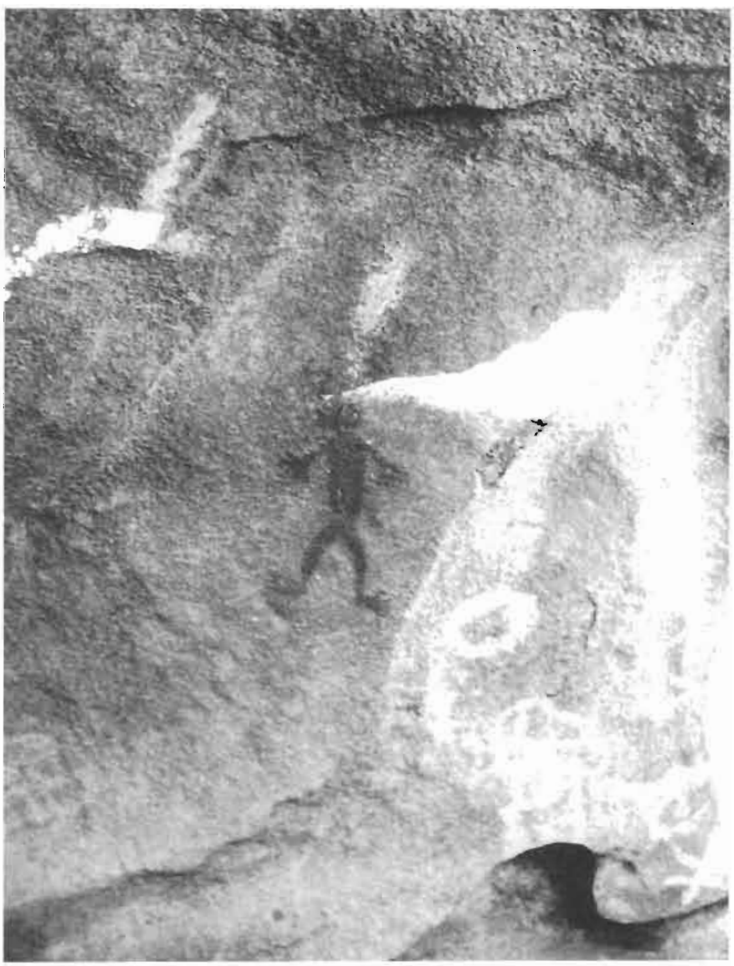


Figure 4. Winter solstice sunrise light inside the rock shelter at La Rumorosa slices through the painted black eyes of a small, horned, red figure painted on the wall. The horns imply shamanic or supernatural power, and this event may be associated with solstice observation and seasonal acquisition of power among the Kumeyaay. (photograph E.C. Krupp)

and very remote, coastal petroglyph site considerably farther south from La Rumorosa, in what seems to have been northern territory of the peninsular Cochimí. The most compelling event involves the formation of a triangle of light, about midday, in summer solstice season, on one of the several rimrock petroglyph panels that preside over extraordinary shell middens. As the triangle approaches a petroglyph of a stylized Cochimí house, it shrinks and enters the door. Framed in the doorway, it shrinks until it finally blinks out. Ewing and Robin have interpreted this effect in terms of the solstice house imagery that is part of the sky and calendar lore of a variety of Southwest peoples, including the Hopi. Just as spectacular, the setting sun disappears behind the mesa, as seen from the vicinity of other petroglyph panels, including one boulder with a line that seems to be drawn toward the point of summer solstice sunset. After the sun slips behind the rock, it reappears dramatically, with all of the glory diffraction rays can inspire, in a natural rock window near the mesa top.

Two highly graphic light-and-shadow effects do not prove such exploitations of the solstice were intended by the people who created the rock art, but they are enough to suggest much more rewarding work may yet await other researchers in Baja. The effects are plausible from the perspective of their cultural context and their imagery.

The well known and colorful pictograph shelter at Cataviña includes a rayed disk on its ceiling, a further example of celestial imagery in Baja rock art. Like the rock art at Mesa San Carlos, the paintings at Cataviña probably belong to the Cochimí Abstract style, and the shelter includes an element reminiscent of the house petroglyph at Mesa San Carlos.

No other sites in Baja are as persuasive as La Rumorosa and Mesa San Carlos, but Elanie Moore, another Baja rock art pioneer, has reported events at a few Great Mural sites in the Sierra de San Francisco.

From the large and richly painted shelter at Cueva Cuesta del Palmarito I, the eastern horizon again possesses calendar potential, but none of the paintings have recognizable celestial imagery (Moore 1986). Without substantiating evidence, Ron Smith has proposed the black disks that are sometimes supported on the arms of Great Mural "monos" (large anthropomorphic figures) symbolize the new moon (Smith 1983). With no better argument, Bernard Jones guessed the disks might interact with solstitial sunlight. His limited observations produced no interesting data (Jones 1990). Elanie Moore and Del Cover have published (Cover and Moore 1986) a more promising report on the solstitial behavior of a natural aperture high in the womblike Mono Alto (Pie de la Cuesta) shelter in Arroyo del Parral. Through midday, in the weeks around summer solstice, the sun is high enough to shine through the hole in the rock, and the beam falls upon a boulder at the shelter entrance, possibly a natural piece of ritual furniture. The equinox and winter solstice also generate a moving light form deeper in the shelter. The deep, high cleft that creates the natural architecture of the Mono Alto rock shelter is generically different from the other Great Mural sites in Arroyo del Parral. The rest are relatively shallow and open overhangs. This distinction may explain why Mono Alto appears to host seasonally significant astronomical effects and why the others don't.

Elanie Moore has also reported (Moore 1999) the formation of small triangle of light that appears for a moment when the summer solstice sun first strikes one of the main figures at Flechas, in the Arroyo de San Pablo, not so far from Cueva Pintada. In shape, this display of sunlight conforms to the lines of the painting of the deer it seems to target.

Finally, Elanie Moore (Moore 1999) has described what she sees as an intentional conformation of the line that defines the silhouette of one of the large figures painted high on the large shelter at Cueva del Corralito, in Arroyo del Parral. As summer solstice light rakes across the ceiling, it reaches a natural cleavage in the rock surface and echoes the figure painted there.

Although light-and-shadow effects at "abstract" style sites in Kumeyaay and Cochimí territory may fit the profile of ritual, symbolic solstice markers, the astronomical connotations of the Great Mural sites are not as compelling. These figurative paintings depart so greatly in style from the other, geometric sites, and their solstitial performances do not have the same theatric, narrative quality as is seen at La Rumorosa and Mesa San Carlos. It may, in fact, make much more sense to compare these paintings -with their large figures of animals and people- with other large-scale figurative painting traditions. Certainly, this includes the paleolithic art in the deep caves of France and Spain. In North America, the Great Mural painting style seems to share, at least superficially, thematic content of paintings in the Lower Pecos of west Texas, in the archaic Great Basin Barrier Canyon Style painting of Utah (but for astronomical interpretations of this material see, for example, Warner 1991), and the Great Basin Coso Range petroglyphs of California.

In some respects, the rock painting traditions in parts of Aboriginal Australia and in San (Bushman) lands of southern Africa are similar to the Great Mural art of Baja. In Africa and Australia, interpretation is partly supported by ethnography, and the shamanic, spirit-world dimension of the paintings is documented (Krupp 1997). When the San paint an eland, they paint a symbol, a metaphor for the visionary trance into which they dance themselves.

We have little evidence for extensive astronomical symbolism in Aboriginal and San rock art. These peoples were nomadic hunters and gatherers who kept track of the seasons in terms of the appearances of key stars. The seasonal stations of the sun may have been of little use to them, and astronomy may have figured little in their graphic symbolic vocabularies. The same viewpoint toward paleolithic art is growing fashionable, and its parallels with the Great Mural rock art in central Baja California argue we are looking at the shaman's engagement with the spirits, not the skywatchers conversations with celestial objects.

Figure 5. The rayed disk, painted in yellow and black on the ceiling of the Cataviña rock shelter, suggests solar symbolism, but the other abstract geometric elements around it elude interpretation. (photograph E.C. Krupp)

REFERENCES

M. BOBER. *Watcher of the Winter Sun* (VHS videotape edition). (Los Angeles, 1996).

J. BRANDT, *et al.* "Possible Rock Art Records of the Crab Nebula Supernova in the Western United States." In *Archaeoastronomy in Pre-Columbian America*, edited by A. Aveni. (Austin, Texas, 1975), 45-58.

J. BRANDT, and R. WILLIARNSON. "The 1054 Supernova and Native American Rock Art, "*Archaeoastronomy* (supp. to *Journal for the History of Astronomy*) 1 (1979), S1- S38.

T. CONWAY. *Painted Dreams--Native American Rock Art.* (Minocqua, Wisconsin, 1993).

D. COVER and E. MOORE. "Mono Alto: A Summer Solstice Site." In *Rock Art Papers, Volume 3*, edited by K. Hedges. San Diego Museum

Papers No. 20. (San Diego, 1986), 13-18.

H. CROSBY. *The Cave Paintings of Baja California.* (San Diego, 1975).

E. EWING. "Summer Solstice: New Discoveries at Mesa San Carlos." In *Rock Art Papers, Volume 7,* edited by K. Hedges. San Diego Museum Papers No. 26. (San Diego, 1990), 23-32.

E. EWING. "Mesa San Carlos: An Integrated Sacred Landscape. " In *Rock Art Papers, Volume 12,* edited by K. Hedges. San Diego Museum Papers No. 33. (San Diego, 1995), 39-44.

E. S. GARDNER. *The Hidden Heart of Baja.* (New York, 1962).

C. GRANT. *Rock Art of the American Indian.* (New York, 1967).

C. GRANT. *Rock Art of Baja California.* (Los Angeles, 1974).

C. GRANT. *The Rock Art of the North American Indians.* (Cambridge, England, 1983).

K. HEDGES. "Rock Art in the Piñon Forests of Northern Baja California." In *American Indian Rock Art III,* edited by A. BOCK, F. BOCK, and J. CAWLEY. (Whittier, California, 1976), 1-8.

K. HEDGES. "The Sunwatcher of La Rumorosa. " In *Rock Art Papers, Volume 4,* edited by K. Hedges. San Diego Museum Papers No. 21. (San Diego, 1986), 17-32.

R. HEIZER, ed. *Handbook of the North American Indians, Volume 8, California.* (Washington, D.C., 1978).

T. HUDSON, G. LEE, and K. HEDGES. "Solstice Observers and Observatories in Native California," *Journal of California and Great Basin Anthropology* 1, 1 (1979), 3963.

B. M. JONES Jr. and M. BERNARD. "Shamanistic Elements in the Sierra de San Francisco Rock Art." In *Rock Art Papers, Volume 7,* edited by K. Hedges. San Diego Museum Papers No. 26. (San Diego, 1990), 11-18.

E. C. KRUPP, *Echoes of the Ancient Skies: The Astronomy of Lost Civilizations.* (New York, 1983).

E. C. KRUPP. *Beyond the Blue Horizon-Myths and Legends of the Sun, Moon, Stars & Planets.* (New York, 199la).

E. C. KRUPP. "Hiawatha in California," *The Astronomy Quarterly* 8, 1 (1991b), 47-64.

E. C. KRUPP. "Archaeoastronomy Unplugged: Eliminating the Fuzz Tone from Rock Art Astronomy," paper presented at the International Rock Art Conference in Flagstaff, Arizona, 1994, in press.

E. C. KRUPP. "Engraved in Stone," *Sky & Telescope* 89, 4 (1995), 60-61.

E. C. KRUPP. *Skywatchers, Shamans, & Kings: Astronomy and the Archaeology of Power.* (New York, 1997).

E. C. KRUPP. "Home Fires Burning," *Sky & Telescope* 95, 6 (1998), 86-88.

C. W. MEIGHAN. *Indian Art and History: The Testimony of Prehispanic Rock Paintings in Baja California.* (Los Angeles, 1969).

W. MILLER. "Two Possible Astronomical Pictographs Found in Northem Arizona," *Plateau* 27, 4 (1955a), 6-13.

W. MILLER. "Two Prehistoric Drawings of Possible Astronomical Significance," *Astronomical Society of the Pacific Leaflet* 314 (1955b), 1-8.

W. MILLER. W. "Two Prehistoric Drawings of Possible Astronomical Significance," *Griffith Observer* 34, 2 (1970), 22-26.

E. MOORE. "Solstice Observations at Cuesta del Palmarito I. ", In *Rock Art Papers, Volume* 3, edited by K. Hedges. San Diego Museum Papers No. 20. (San Diego, 1986), 101-106.

E. MOORE. personal communication. January, 1999.

M. ROBIN and E. EWING 'The Sun Is in His House. "In *Rock Art Papers, Volume 6,* edited by K. Hedges. San Diego Museum Papers No. 24. (San Diego, 1989), 2936.

R. SMITH. "Color Encoding Sequences and the Pursuit of Meaning in the Great Mural Rock Art of Baja California. In *Rock Art Papers, Volume 1,* edited by K. Hedges. San Diego Museum Papers No. 16. (San Diego, 1983), 17-24.

J. WARNER. "Solar Observations on a Tributary to Ferron Creek." In *Utah Rock Art Volume* VIII, Section 3, edited by B. Morris. (Salt Lake City, 1991), 1-16.

K. F. WELLMAN. *A Survey of North American Indian Rock Art.* (Graz, Austria, 1979).

HALEETS, THE AGATE POINT PETROGLYPH STONE

John H. Rudolph
Bainbridge Island, Washington, USA

INTRODUCTION

The Agate Point Petroglyph Stone, called Haleets by the Salish Indians, is well known but has been an enigma to all who gazed upon this group of blank staring faces. This paper attempts to provide purpose and meaning to this petroglyph panel.

It is situated on the cobbled beach near the northernmost point of Bainbridge Island, on the western shore of Puget Sound, opposite the city of Seattle, Washington, USA. (Figure 1) Its position is shown on early (1868) topological maps and hydrographical charts. There is a USC&GS Reference Marker in its top. It is a fine grained, dense sandstone erratic, carried down by a glacier that plowed down from the north and once stood almost a mile deep in the Puget Sound basin. The east face of the stone shows glacial polishing and striations.

Figure 1. The Agate Point Petroglyph Stone on the beach with Dan Patterson

The petroglyph panel of faces was pecked into this polished surface at some undetermined time in the past. The native people living in the area at the time Europeans began arriving, were in awe of this stone, and avoided it. When questioned as to the origin of the carvings, conflicting answers were given, but generally attributed to people in the distant past. (Hill & Hill) . No meaning for the pecked faces seems to have been related by the Indians.There seems to be no connection in the minds of those questioned that this panel or the position of the stone itself had anything to do with keeping track of the passage of time during a year. Indeed, it is not recognized that native peoples of the Northwest Coast tribes used any sophisticated means to establish a calendar.

People were inhabiting the general area from very early times as witnessed by the discovery of a Mastodon kill site near Sequim, Washington dating to approximately 11,000BP. (Petersen et al.). Tribes in the area belonged to the Coast Salish including the Suquamish now situated on a reservation west of Agate Pass (Hill & Hill).

OTHER SITES

At various sites in the western United States, this author and many other investigators interested in archaeoastronomy, have found that tribes from Canada to Mexico have contrived a great variety of devices to determine the times of the solstices, equinoxes and cross-quarter events. (McGlone et al; Morris; Rudolph). One of the simplest methods is to observe the movement of the sunrise or sunset along the horizon throughout the year from a specific vantage point. These observing stations are often marked with petroglyphs that commemorate the place from which to observe.

Figure 2. Equinox sun as seen from the Agate Point Petroglyph Stone rising out of the Skykomish Canyon, the deepest notch along the Cascade horizon.

OBSERVATION

In 1997, on the day of the equinox, September 21, the weather was clear, so I went to the site before dawn to observe the sunrise. The sun rose out of the bottom of the deepest notch in the Cascade Mountain horizon, the Skykomish Canyon that runs in a straight east/west alignment beginning 60 miles to the east of the Haleets site, for 10 miles farther to the east (Figure 2).

The canyon is so deep that the sun rises behind the foothills in the foreground and the canyon is so long and so distant, that the mountains farther to the east, in line with the canyon, fall below the line of sight due to the earth's curvature. The sun appears to rise from out of a hole in the earth. To observe this effect, an observer must be aligned with the axis of the canyon. The Haleets marks the optimal observation point on the shore of Bainbridge. (Figures 3 and 4).

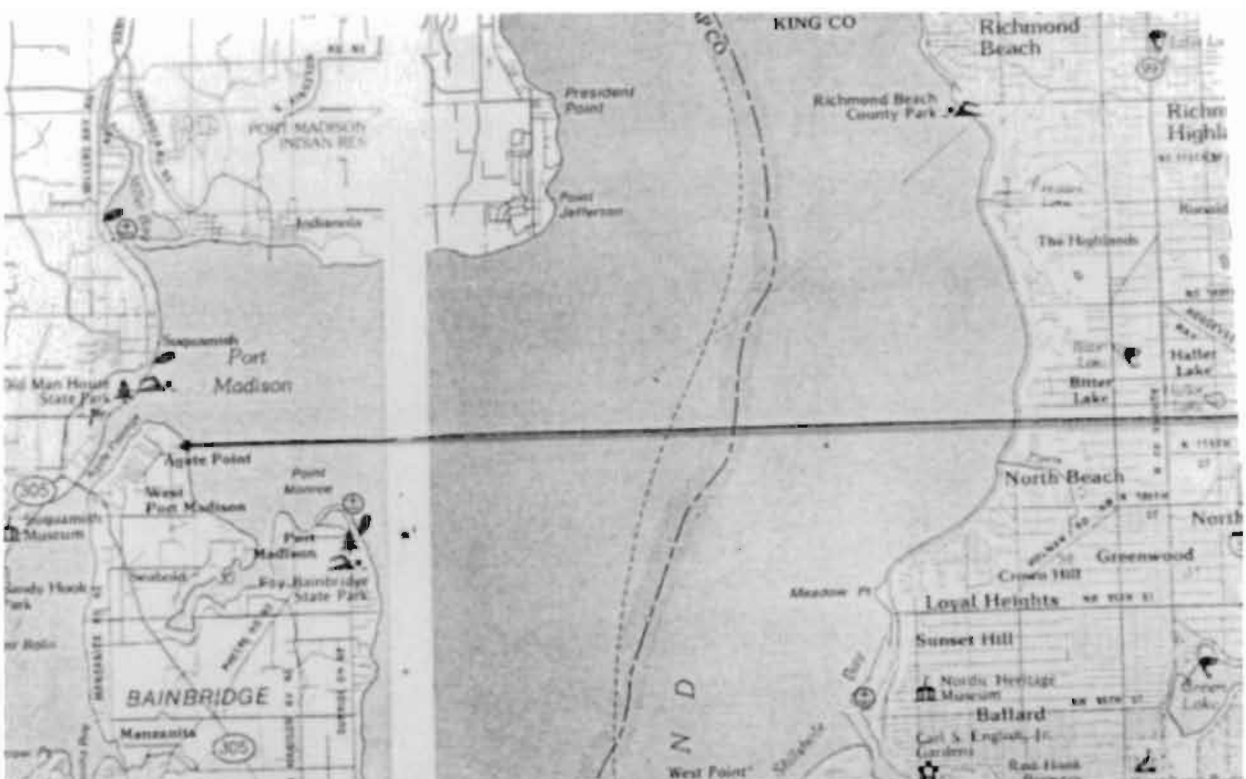


Figure 3. The western end of the east-west axis running from the Haleets through the Skykomish Canyon at the eastern end.

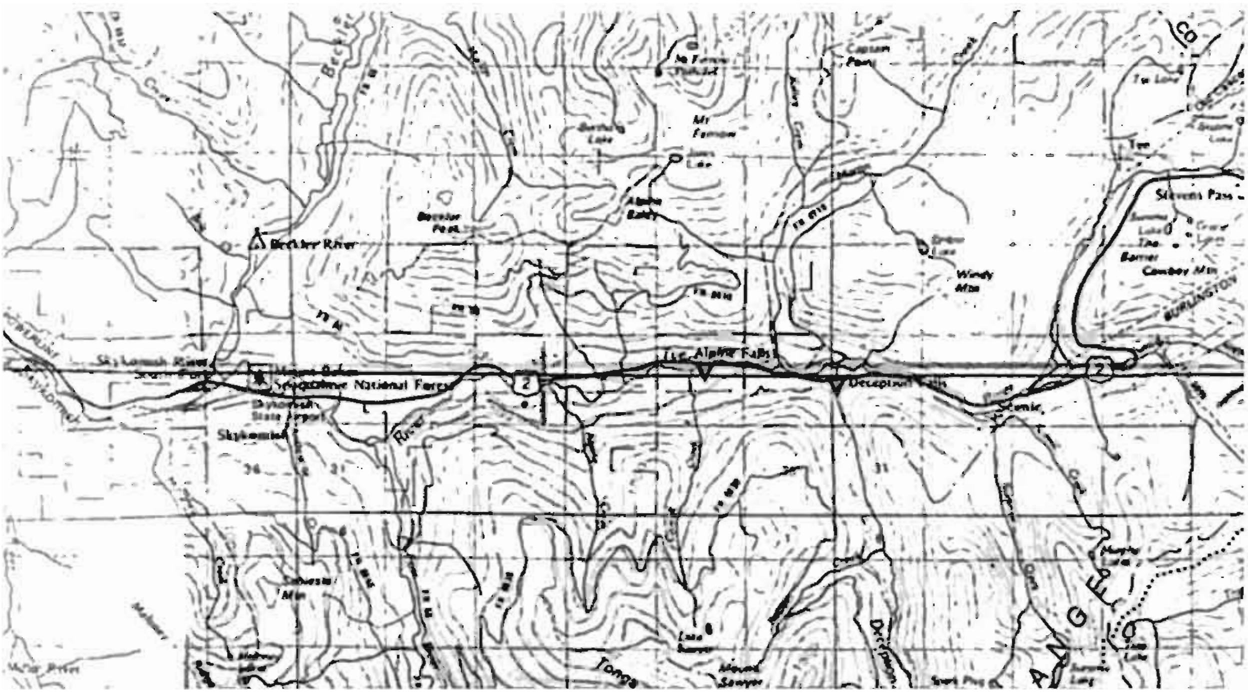


Figure 4. The eastern end of the east-west axis line of sight through the Skykomish Canyon.

THE PETROGLYPHS

Having witnessed the autumnal equinox sunrise from Haleets, it seemed logical that this stone with the faces pecked into the east face, perfectly aligned with the equinox sunrise might be examined in an astronomical context. These faces (Figure 5) can be seen as a reflection of the events happening along the eastern horizon and contain several features that are similar to features to be seen with the naked eye on the face of the full moon. (Figure 6)

The round outlines of the faces, the round eyes (some completely blank), the vertical line between the eyes, the round blank mouth, can all be seen on the moon, created by the dark maria. There are pecked dots on the cheeks, which may represent the bright areas on the left and right side of the moon's face.

Figure 5. The panel of petroglyph faces on the east face of of the Agate Point Petroglyph Stone.

Figure 6. The waxing gibbous moon showing features similar to those on the petroglyph faces.

Beginning on the right (north), we see a face that seems to be rising from a horizon, a glacial striation. While the lunar features are seen on this face, indicating it is the moon, it has a rayed headdress, possibly indicating that it is a special case, perhaps doubling as the summer solstice sunrise. Above this face is an arc with a circular depression at each end and a mark at the top or midpoint of the arc. This notation can be seen at other sites and seems to be a notation of the sun's course from summer solstice through the equinox to the winter solstice (Morris).

The second face and third are stacked, perhaps to accommodate the restriction of space. The features of the upper face most clearly represent the moon as noted above. The lower face is less carefully pecked but it too is distinctly lunar. Note that there is a connecting horizontal line between the faces perhaps indicating a continuous progression.

The next feature to the left is an eight-rayed device that must represent the sun. Below this is a line, rising from a fissure in the rock. This line divides into "Y" at the top and holds a round pecked object. I propose that this may be the sun being brought up from beneath the earth between the shoulders of the Skykomish Canyon notch. The fourth face has four of the lunar features, missing only the cheek dots.

The fifth face from the north end, is a face that has the five lunar features plus a circle with a dot in the center at the lower edge. This feature can be seen on the moon as a distinct lighter circle with a dark center. The nose and mouth of this face have lines that proceed from along the nose down to the corners of the turned-down mouth. These appear on the waxing gibbous moon. Above this face is a headdress with a curved base, extending from the vertical line between the eyes. From this curved line extend six vertical lines, three on each side of two short horizontal connecting lines. The short connecting lines are appropriate notations for the two equinoxes, one as the sun travels north, the other for the sun traveling south. This array repeats the count of the entire panel of faces (Closs).

The sixth and seventh faces, at the far south end of the stone, are more of an enigma. I propose the following interpretation. The upper face has a certain bird-like quality. It also has a headdress extending from the line between the creature's eyes. The southernmost eye has two lines sloping down and to our left. These two lines are also features found on the right eye of the lunar face, but the faces on the stone are mirror images, so these lines appear properly on the left (south) as we observe the panel.

Below this avian countenance is an up-side-down face with a rayed headdress. This may again represent the sun. Arms with four-fingered hands project from each side. The four-fingered hands may represent the eight solar months of a year as used by some tribes such as the Fremont Indians of Utah (Morris). A small moon-face is just to the left and a circle appears between the head and the left-most arm.

This array of two faces may represent the story of the Raven, friend of the people, who brought light into the otherwise dark world by rescuing the sun, the moon and the stars from the lodge of a magician who kept these celestial objects in a box in his lodge. Upon fleeing with these brilliant objects, the Raven was scorched by a ball of fire thrown at him by the irate magician, turning the Raven's colorful plumage black. (Reid and Bringhurst)). To escape, the Raven threw the sun, moon and stars up into the sky. These two faces and the legend portrayed may be in an appropriate position on the panel being positioned at the south and winter solstice end (Figure 7).

THE CALENDAR COUNT

If the face on the far right represents the sunrise and lunar month at the summer solstice, we can call this our June. Moving to the left (south), the next two faces can be July and August. The sunburst is then in its proper position to represent the autumnal equinox of September, with the fifth face being October. The headdressed face becomes November and the last two faces are December. There may be a double meaning here as there is sometimes a thirteenth full moon in the year, requiring an extra face and /or may represent the Raven story as related above. Moving back to the right (north) the headdressed face becomes January, the next is February with the sunburst representing the vernal equinox of March. The stacked faces are then April and May with the last (northernmost) face again returning as June and the summer solstice.

Close examination of the southern shoulder of the stone reveals a small, 3 inch diameter circle with ten short lines radiating out from this circle. (Figure 8) This sunburst is positioned so that a person walking along the upper edge of the beach can see it, announcing the significance of the stone.

Figure 7. The Raven clutching the sun in his talons, holding the moon under his arm with a scattering of stars below.

DATING THE PANEL

Arriving at a date for the time that this panel of petroglyphs was pecked into the stone is difficult, perhaps impossible. Petroglyphs in a desert environment can be dated approximately due to the accumulation of desert varnish. Carbon fourteen (^{14}C) analysis of organic material exhumed from the lowest level of material to be found in the petroglyphs themselves provides the means for dating. However, the Agate petroglyph panel is completely submerged at high water dailey. Barnacles grow over part of the stone and have been repeatedly scraped off over the years to reveal the faces themselves. The grooves of the petroglyphs appear as bare rock, no different than the uninscribed sandstone adjacent. Hill and Hill write about the difficulty of dating these coastal rock carved figures at some length. After discussing various methods attempted by researchers, they conclude that, "With regard to the age of the petroglyphs (in the northwest coast region) we can only say that some are comparatively recent while others may be as old as the history of men on this coast". The dates quoted range from 4300 BC to 8230 BC. However, as mentioned in my introduction, men killed a Mastodon about 11,000 BC only 35 miles northwest on the Straits of Juan de Fuca. Nonetheless, I determined to try to calculate, if not exactly when the faces were carved, at least when the glacial erratic became available to the native people as a place to inscribe these faces.

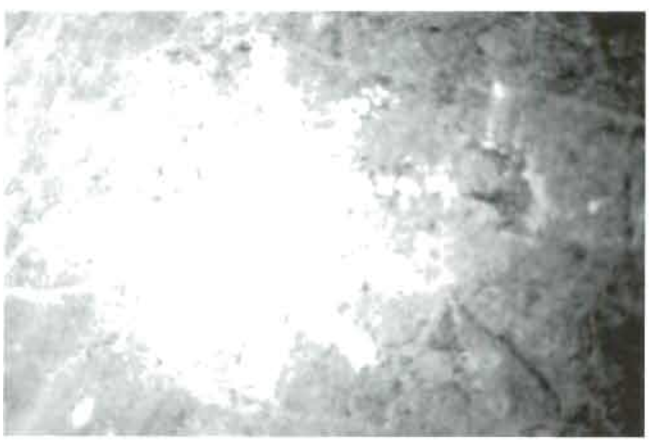


Figure 8. A small sunburst pecked into the shoulder of the Haleets stone, amplified with natural clay for clarity.

The Haleets petroglyph stone rests 50 feet (15.3 meters) from the toe of the present 35 foot (10.6 meters) high glacially compacted sand, gravel and clay bank. The present high tide water eats away at this bank and except where new rip-rap protects the toe, the bank is being washed away as it has been since being laid down by the most recent glaciation. From the bottom of the Haleets stone to the level of the present bank toe is 5.5 feet (1.67 meters).

A study of sea level rise in the Puget Sound area (Eronen, Kankainen and Tsukada) demonstrates a rise of 1 meter per 1000 years during the past 5000 years. Prior to this time, the sea level rose approximately 3 meters per 1000 years. The difference in elevation of the base of the stone and the toe of the bank is 5.5 feet (1.67 meters). Thus: 1.67 meters x 1000 years = 1676 years. 2000 AD minus 1676 years = 324 AD, the approximate date that the stone was washed out of the receding bank and made available for inscribing.

It must be added that several variables bring this date into question such as isostatic rebound of the earth's crust after the weight of the glacier was removed upon meltback. Earthquake uplift or subsidence, and the sea level rise relative to the actual level of the beach should be factoired into this calculation for a more precise date. These details are beyond the scope of this paper. However, if the the assumptions are reasonable, then the date postulated may be close to the actual time of availability. Of course, this does nothing to tell when or who did these faces on the stone since that time, but it does narrow the window of opportunity.

CONCLUSION

It has been thought that agricultural cultures were the only ones needing a method to determine the time of year. Recently, it has been found that hunter-gatherer cultures needed to know where they were in time as well as in place. For Puget Sound tribes, the return of the salmon, the availability of natural food sources, trading rendezvous with other tribes and certain ceremonies all necessitated the keeping of a calendar. The moon could be used to note the passage of shorter periods of time, but the sun determined the year's beginning and end. Noting a specific position of the rising sun, in this case the equinoxes, reset the lunar clock. The Hopi continue to observe the sunrise position to this day (McGlone et al) for both ceremonial and agricultural timing. I believe that the observation and analysis of the Agate Point Petroglyph Stone described in this paper, suggests that it was used as a station point from which to observe the sunrise at the equinoxes to provide a twice yearly determination to set the yearly calendar.

REFERENCES

M. P. CLOSS, *Native American Mathematics*, (University of Texas Press, Austin), 1 - 43.

M. ERONEN, T. KANKAINEN and M. TSUKADA, "Late Holocene Sea-Level Record in a Core from Puget Lowland, Washington, *Quaterenary Research* 27,147-159 (1987)

C. GUSTAFSON, and C. MANIS, *"The Manis Petroglyph Site: An Adventure in Prehistory"*, (pamphlet by the authors, pp. 1-13), 1980

B. HILL and R. HILL, *Indian Petroglyphs of the Pacific Northwest*, (University of Washington Press, 1995) 17 - 47.

B. McGLOE, P. LEONARD and T. BARKER, *Archaeoastronomy of Southeast Colorado and the Oklahoma Panhandle, 1999*, (Mithras, Inc., Kamas, Utah) 1-23, 47, 48, 54 - 63, 100.

N. MORRIS, The Parowan Gap ISTEA Enhancement Project, Archaeoastronomy Report, Vol I, Space, Time, Light and Number (Solarnetics, Inc. Salt Lake City, Utah 1998)

K. L. PETERSEN, P. J. MEHRINGER, Jr., and C. E. GUSTAFSON, "Late Glacial Vegetation and Climate in the Manis Mastadan Site, Olimpic Peninsula, Washington (USA)", *Quaternary Research*, Vol. 20, No. 2, Sept. 1983, pp. 215-231

B. REID and R. BRINGHURST, The Raven Steals The Light, (University of Washington Press 1984)

J. H. RUDOLPH, "An Ancient Observatory, Willow Creek, California" *New England Antiquities Research Association Journal* , Vol. XXVII, No. 1 & 2, Summer/Fall 1993.

ISSUES IN ARCHAEOASTRONOMY METHODOLOGY

Bryan C. Bates[1] and Todd W. Bostwick[2]
[1] Coconino Community College, Flagstaff, USA
[2] Pueblo Grande Museum , Phoenix, USA

ABSTRACT

Over the past three decades, the study of archaeoastronomy has contributed to an increasing database concerning the relationships of rock art and architecture to ancient astronomical observations. However, a standardized method for recognizing, recording and interpreting those data has not yet been fully developed. This paper outlines a number of important issues that need to be considered when undertaking a systematic study of the archaeoastronomy of a site or group of sites. These include the definition of key terms, various methods of documentation and the challenges of interpretation. Definition of terms should distinguish differences in the three separate but inter-related processes of (1) observation, (2) perception and (3) use of astronomical information by the culture(s) being studied. Formal documentation should include photographic records, forms analyzing the cultural context of a potential alignment (included herein) and field forms completed during multiple visits to the sites(s) that record not only significant light and shadow interactions and alignments, but also their changing conditions over time. Finally, if possible, interpretation should be informed through ethnographic analogy and the consideration of multiple hypotheses.

INTRODUCTION

The overall approach of any archaeoastronomy research must be based within the culture of study[1,2,3,4,5,6,7] . One of the main difficulties facing archaeoastronomy as a science has been the failure to distinguish between culturally significant astronomically projected light interactive processes and those processes that occur serendipitously due to earth's orbit through space[8]. Impressive and dynamic light shadow interactions do not of themselves constitute culturally significant events or time periods.

Ruggles and Saunders[1] have made an eloquent case that cultural beliefs about the celestial sphere are linked to the realm of politics, economics, religion, and ideology. We would add environment to such a list. The ability to survive, particularly within a marginal environment e.g. a desert, is directly tied to an ability to recognize recurrent patterns in the biophysical world. While observed celestial patterns and concurrent light-shadow interactions result from one's latitude, documentation of climatic change and biological patterns (e.g. plant and animal life cycles) is based upon observations of biophysical patterns. The construct of a mechanism by which to determine seasonal, and perhaps, precise time periods are observational dialogues between the artifact creator and the biological patterns of the region[6]. In its formative roots, archaeoastronomy (from the perspective of the originator) may be (1) a physical mechanism by which to extract information from the natural world[9] and (2) an expression of human need to create a sense of centeredness within the natural world[10]. A correct cultural reconstruction of such knowledge depends upon consideration of multiple aspects which may be best achieved through "morphological thinking"[11] and consideration of multiple hypotheses[12].

Three inter-related yet distinct processes have defined by Ruggles and Saunders[13] that we would like to explore more fully.

1) *Observation*: There is a distinct difference between observing a phenomenon and understanding the physical forces involved in its origin, for example solar standstills. In order to recognize and/or predict a recurrent event, an ancient astronomer would have needed to document the sequence of events in order to substantiate making a prediction of recurrence.

2) *Perception*: Perception is attaching meaning to that which is observed, the assignment of cultural significance. Out of the perception, cultural classification systems begin to emerge [5]. The challenge of archaeoastronomy may lie more in understanding cultural classification systems and less with identifying intriguing light-shadow interactions.

3) Use: Use of the extracted information then becomes a social, religious, political, and survival issue. The timing of activities which a society chooses to engage in reflect the ecological relationship of that society with its biophysical environs[14,15]. The values that are established reinforce the structures of the society, be they political or ideological[1].

By documenting the use of astronomy (including mythology, cosmology, and the observation of cyclic motions) through cross cultural comparisons, we may garner clues as to how astronomical information has been perceived and manipulated by humankind. Some of these clues may include the following:

1) Cyclical processes provide opportunities for anticipating/ predicting changes in the sky[16.]

2) The act of prediction and apparent compliance of celestial objects provides a sense of control over the environment. This invites the perception that the observer can influence heavenly interactions[17,18]

3) The apparent control of natural processes may allow for the claim of divine spiritual or political power, which, in turn, may increase the political- religious power of the observer[19].

Numerous complicating factors exist, several of which are addressed below. It is not feasible for researchers to know the interaction between an ancient (or contemporaneous) observer and the site at which an alignment may occur. We can not quantifiably document the emotional, spiritual or psychological impact of observing some alignment or celestial event. Not only is it personal to the individual, it is also culturally based and time significant. We must then ask, "How can we be reasonably certain that what we are observing at a site is culturally significant to an ancient culture?"

An obvious answer is to inquire within the culture and confirm our observations with those living descendents of the ancient astronomers. Yet caution is advised. M. Jane Young[20] has detailed an instance where two different interpretations of the same petroglyph panel have been offered by the same Zuni war chief, one year apart, with the war chief having had interceding visits with archaeoastronomers. She raises the issue that by attempting to gain verification of our hypotheses, we inherently taint our sources of cultural information.

Other concerns involve using current cultures as a basis for interpretation. Numerous factors can affect and alter a culture's perception of the natural world including but not limited to: changes within the culture itself, the degree of influence by a second culture, ecological changes and technological shifts. The legitimate documentation of another culture's classification system[21] is difficult. This is especially true (as in the case of the U.S. Southwest) when some of the original ethnographic documentation may have been biased, and current day informants may either not know or not relinquish information necessary for an outsider to gain an unbiased characterization of a cultures' perceptual system. Such challenges are indeed complex. Attempting to state categorically that certain artifacts have designated meaning within a culture is both naïve and disrespectful of those whom one is attempting to better understand.

When using past ethnographic documentation, questions arise as to the accuracy, completeness and potential for biased interpretation by the recorder. There are limitations to what we can extract from an observer's documentation several or many years ago. Only through rigorous study of multiple accounts can we be reasonably certain that what is being stated in print is an accurate reflection of reality. And even then, there may be elements that were not recorded or known to the observer.

It is essential that the archaeoastronomer approach their research through a "cultural context"[5,6]. Such a methodology is dependent upon a "... rigorous methodology [of] situating phenomena within the appropriate socio-cultural context[22]." Yet our interpretation of the patterns observed and meaning attendant to a glyph and/or structure are inherently dependent on our reconstruction of such a "cultural context," and careful anthropologists attempt to avoid such paradigm dependent, cultural traps. Even if we base our interpretation upon the archaeological record, we must remember that the recovery of, and patterns revealed by, archaeological assemblages may not relate to the cosmology of the culture.

PROPOSED RECORDATION AND ANALYSIS GUIDELINES

What follows is a set of condensed recordation charts that we propose for use in the field and library. This is an attempt to assist the researcher in organizing the myriad of information, and testing hypotheses for potential assumptions, biases or perspectives that tend to lie outside an accepted cultural context. It is not possible to cover all the exigencies; therefore, we pose the fundamental question: Is the observed alignment one that reflects the perception and timing of cultural events? (i.e. Is the site in question "culturally legitimate"?).

The table charts we have prepared are:

1) General Cultural Background

2) Climatograph

3) Cultural Biograph

4) Cultural/ Physical Astrograph (not to be confused with current day astrology).

5) Calendrical vs. Ceremonial Timeline

6) Cultural Landscape

7) Language

8) Site Measurement & Recordation by Anthony Aveni, used with permission

9) Site Light-Shadow Interaction Form by Clay Johnson, used with permission.

10) General questions to be addressed.

It is hoped that the researcher will work through these forms and gain an intuitive sense of what works within a cultural context and what doesn't. Hopefully, this methodology will reduce the ascription of fantastic interpretations to coincident alignments and light-shadow interactions. These charts have been condensed for publication purposes and need to be reconfigured prior to use.

TABLE I. GENERAL CULTURAL BACKGROUND

Culture:

Recorder:

Clan or Subgroup:

Date:
Time of Occupation:
Site Occupied:
Regional Biome:
Latitude:
Common plants during occupation:
Longitude:
Soil types:

Subsistence activities: (document information source for each entry)
Degree dependence on specified species for food &/or raw materials:
Mode/ degree of mobility:
Items of trade & source:
Housing construct & periods of change:
Other archeological findings:
Reconstructed Occupational Timeline: (migrations; building phases; cultural changes; shifts in land use and/or food; ethno-science developments; war; moieties; etc.)
Reconstructed Biophysical Factors: (Drought; flood; climate change; lapse of resource base; etc.)

TABLE II: CLIMATOGRAPH

Time period	Temperature	Precipitation	Wind speed/ direction	Informational Context
				Dendrochronology
				Palynology
				Paleo-ethnobotany
				Paleontology
				Geologic sediment

TABLE III. CULTURAL BIOGRAPH [Ethnographic record of biological activity.]

Time of year	Activity	Associated Cultural Activity	Documentation
Ancient culture	Planting		
	Harvest		
	Seeds, nut, berry collection		
	Hunting: animal and stage life cycle		
	Other		
Current culture			

For Agrarian societies:

Food Raised	Growth Season	Water needs	Freeze susceptibility (range)

TABLE IV. CULTURAL/ PHYSICAL ASTRONOMY (Document each item)

Celestial object pattern:
Time of cultural recognition:

Time of physical appearance:
Alignment or event observed:
Site of observation:
Ethnographic/ceremonial association:
Survival association:
Myth relation:
Analogy in story:

TABLE V. CALENDRICAL/ CEREMONIAL RELATIONSHIPS

Cultural Activity:
Time of year performed:
Relationship to astronomy:
Relationship to biophysical world:
Responsible group:

TABLE VI. CULTURAL LANDSCAPE [requires full page]

Diagram of alignment horizon:
Identification of significant structures (natural and human):
Location of site in question:
Mythologies related to natural features:
Common astronomical symbologies and relationship to site:

TABLE VII. LANGUAGE

List of words and associations used to describe natural world:
Context in which words most often used:
Other word associations that imply special meaning:

TABLE VII. SITE MEASUREMENT[22]

Site:		Site Latitude:
Transit Operator:		
Anticipated Alignment: Date:		Site Longitude:
Four Alignment Azimuth readings	:	Average Alignment Azimuth:
Horizon Altitude:	Watch Time:	Watch Correction:
True GMT:		
Sun Azimuth rdg.:	Sun Altitude:	Declination Sun:
Sun Azimuth calculated:	Sun Azimuth calculated:	Equation of Time:
Alignment Azimuth calculated:		Magnetic declination:

[Note: Aveni [23] provides an excellent review of site measurement procedures and mathematics.]

TABLE XI: PETROGLYPH RECORDATION FORM[24]

Panel Activity During One Day

[Note: researcher should visit site on numerous "non-significant" dates to understand process.]

Site: Key Date: Date Observed:

Site #:

*** = panel dark — = lit

[] = active N = No interaction S = Interaction M = suggestive alignment

Alignment type: H = Horizon D= dagger P = spot C = line only A= complex templates !
= sunrise/ sunset

Panel #: Name: Time (use standard time for region, not daylight savings):

0500 0600 0700 0800 0900 1000 1100 1200 1300 1400
1500 1600 1700 1800 1900 2000

TABLE X: GENERAL QUESTIONS TO BE ANSWERED

What celestial objects/patterns are documented in the ethnography?

What time of year is each celestial object /pattern acknowledged?

What associations exist between the celestial object and the culture?

What other objects/ animals/ forces are found in association with the celestial object?

How are these different objects/ patterns related in the mythology?

What analogies are told thorough the use of stories?

What is known about the cosmology of the culture?

In the taking of site measurements, what steps has the researcher taken to assure that the accuracy and precision of the measurements are within the limits of the available technology and means of observation of the base culture?

CONCLUSION

The objective of this paper has been to discuss complicating factors in archaeoastronomy research methodology and offer a mechanism by which the researcher can assess whether or not specified site interactions fit within the cultural context of the society thought to be the originator of the calendar/ observatory. It is proposed that the individual first conduct extensive research in the culture of concern, fill out the above forms and then initiate fieldwork. Information beyond the scope of these forms may be necessary. The construction of a cultural matrix may allow one to assimilate the cultural information and astronomical use patterns to address larger cultural issues as defined below.

1) Is there a pattern in the alignment types or symbology used within the culture?

2) Does the assembled historic and current field data reflect the same pattern?

3) What prior experience was required by the culture prior to allowing someone to visit,

observe, interact with, and/or interpret an interaction involving a cultural artifact and celestial body?

4) How can inference by analogy be used to allow one to ascertain correlations within a cultural classification scheme?

Only with a firm handle on the cultural context of a society's astronomy can more accurate interpretations emerge. Through more work up front, the researcher should be able to make more efficient use of field and research time. Combined with systematic field recording, embarrassing mistakes of invalid interpretations can be avoided.

REFERENCES

1. C. RUGGLES and SAUNDERS, "The Study of Cultural Astronomy", in *Astronomies and Cultures, ed.* by Ruggles and Saunders (U. of Colorado Press,1993).

2. A. AVENI, personal communication,, May 30, 1996.

3. A. AVENI, *Archaeoastronomy & Ethnoastronomy News* #30 (Center for Archaeoastronomy) (winter 1998), 2.

4. B. BATES, "A Culturol Interpretation of an Archaeoastronomy Site at Wupatki National Monument" in Proceedings of the Fifth Oxford International Conference on Archaeoastronomy, Santa Fe, N.M., 1996 (In press).

5. M. J. YOUNG, "The Interrelationship of Rock Art and Astronomical Practice in the American Southwest" *Archaeoastronomy* (supp. to Journal for the History of Astronomy), no. 10 (1986) S43-57.

6. J. BRODA, "Astronomy and Landscape", paper presented at the Sixth Oxford Conference of Archaeoastronomy, June, 1999; A. AVENI, "Archaeoastronomy in the Americas since Oxford 2", In *Archaeoastronomy in the 1990's*, ed. by Clive Ruggles,. (Loughborough, UK. 1993), 15-32.

7. M. J. YOUNG, "Issues in the Archaeoastronomical Endeavor in the American Southwest, " *Astronomy and Ceremony in the Prehistoric Southwest*, ed. by J. B. Carlson and W. J. Judge (Maxwell Museum of Anthropology Papers no. 2, 1987), pp. 219-232.

8. A. AVENI, "Archaeoastronomy in the Americas Since Oxford 2," *Archaeastronomy in the 1990s*, ed. by C. Ruggles (Loughborought, U.K., 1993). 15-32

9. C. SCHWEIGHAUSER, personal communication, (1978 to 1999). Director of Astronomy, University of Illinois at Springfield; instructor of Environmental Perception.

10. M. ELIADE, *The Sacred and the Profane* (Harper and Row, 1963)..

11. F. ZWICKY, "Task We Face", *Journal of American Rocket Society* (March, 1951) No. 4, pg. 3-20.

12. M. J. YOUNG, op.cit. (ref.5) pg.S44

13. C. RUGGLES and SAUNDERS, op.cit. (ref.1) pg. 2-4.

14. C. SCHWEIGHAUSER, op.cit (ref. 7).

15. P. SHEPERD, *Coming Home to the Pleistocene*.

16. M. ZEILIK, "Keeping the Sacred Calendar", in *Astronomy and Ceremony in the Southwest*, ed. by R Carlson and W. J. Judge.(Maxwell Museum of Anthropology anthropoological Papers no. 2, U. of New Mexico Press, 1987), pp. 25-42.

17. J. CARLSON, Director of Center for Archaeoastronomy, personal communication., June 1999.

18. R. WILLIAMSON, *Living the Sky: The* Cosmos *of the American Indian* (U. of Oklahoma Press, 1987)

19. J. REYMAN, "Priests, Power, Politics: Some Implications of Socio-ceremonial Control." *Astronomy and Ceremony in the Prehistoric Southwest*, ed. By J. B. Carlson and W. J. Judge (Maxwell Museum of Anthropology Papers no. 2, 1987), pp. 121-147.

20. M. J. YOUNG, Op cit (ref 5) pg. S47

21. Ibid. pg. S43

22. Ibid. pg. S47

23. A. AVENI, *Skywatchers of Ancient Mexico* (U. of Texas Press, 1980). Used with permission of author.

24. C. JOHNSON, "Some Seasonal Elements in Uinta Fremont Rock Art", in *Utah Rock Art*, Vol.XVII, Utah Rock Art Research Association, Salt Lake City, Utah (In Press).

APPENDIX A: TERMINOLOGY

ALIGNMENT: a line of vision or light-shadow line that draws on a minimum of 2 points in space.

ARCHITECTURE: a building or structure created by humans for the purpose of defining space.

CELESTIAL OBJECT: any of the natural bodies, which are visible within the sky. Excludes all man-made objects.

CELESTIAL MOTION: the temporal change in position of any celestial object. Can be anticipated due to the earth's rotational (daily) or revolutionary (seasonal or annual) processes or a combination thereof.

CULTURALLY SIGNIFICANT: an event or activity carried out by a group of people for creating a sense of specialness or importance about that point in time and sequence of events.

GNOMON: a shadow casting object or surface either natural or cultural.

HIEROPHANY: a structure of demarcation indicating a place where the sacred has and may again reveal itself.

INTERACTION PROCESSES:

a) HORIZON RELATIONSHIPS: change in celestial object azimuth along the rise or set horizon. Changes in altitude of horizon will cause changes in azimuth. (See Aveni, *Ancient Skywatchers*) Potential use as a calendar. Caused by changes in azimuth.

b) ALTITUDE RELATIONSHIPS: Pre- or post- rise or set markers. Caused by a shift in Declination and corresponding altitude. (See Aveni, *Ancient Skywatchers*)

MARKING: a modification of the landscape to identify a particular alignment. Note that the marking must be in relationship to the original viewer and will somehow indicate how space was defined.

OBSERVER: an individual who from a given location may observe alignments and temporal changes in celestial motion.

APPENDIX B: METHODOLOGY CONSIDERATIONS

I. PHYSICAL CONSTRAINTS:

a) Light projection best if < 1m., acceptable up to 2m. but after 2m, light shadow line so hazy due to light bending that you lose the specificity of the interaction.

b) Astronomical cycles mark the potential times of calendar functions. Rituals required by humans need to be set according to natural cycles.

II. ON-SITE CONSIDERATIONS:

a) Has there been some modification of the environment or landscape by humans? Remember that architecture is designed to locate humans within space. Check for a stationary reference point or architectural structure from which to observe interactions.

b) Marking may be of space or an alignment. The alignment is a visual manifestation of a connection between humans and the natural world.

c) Transition between land and sky often is a religious, emotional, and/or sacred transition.

III. CARE AND USE OF EQUIPMENT:

a) Avoid over-measurement. The Pekwin Priest of Zuni were allowed to be off a day of prediction of a solstice. The community of elders would evaluate the consistency of the Pekwin's observations.

b) In reading different documents (Aveni, *Ancient Skywatchers of Mexico*) significant time, space and energy is spent on explanations of extinction, affect of altitude and precession. Certainly these are important and we can get obsessed with them. A question to address is "what level of accuracy was obtainable or necessary within the time frame of the culture?"

c) Remember, calendars are different from watches. The frenetic obsession with time is an Euro-American invention necessary as a pre-condition to societal ulcer.

d) Choose computer partners carefully. Besides viruses, some contain inaccurate information.

e) What are the advantages of a particular site for observation reasons?

f) Remember, we are re-creating the observational process. The role of religion is to CENTER the human within the universe. The observer is a key to the process. An individual must be acceptable for the hierophany to reveal the sacred.

IV. BASIC RECORDATION PROCEDURES:

a) Visit site first and identify potential interactions via measurements/ calculation.

b) Visit site at least 10 days before and after anticipated events to record shift in interaction pattern/ conditions

c) Visit site throughout solar year (minimum solstice to solstice for solar site) Visit at cultural non-significant times as well as significant times.

d) Use astronomers' almanac for predicting events likely to have interactions.

e) Visit non-rock art panel sites that have changing light on them to determine whether light interactions maybe coincidental.

V. LIGHT AND SHADOW CONSIDERATIONS:

Clay Johnson has compiled a catalogue of light shapes and sizes, symbolic patterns, and basic solar/ lunar conditions(not repeated here):

a) Catalog of different shapes of light and shadow
   1) catalog based on celestial object casting light/shadow
   2) catalog based on symbolic depiction of different light sources
b) Terms of basic solar condition applicable to panel
c) Key question: What evidence exists within culture that gnomons were used?
   1) Were gnomons from natural feature (rock outcrop) or were gnomons culturally constructed?
   2) Gnomons can be up to 10-20 m from rock art panel (M. Zeilik states 1-2 m maximum due to increased fuzziness of line).

EXPERIMENTAL ARCHAEOASTRONOMY:
A laboratory for study of interaction of light, shadow and symbolic imagery

Angela M. Richman
Chaco Culture National Historical Park, Bloomfield, New Mexico, USA,
Von Del Chamberlain
Utah Valley State College, Salt Lake City, Utah, USA
and
Joe Pachak
Artist and Archaeological Consultant

INTRODUCTION

Based on a long-time interest in American Southwest rock art, artist Joe Pachak created a piece of sculpture located at Edge of the Cedars State Park and Museum in Blanding, Utah (figure 1). Sculpted in the form of a flat-spiral, with primary axis on a north-south line, "Sun Marker" replicates split-boulder prehistoric archaeoastronomy sites found in the Southwest (Ambruster and Williamson 1993; Lance 1994; Sofaer, Sinclair and Doggett 1979). The spiral form is an engaging representation of many natural cycles, including the annual migration of the sun. As the sun rises, moves across the sky, sets, moves under us to rise again at a slightly different place each day, a never ending three dimensional spiral is created, running northward to the path of the summer solstice sun and southward to the path of the winter solstice sun. For the Pueblo culture, the spiral is a migration motif, corresponding to creation mythology symbolizing the movement of people, and possibly the movement of the sun as well (Young 1988: 135-137, 154, 226-230, 232-233).

The three dimensional spiral of the movement of the sun in the sky combined with the migration and possible solar symbolism of the spiral for Puebloan people provides the essential concept for the structure of Pachak's Sun Marker.

Carved into and painted upon the surfaces of Sun Marker are spirals, concentric circles, animals, tracks of animals and a prominent feature of the local landscape. As the sun creates its annual spiral in the sky, the play of light within

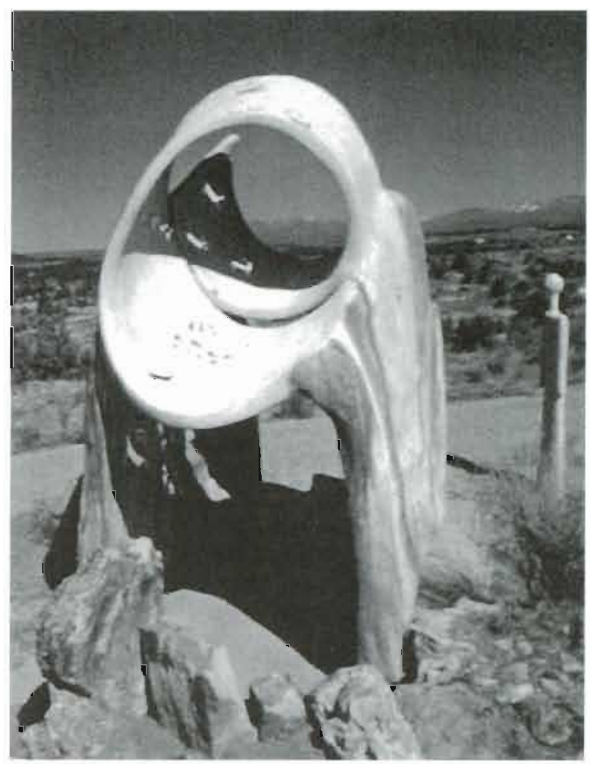


Figure 1. Pachak's Sun marker seen from the south. Note the «Observer» standing at the north east corner.

the chambers of Sun Marker creates migrating spirals of light, shadows and images.

Pachak's Sun Marker was created as a representation of the Puebloan people who once lived at Edge of the Cedars. This is the site of a Chacoan Outlier great house community where people lived from about 1050 to 1200 A.D. They planted crops and performed ceremonies on an annual cycle. It is likely that they used the points of rising and setting of the sun on the horizon to keep their calendar. Pachak has incorporated one prominent horizon feature known as the, Bear's Ears into his sculpture, carved onto the north end of the west wall, At the northeast corner of Sun Marker stands a sculpted "Observer" as if to represent the prehistoric people once residing at this place.

It is important to understand how the artist approached the creation of this work. First he designed the basic structure founded on what he had observed at split-boulder and other sites, then he incorporated the same types of rock art light and shadow interactions that are being discovered and reported all over the Southwest. Once the basic form existed, he carefully noted the interactions that resulted, then made modifications to produce final desired results.

Over the past two years we have used Sun Marker as a laboratory for study of interaction of light and symbolic images. As we watched the dramatic interplay of solar light, shadow and symbols we attempted to comprehend the significance these phenomena might have had for Ancestral Puebloans, and we thought a great deal about light-shadow-icon research that is being reported. We hope that our experience and conclusions might be useful to others

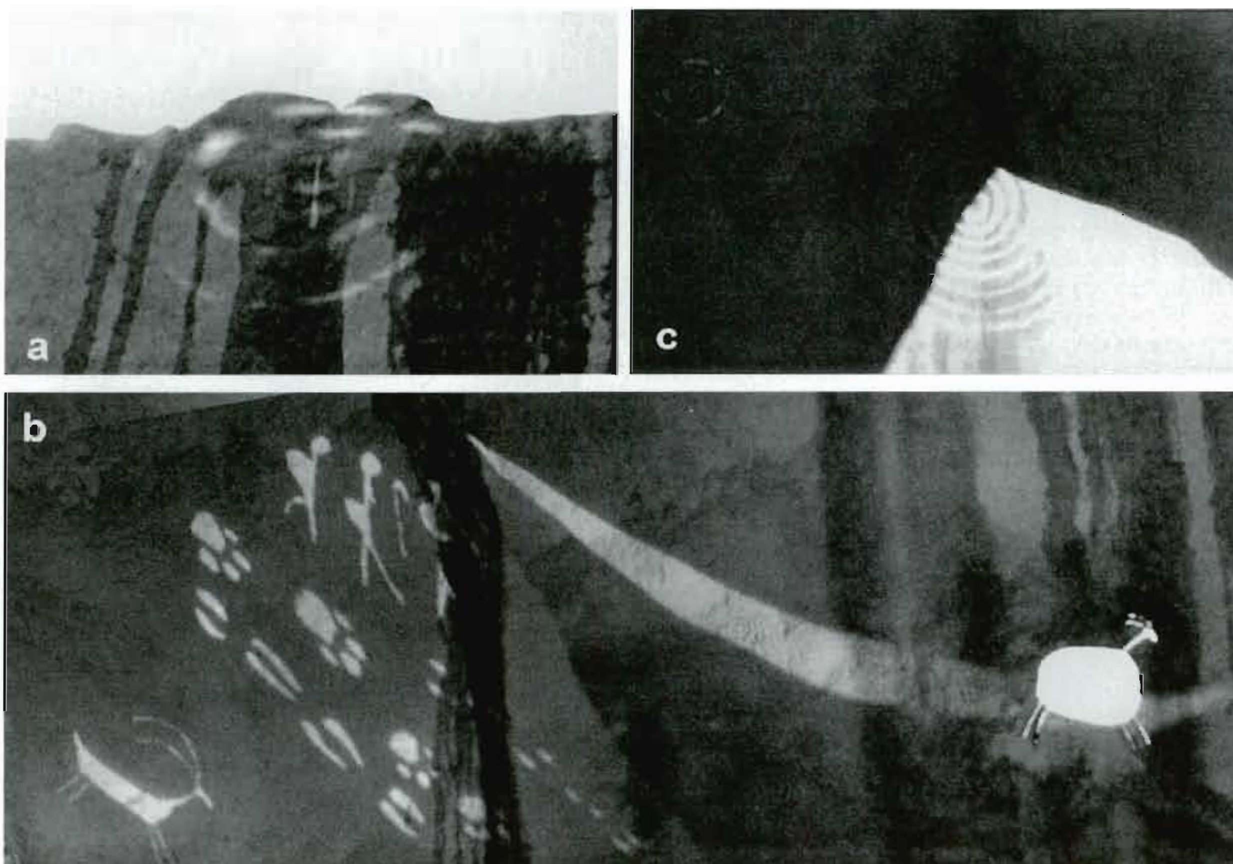


Figure 2. Interactions at winter solstice: a) first light projected spiral falling onto carved Bear's Ears; b) mid-morning projected migration figures and shaft of light moving onto cut-out archaic bighorn sheep (computer composite to show both portions of the panel); c) solstice anticipation shadow playing onto espiral rings.

involved in such work. Here, then, is a summary of our observations. With limited space, we can review only part of them.

OBSERVATIONS

Winter Solstice

As the winter solstice sun rises onto Sun marker it strikes a spiral cut into the east wall, projecting a spiral of light onto the opposite wall directly onto the base of the carved Bear's Ears (figure 2a). Similar images are projected throughout the year. Pachak will match three of them, winter solstice, equinox and summer solstice with petroglyphs.

As the sun rises upward, images of flute players, a bighorn sheep and animal tracks are projected through the upper spiral and begin to migrate down the west wall (figure 2b). These, too, will eventually be matched to pictographs to depict this sacred image migration at both solstices and equinox.

A bit later, between 9 and 10 a.m., a curved light shaft from the center of the flat spiral moves down the west wall, directly over an archaic desert big horn cut into the west wall and projects through it to the west side of the sculpture, falling onto the ground for a few minutes.

Just before midday, the projected desert big horn steps off the inner west wall of the corridor onto the floor. The image of this pecked into the floor marks the furthest north the image of the desert big horn will travel in its annual modulation. There will be three pecked images on the floor marking this migration for winter, equinox and summer.

At sunset, the last light of day casts through the archaic bighorn sheep to fall onto the chest of "The Observer." Again, there will be three painted images to mark the last light of day at solstices and equinoxes.

Also at winter solstice sunset, a wedge of light from the southwest comer of the corridor plays into the rings of the large pecked spiral (figure 2c), offering a way of anticipation of winter solstice by observation of its exact position over the days leading up to the solstice.

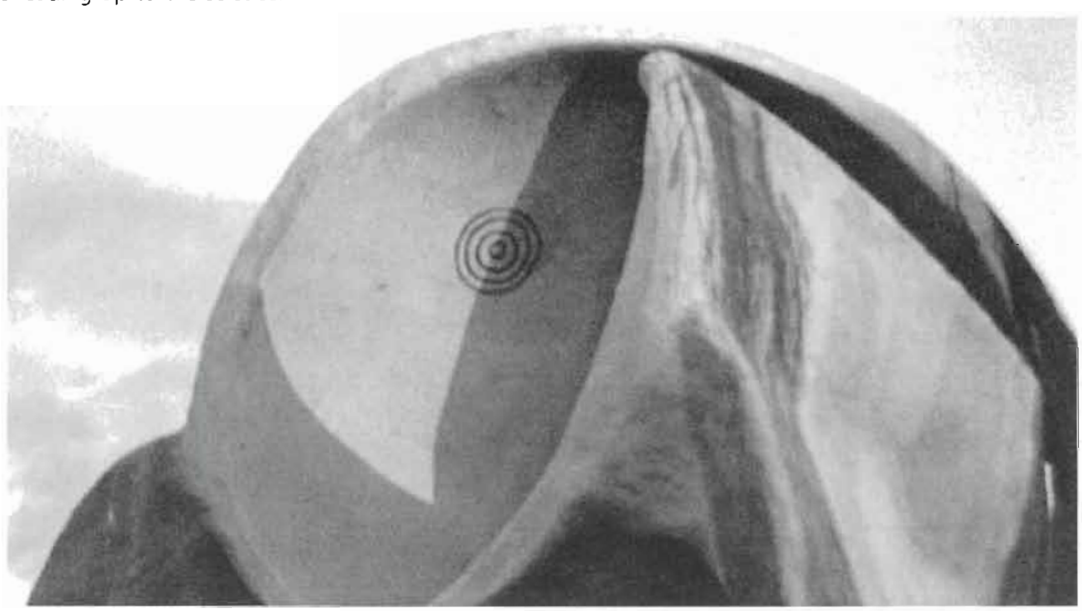


Figure 3. Last light bisection of concentric circles: February time for preparing fields and sprounting seeds; October time for celebrating the harvest.

Finally, at winter solstice last light, a sliver of light comes through the aperture in the upper part of the sculpture, falling upon the inside bottom of the flat spiral. A birthing motif is being considered to be painted at this interaction site to symbolize the rebirth of the sun, and year, at winter solstice.

Planting and Harvest: February 18 & October 22

As sunset approaches on the date of February 18, also on October 22, a shadow moves toward and into the concentric circles located within the upper flat spiral. At last light the shadow vertically bisects this solar symbol (figure 3). This event marks the February time for preparation for planting and sprouting of seeds and the October time for conclusion of the harvest.

Equinox

We have already noted some of the interactions that take place at equinox, such as the projected first light spiral, migration panel, pecked bighorn and last light archaic sheep projection. One unique equinox phenomenon takes place as the sun sets on the north edge of the Bear's Ears. A viewer can stand to the cast of the sculpture and line up the carved Bear's Ears located on the top of the west wall onto its counterpart on the distant horizon. This is an example of direct alignment of the type that could have been used by the Puebloan inhabitants at Edge of the Cedars.

Summer Solstice

At summer solstice time, early in the afternoon, a small dot of light coming from the west aperture moves up the wall toward the pecked spiral within the corridor as the sun moves downward to the west. When the light hits the edge of the spiral it becomes a thin line, and within five minutes moves upward through the center extending to the top of the spiral (figure 4a). Within half-an-hour it broadens, moving upward to the south. As the aperture closes to sunlight, it turns into a fine sliver representing an atlatl that stabs a red painted desert bighorn sheep (figure 4b), then vanishes.

As sunset approaches, a pointed shadow from the northwest side of the flat spiral moves up toward the painted concentric circles. At last light the tip of the shadow touches the center of the circles, sharpening as it fades away. As this happens, the shadow of the carved Bear's Ears is cast onto the inner east wall of the corridor, moving up to touch the cut spiral as sunlight fades (figure 4c).

ANALYSIS OF THE INTERACTIONS

Some of these interactions were intended by the artist. Others were not intended. Once discovered, some of the unintended ones were so interesting that they were then incorporated into the sculpture. We ask readers to pause and consider which of the interactions we have reviewed they think were intended by the artist and which they think are purely accidental?

The first light spiral projection was intended for winter solstice, equinox and summer solstice, but it was a pleasant surprise to find that at winter solstice it fell onto the base of the Bear's Ears (figure 2a), a highly symbolic phenomenon. The shaft of light moving through the archaic bighorn was not intended. However, the sunset light projected through the archaic sheep was intended for marking at both solstices and equinox, but the artist had to add "The Observer" to correct a mistake in the exact geometry of the sculpture in order to mark where the image would fall at winter solstice. The wedge of light playing onto the rings of the spiral that could be used for anticipation of the winter solstice (figure 2c) was not intended, but made an interesting discovery of how the elements of the work could be most useful for calendrics. The sliver of light cast onto the bottom of the flat spiral in late afternoon at winter solstice was covered through observation and the artist is considering painting a birthing scene at that point to represent the rebirth of the sun at winter solstice.

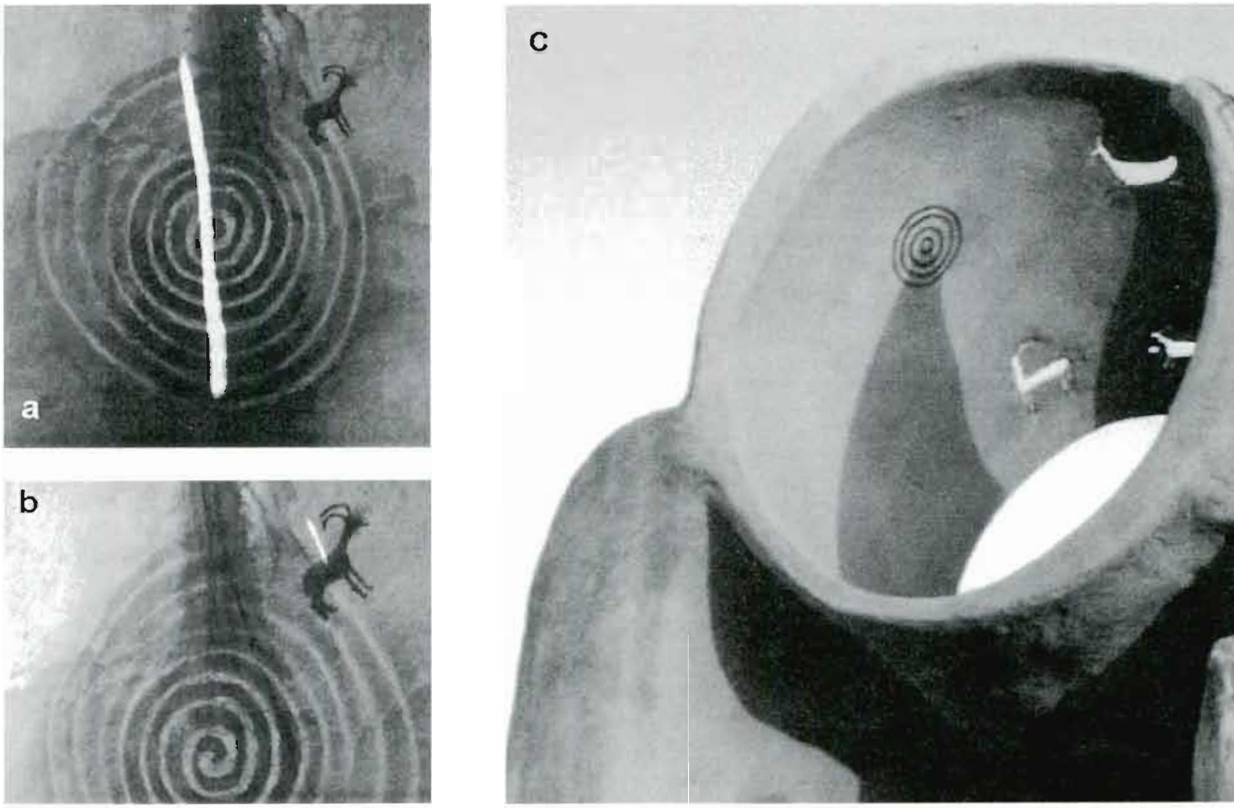


Figure 4. Summer solstice: a) afternoon snake of light through spiral; b) atlatl of light stabbing desert bighorn sheep; c) last light pointed shadow cast into center of concentric circles while shadow of Bear's Ears touches cut spiral (lower left of center).

The symbolic migration of animals, animal tracks and flute players was intended to be clearly marked at some appropriate time in the morning hours at each solstice and equinox. By observation, the artist discovered that he could mark this most precisely by the location where the bighorn stepped from the wall onto the floor, so he is in the process of marking each of these with petroglyphs.

As we observed light and shadow phenomena on Sun Marker, we became very interested in the play of last light onto the concentric circles. We could see how this might he useful for marking various dates. We found that the dates when the circles were bisected right at sunset (figure 3) was at the time of year when the people once living there would have been making preparation for agriculture in mid February, as well as the time when the harvest would likely be celebrated. This is a very dramatic phenomenon to observe, but it was not intended.

Pachak carefully planned the unique equinox observation for sunset to be observed behind the sculpted Bear's Ears, aligned with the Bear's Ears on Elk Ridge. Then, he discovered that a small aperture produces a thin shaft of light that falls to the west of the sculpture, moving to a tiny point where it disappears. This provided an exceptionally accurate marking for equinox. Thus, Pachak has moved a boulder into position and the vanishing-point of the projected light will he marked by a reflective stone set into the larger stone inside pecked concentric circles: a marvelous way of accurately marking the equinox, yet it was not intended at the outset.

The most dramatic summer solstice effect, the moving snake of light through the center of the spiral (figure 4a), was carefully designed using an aperture for sunlight. Once this could be observed, the artist fine-tuned it by filing the aperture, pecking in the spiral, then adding the desert bighorn for the arrow of light to stab as the aperture closes to sunlight. The pointed shadow moving right to the center of the concentric circles was also intended, but the shadow of the Bear's Ears moving onto the carved spiral was merely a happy accident (figure 4c).

CRITERIA FOR EVALUATION OF CALENDRIC INTERACTIONS

So what does all of this tell us about light-shadow-image interaction research? What most intrigued us and motivated our work was the interesting accidental interactions, so resembling many being reported in archaeoastronomy field work. It has been inspiring and instructive to see how the artist fine-tuned the intended interactions, and even more so to see how he discovered and incorporated some not planned. Surely this reflects, at least to some extent, what was involved in the creation of rock art at prehistoric sites. As you have seen, these accidental phenomena can be easily interpreted as though they must have been masterfully created within whatever philosophical framework we might imagine for the ancient artists. We suggest that what is being discovered by archaeoastronomy light-shadow-icon research is a combination of these three types: (1) planned; (2) discovered and possibly used; and (3) simply accidental phenomena. We suggest that in most cases the ancient people likely discovered light phenomena created by the local landscape, then added the sacred images as ways of expressing reoccurring motifs that had deep significance within prehistoric traditions, connecting them to their ancestors as well as to solar, planting and ceremonial cycles.

We feel that the most important aspect of our work is to attempt to derive criteria for evaluation of calendric interaction of light, shadow, and symbolic imagery, and we propose the following criteria for such research.

1. The most compelling interactions are those where there are strong indigenous cultural arguments to relate the symbolic images and reoccurring symbolic images to the light and shadow interactions. Some motifs, for example, such as spirals and concentric circles, are known to have significance to Puebloan cultures.

2. It seems to us crucial that significant interactions are strongly focused on seasonal dates of known or arguable importance within the cultural context of the imagery. Solstice dates for example have been of greatest importance to many cultures and there is good ethnographic evidence that such things as planting times have been critical for Puebloan people.

3. If solstice interactions are involved, they become more compelling when there is an apparent method of anticipation of the solstice. It is surprising to note how little attention has been paid to light and shadow interactions anticipating the solstices as well as dramatically marking them. Adding anticipation observational data into the record might help separate the most interesting sites from others.

4. Interactions taking place at first light and last light are particularly dramatic and very persuasive. Interactions that are precisely definable, such as a dot or line of light or concentrated shadow tracking a glyphic line, or light through an aperture producing a short lived interaction that is clearly focused onto an appropriate motif are also engaging. The most significant interactions are those that are uniquely and precisely defined by the light or shadow occurrence.

5. Convincing interactions are produced by either natural or manipulated surfaces or apertures that result in what can be strongly argued to be formalized expressions of the cultures involved.

6. It seems important to us that the site has geological antiquity: i.e. the interactions involve only surfaces and structures that have been apparently stable within the time period between the best indications of when the imagery would have been made and the present.

7. Sometimes researchers find rock art panels that would be terribly interesting if only some light or shadow interaction would take place. It can be tempting to seek ways of creating the possibility of such interactions, but doing this can lead to very sloppy science. We suggest that it should not be necessary to add "implied" elements that are not found at the site, such as rock, wood or other shadow-casting or light projection objects or surfaces, unless there are unusually strong evidences or arguments that these would have been present when the site was in use by the indigenous cultures involved.

CONCLUSIONS

This work has convinced us that the most compelling interactive rock art discovered and reported was most likely made by prehistoric people who had become sensitized to cultural interpretations of solar energy interacting with sacred images at critical times of the year. We think it probable that they became skilled at discovering and using the natural landscape to provide everything needed so that all they had to do was peck or paint the appropriate images. Random interactions of the sort that sometimes get reported in archaeoastronomy research, interesting as they might appear to our eyes, have weaker scientific value than those clearly satisfying the criteria established above. We hope these criteria will be useful to those doing this type of research, and we hope that our work will promote additional "experimental archaeoastronomy" that can help us all be more rigorous in both collection of data and publication of results. We recommend continuing study of Pachak's Sun Marker for those interested in such work.

ACKNOWLEDGMENTS

Utah Valley State College generously encouraged and supported this research leading to its presentation at the Oxford VI conference and its publication. The Edge of the Cedars Museum encouraged the work, allowing free access to "Sun Marker" in order to obtain needed data. Jean Tappan kindly volunteered her skills and computer equipment to formulate the illustrations. For all of these we are deeply grateful.

REFERENCES

C. W. AMBRUSTER and R. A. WILLIAMSON, "Sun and Sun Serpents: Continuing Observations in Southeastem Utah." In *Archaeoastronomy in the 1990's*, ed. by C. Ruggles (Longborough, UK, 1993), 219-226.

R. LANCE, "An Ancient Sun Calendar in Southeastern Utah," *Blue Mountain Shadows* 13 (1994), 13-15.

A. SOFAER, R. M. SINCLAIR and L.E. DOGGETT, "A Unique Solar Marking Construct," *Science* 206 (1979), 283-291.

M. J. YOUNG, *Signs From the Ancestors* (University of New Mexico Press, 1988).

BABYLONIAN ASTRONOMICAL RECORDS AND THE ABSOLUTE CHRONOLOGY OF THE NEAR EAST CIVILIZATIONS

Vahe G. Gurzadyan[1], *H.Gasche*[2]
[1] Yerevan Physics Institute, Yerevan, Armenia
and
ICRA, Dipartimento di Fisica,
Universita di Roma La Sapienza, Rome, Italy
[2] University of Ghent, Ghent, Belgium

While the astronomical records had enabled to define the framework of datings of the first millennium BC, the problem of absolute chronology of ancient Near East during second millennium BC was unsolved in spite of efforts of many scholars. The reason is clear - the records become highly obscured and fragmentary, often being later copies of early inscriptions. Three chronologies were most popular among many proposed: so-called High, Middle and Low; the fall of Babylon by Hittides was attributed to 1651 BC by High, to 1595 by Middle and to 1531 by Low Chronology. Among these, the Middle Chronology was the most quoted one, yet still the most frequently criticized. These chronologies were proposed based essentially on the data of the so-called Venus Tablet of Ammisaduqa.

Our recent study within the *Ghent-Chicago-Harvard Joint Project* aimed the coherent multidisciplinary study of the second-millennium chronology problem. Its results along with extensive bibliography, are summarised in the volume [1], where the detailed analysis of the archaeological, textual and astronomical data enabled to reveal the absolute chronology of the Ancient Near East, dating the fall of Babylon to 1499 BC.

The available archaeological material of the three most informative pottery shapes enabled to trace the evolution of pottery technology through different layers and sites in Mesopotamia. The conclusion of that comprehensive study was that the Middle Chronology is too long for about a century. The textual sources including mainly the manuscripts of Assyrian Kinglist, inscriptions of Shalmaneser and Tglath-Pileser I, also permit to construct a plausible shorter chronology, namely 85-105 years shorter than the Middle Chronology.

In the astronomical part of the study we dealt with the data of Enuma Anu Enlil tablets, including the Venus Tablet (Tablet 63), two Ur III texts mentioning lunar eclipses, (Tablets 20 and 21), and finally, a tablet discovered recently at Tell Muhammad, a site near Baghdad, with two mentioning of a lunar eclipse.

The Venus Tablet contains data on first and last visibilities of Venus during 21 year period believed to correspond to the reign of the king Ammisaduqa. Already since the discovery of Venus Tablet in 1920s, it was clear that the information in the Venus tablet is 'noisy', i.e. is distorted by a number of reasons, namely, the text is incomplete, wrongly copied, obscured, unreadable, etc. Therefore there were both - claims on the impossibility of extracting of reliable information from the Venus tablet (e.g. Reiner and Pingree) [2], and attempts to construct the chronology based on Venus Tablet (Huber) [3]. By interesting coincidence precisely at the same period of work on the Venus Tablet, one of us (V.G.G.) was working with S. Torres on the analysis of the data 2 obtained by the COBE satellite (NASA) on the anisotropy of Cosmic Microwave Background radiation with ratio (signal/noise)=2. We detected a thiny signal of a theoretically predicted effect of anisotropy behavior, indicating probably the negative curvature of the Universe [4]. The noise there was of Galactic, interplanetary, atmospheric, instrumental, etc. origin and was removed/simulated by Monte-Carlo scheme and special codes. Applying actually the same statistical scheme for the data of Venus Tablet of Ammisaduqa we failed to detect a statistically significant 'signal' of any chronology, thus ruling out the possibility to use the Venus Tablet at least for this aim directly, except the fact of the correspondence of Ammisaduqa year 1 to 8 year Venus cycle. In other words Huber's probability calculations [3], though heuristically interesting, do not define any preferable chronology with respect to a null hypothesis. Schaefer [5] also claimed to be cautious with the probability estimations made by archaeoastronomers, explaining why even 3-sigma calculations can be not true. Then, however another interesting problem is arising for the future investigations, namely, to try to analyse the nature of that noise of the Venus Tablet, i.e. to reveal the systematic errors by the scribe, of its subsequent copiers, etc.

Besides the Venus Tablet, we used the data of lunar eclipses of Ur III. The predicted eclipses - of 27 June, 1954 BC, and of 16 March, 1912 BC or of 6 March, 1911 BC, not only fit by their main characteristics the descriptions of the eclipses but also satisfied the textual evidence for the time span between these events - death of king Sulgi and the fall of Ur.

The picture was completed by the use of the newly discovered text of Tell Muhammad, since it mentioned also a crucial formula - namely, the lunar eclipse occurred at year 38 that Babylon was resettled. It was possible to locate also this eclipse: 16 May, 1459 BC. Textual evidence on the periods of reigns of kings Samsutidana and Ammisaduqa, enabled to link self-consistently the sequence of the events both of Ur and Babylon.

Several words about the accuracy of the eclipse predictions. There are principal problems with both – high accuracy observations and the theory of planetary perturbations. Thousands of observations during decades of occultations of stars by the Moon, and especially via the Lunar laser ranging due to Apollo program, enabled to analyse up to some limiting accuracy the role of various effects – the variation of the rate of Earth's rotation with respect to the international atomic time scale, as well as the dynamics of the Lunar orbit with respect to the role of principal perturbations by Sun, Venus, Jupiter, etc. (see e.g. [6] for an account of modern perturbation theory), the secular shift of the dynamical equinox, etc. The perturbations are responsible for numerous effects up to chaos and unpredictability in the motion of planets, as revealed by Laskar [7] and others by means of frequency map technique. Particularly, a glance on the perturbation theory formulae, is enough to realize that it is naive to speak on accuracy of several minutes, as for example, does Koch [8], while analysing the Ur III eclipses. Indeed, the effect of increase of the period of rotation of Earth is well established since the measurements of the Moon acceleration, Nordtvedt effect via the laser ranging [9]. This yields about 26 seconds per century for present rate of correction for lunar ephemeris [10]. Stephenson and Morrison have shown that this implies a mean stationary rate of day lengthening about 1.7 ms per century during the last two millennia at least, while, say core-mantle effects can lead to more longer-term variations. They had also established that although the cubic formula more closely fits the clock error for the eclipses, the relation $\Delta T=31\ t^2$, gives discrepancy only about 500 sec up to some 2500 years time span; while the tidal parabola widely used at calculations, fits rather poorly. Though no trace for second millennium time delay error box is known definitely, assuming that for Ur III epoch the same rate of period variation of Earth remains marginally valid, we will have a time delay of about 2 hours for the eclipses with respect to those predicted by the standard codes used by Koch. Then obviously the eclipses will fit the watch time better, being above the horizon, etc. This example is clearly showing that any slight change of the above rate will influence the delay time. Therefore the numbers given in the [1] are the earlier limits for the eclipses but can never be considered literally within the accuracy of minutes or degrees. The higher order members in perturbations and highly accurate initial data (given the existence of non-zero Lyapunov numbers and hence of positive Kolmogorov-Sinai entropy), and not only standard codes or eclipse 'canons', should be consulted in such cases. The eclipses mentioned above [1], thus fit the best the set of the available data within the modern planetary perturbation theory and the constraints on inaccuracies established experimentally at present, and therefore the chronology based on them has to be considered as the most probable one.

The revealed low chronology is already supported by the study of Terqa glyptic materials, i.e. by the data of about 160 seals of Terqa, Babylonian, Mitannian and Kassite styles [11]. There is an independent evidence from Egyptian sources again supporting this low chronology [12].

Thus, every piece of evidence with historical significance from the Near East civilizations belonging to the earlier part of the second millennium and dated directly or indirectly by reference to Babylonian chronology have to fit this new chronology. This includes evidence for the relevant Elamite dynasties, Old Hittide Kingdom, the Levant in the Middle

Bronze Age, and the Second Intermediate Period in Egypt.

We are thankful to M.Gerber, J.Laskar, R.Krauss and K.Nordtvedt for valuable discussions.

REFERENCES

1. H. GASCHE, J.A. ARMSTRONG, S.W. COLE and V.G. GURZADYAN, *Dating the Fall of Babylon. A Reappraisal of Second-Millennium Chronology*, Mesopotamian History and Environment, Series II, Memoirs IV, (Ghent and Chicago, 1998).

2. M. REINE, D. PINGREE, *Babylonian Planetary Omens. Part I. The Venus Tablet of Ammisaduqa*, (Malibu, 1975).

3. P. HUBER, in *High, Middle or Low?*, (Gothenburg, 1987).

4. V.G. GURZADYAN and S. TORRES, *Astronomy and Astrophysics*, 321, (1997), 19;

5. B.E. SCHAEFER, New Methods and Techniques for Historical Astronomy and Archaeo-astronomy, these proceedings.

6. G. A. GURZADYAN, *Theory of Interplanetary Flights*, (London, 1996).

7. J. LASKAR, F. JOUTEL and P. ROBUTEL, *Nature*, 361, (1993), 615; J. LASKAR, Chaos and Organization in Solar System, in *The Chaotic Universe*, ed. by V. G.Gurzadyan and R. Ruffini, (New York, 1999) (in press).

8. J. KOCH, News on the Ur III Lunar Eclipses, *NABU*, 4, (1998), 126.

9. J. O. DICKEY et al, *Science*, 265, (1994), 482.

10. F. R. STEPHENSON, *Historical Eclipses and the Earth's Rotation*, (Cambridge, 1997); F.R. STEPHENSON and L.V. MORRISON, *Phil.Trans.Royal Soc.*, 351, (1995), 165.

11. G. GUALANDI, Terqa Glyptic Data Highly Support the Low Chronology, *NABU*, 4, (1998), 133.

12. R. KRAUSS, 1999 (private communication).

THE WHOLE COSMOS TURNS AROUND THE POLAR POINT: ONE-LEGGED POLAR BEINGS AND THEIR MEANING

Michael Rappenglück
Emmering, Germany

Since paleolithic times many ancient cultures had created the conception of the one-legged beings. These are animals, human beings, gods or hybrid beings with one leg oversized (unipedes, monoskeleis, monokolai, skiapodes). Such beings are familiar to us from pictures, symbols, myths and fairy-tales world-wide. Some of them can be understood and explained in the light of astronomy.

From paleolithic epochs come several handy staffs, which are topped with the figures of different animals (Figure 1 A, B, C, D; Figure 3, A, C). Throughout the world from ancient times and even today shamans have erected figure-posts, crowned by animals (Figure 3 A, C, D, E; Figure 4, A, B). Among creatures perched on the rod we find bears, birds, bovines, elks, horses, reindeers, snakes, stags or turtles.[1] Mostly birds are put on the staffs. These in particular could be eagles, ravens, chicken, cuckoos, cranes, quetzals or other kinds. Sometimes they simply stood upright on the ground, sometimes they were inclined with a determined angle and aligned to a particular direction. There existed handy forms of them (Figure 1; Figure 4, C). In some cases the animal figure looks like being impaled by the staff or post (Figure 3, A, C, D). In others the

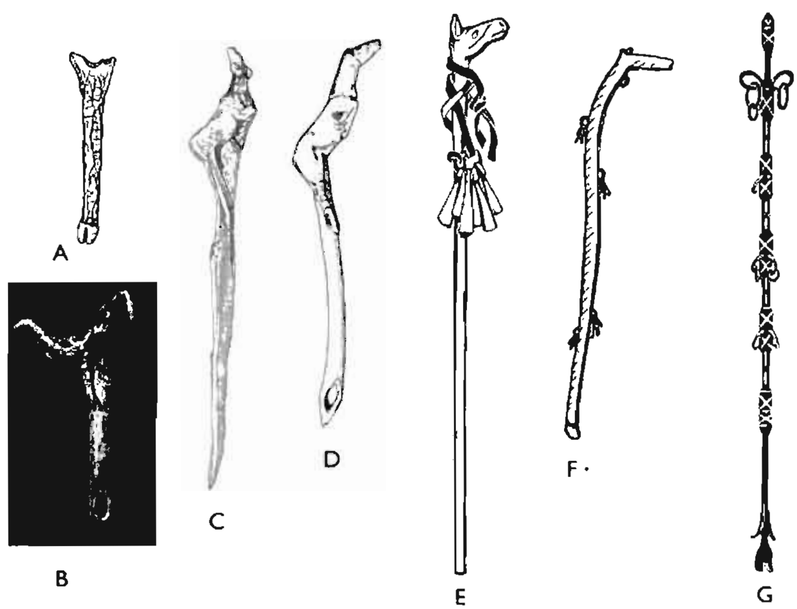


Figure 1: (A) A broken animal-sceptre ending in one single foot coming from the Abri Brunqiuel (Dép. Tarn-et-Garonne, France), Magdalenian Epoch about 16,000-12,000 BP (J. Ozols, op. cit., 9, fig. 1) / (B): Rod with the sculpture of a black grouse from the Grotte du Mas-d'Azil (Com. Le Mas-d'Azil, Dép. Ariége, Rég. Midi-Pyrénées, France), Magdalenian IV, about13,000 BP (after W. Torbrügge, Europäische Vorzeit (München, 1969), 31) / (C) An animal-sceptre found in the Abri Laugerie-Basse (Les Eyzies-de Tayac, Dép. Dordogne, France), Magdalenian, about 16,000-12,000 BP (H. Müller-Karpe, op. cit., pl. 79, 10) / (D) Another animal-sceptre coming from the Abri Brunqiuel (Dép. Tarn-et-Garonne, France), Magdalenian Epoch about 16,000-12,000 BP (H. Müller-Karpe, op. cit., pl. 13, 20) / (E, F, G) Shamans batons with an animals head at one end and sometimes an animals foot at the other end (J. Ozol, op. cit., 11, fig.)

legs of the living being are stretched, narrowed and united in the rod (Figure 1, C, D, F; Figure 2, A, B), which then appears as only one oversized leg. Common to all forms of the figure-staffs is the emphasize of the supporting and/or impaling stick or staff, which reminds oneself of a monopod.

All over the world in myths and rites legs illustrate stability, firmness and the ability to raise up. Reducing the two legs to only one symbolizés the increasing power and the possibility of rotation. A unipod being can easily spine or dance around itself. Leg and foot contain a particular vital force and creative power. Therefore they often have phallic sense and are divine or demoniac.[2]

These monopod figures express a cosmic meaning, as it can be proved by symbols, myths and rites worldwide and since paleolithic epochs. Some examples may explain this idea.

In some Indian myths ajá ekapâda[3], is "the one-footed He-goat". He supports the sky. In doing so, his sole leg and bright foot serves as the cosmic pillar, holding apart the paired spheres of the universe.

The one-legged goat symbolizes the primordial matter, water, fire, man, soul, and power of the cosmos. Ajá ekapâda is also known as apam napât, the "child of the water" or the god in the cosmic ocean and related to Ahi Budhnya, the serpent in the depth, a kind of a water monster. The body of the chimera represents the whole cosmos. The breast is assigned to the earth, the back to the sky, the center to the area of the air, the sides to the cardinal directions, the hips to the oceans. Earth and sky are founded on ajá ekapâda. The monopod being establishes the six cardinal directions and areas of the cosmos. The one-legged goat is related to skambhá the pillar of the universe, it´s polar axis. Skambhá also is yupa, the post of the sacrifice and the thrown thunderbolt vajra (the Greek keraunós), which embodies the year und serves as an instrument to regulate the calendar. Where the divine thunderbolt penetrated in the ground, originates a system of spatiotemporal order. So the one-legged goat not only marks the polar axis, but also the whole system of meridians, in particular the colures. This is the framework of the universe, to which all phenomena and movements are related.

The human being, often equivalent to the goat, is also linked with this universal framework. On that account a meditating person tries to assimilate this cosmic structure. In yoga a posture named ekapâda-asana (the one-legged posture), help to improve the sense of balance by poor concentration. Standing upon one leg only, the other leg and the arms are extended parallel to the ground.

The Indian god Siva is one-legged (ekapâda) too. Sometimes one of his legs ends in a pedestal instead of a foot. The base represents the cosmic axis in form of a pillar like phallus (linga). This strange posture reminds us strongly of a mythical figure from another far away culture: the Aztec god Black Tezcatlipoca with his amputated leg (Figure 2, A, B). This will be considered later on. Sometimes Siva is sitting upon and rotating around his phallus (linga), which is both the axis of the universe and the sexual organ of the sun as creator.

Figure 2: (A) The Aztec god Black Tezcatlipoca with his amputated leg (Staal, op. cit., 88) / (B) The Indian god Śiva is one-legged too. Sometimes one of his legs ends in a pedestal instead of a foot. The base represents the cosmic axis in form of a pillar like phallus (E. Schlehberger, Die indische Götterwelt: Gestalt, Ausdruck und Sinnbild. Ein Handbuch der hinduistischen Ikonographie *(Köln, 1986), 106) / (C) The Egyptian one-legged constellation meshketiu, Epoch of the Roman Empire (M. Rappenglück, op. cit. (ref. 2), 152, fig. 144).*

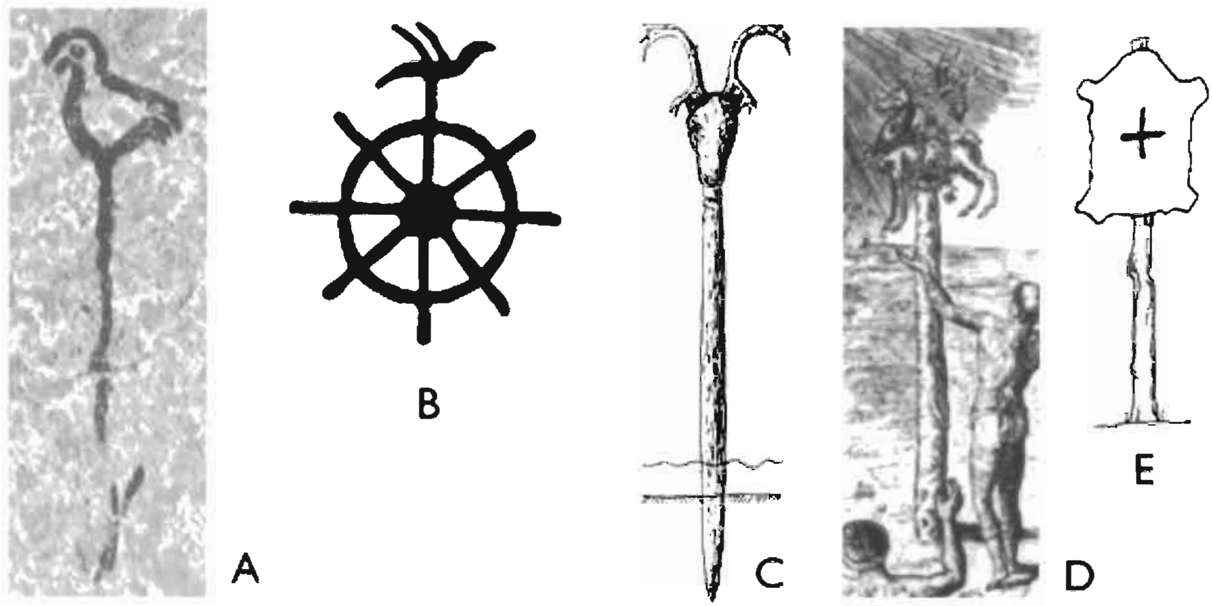


Figure 3: (A) A bird, probably a wood or black grouse put on a stick, from the scene in the shaft of the Lascaux grotto, about 16,500 BP (M. Rappenglück, op. cit. (ref. 2), 93, fig. 76) / (B) A bird placed on a stick, which marks the meridian line. Drawing from a shamans drum of the Keten natives (M. Rappenglück, op. cit. (ref. 2), 173, fig. 162) / (C) A cranium with the antler of a reindeer placed on a pole, found at Stellmoor, Germany, about 12,000 BP (after W. Müller, op. cit. (ref. 2) pl. 21, 1) / (D) A stag put on a staff during a ceremony of the Timukua natives, Florida (after W. Müller, op. cit. (ref. 2), pl. 21, 4) / (E) A post with a hanging skin of a stag during a ceremony of the Winnebago natives (after W. Müller, op. cit. (ref. 2), pl. 21, 3).

Standing at the pivotal point of the cosmos, ajá ekapâda arises not only from the primeval water, but also generates the primordial fire (agni) of immortality and embodies it. That is the meaning of the phrase "to kindle the fire at the top of the world ". So the one-legged goat symbolizes the cosmic procreative power. As it will be shown later on, a particular property of monopod beings is to create and maintain the fire in the universe. According to the mythic language, fire means energy of motion, rotation, and transformation. Thus, it is understandable, that ajá ekapâda is equated with the sun (Agni-Surya). The chimera illustrates both, the origin of the cosmic fire at the sky pole, the centre of rotation and its distribution in the fixed and wandering stars, as well as in the Milky Way.

Ajá ekapâda is related to the younger idea of ekacakra ("one wheel"), on which all beings are set. This is a good picture for the revolving circle of the zodiac and the moving sun within. Depiction of striking likeness come from the ancient Egyptians, Germans, Greeks, and Hittites: There horizontal lying wheels were found, with a projecting vertical axle, which carries an animal or its head, a bird (often a duck), a cow, a goat, a horse or a ram.

According to Indian myths the golden sun is the head of a cosmic being with one leg only. With this the waters are pulled up. It is the image of a waterspout. So to be on-legged is a feature of the wind, the cloud, and the ray of light. The monopod sun as an aspect of the primordial fire of the sky pole, generated by the unipod pivot of the universe, inseminates the earth. Both, the one leg of the cosmic axis and that of the sun possess phallic, procreative, and transforming powers. This idea is shown in the Siamese ceremony of ploughing: A man had to stand on one leg only in the field, while the ploughs are moving in circles around him. He embodies the polar axis and the polar constellation, around which the sky and the wandering stars rotate.

Finally the goat attached to the holy cosmic pillar is killed, impaled and roasted. In that way other living beings, for example a horse, a ram or a man is immolated. Later on it is shown, that this ritual renews the primordial and cosmogonic sacrifice at the world axis and may be derived from shamanism since paleolithic times.

The goat as a heavenly polar being may be found in the field of today's constellation Lyre. The Sumerians and Babylonians named the star Wega UZA (= UZ) the "goat" (mu-ul-ú-za), the Accadians ^{mul}UZA = enzu "goat-star". They recognized the picture of an upright standing goat there at this point in the sky.[4] If this idea could be further substantiated, the picture of the one-legged goat would be dated back to the Magdalenian epoch, about 12,000 BP.

The figure of ajá ekapâda bears a strong resemblance to the ancient Norse god Heimðallr.[5] He, "who shines all over the world" is the head of a ram, topped on pole, which is inclined to the northern sky pole. Thus Heimðallr looks like a monopod being. The post is named Heimdolde, the world-tree. Heimðallr is the son of Mundilföri, meaning "he, who turns the pivot". Other names of the god are Hallinskidhi, denotating "forward leaning log or post" and Vindlér, meaning "turning around helically". Heimðallr is characterised as a form of a surveyor´s rod. The head of the ram is denoted as "a measure", which watches over the intersection of the ecliptic and the celestial equator. Thus he forms the centre of a reference system, a framework of the universe. In this function he regulates and rules the changing cosmos and determines fate . Heimðallr´s stronghold, which is the motionless pole of the sky, is said to be located near the cosmic bridge Bifröst (Bilröst). This name probably denotes the Milky Way, but perhaps the rainbow too . If it is right to identify the bridge with the Milky Way, Heimðallr´s castle may be related to the constellation of the Lyre, standing at the northern sky pole, 12,000 BC, just as the Indian ajá ekapâda.

A stronghold turning on a pole, looking like a gigantic monopod, is familiar to us from some Hungarian, Polish and Russian fairy-tales.[6] There the home of mother Bába turns on an axis, which is shaped like a single leg and foot of a bird, mostly a chicken, a goose or a swan. A Japanese myth shows a similar motive. And in Hungary the residence of the gods, in the uppermost center of the sky, is a large castle, turning around on a broad foot of a duck, which is fixed on the ground. The revolving house represents the whole sky or in particular the constellation at or nearby the celestial pole. Mother Bába is associated with the creation of fire by a fire-drill and the transport of the fire by the sun. She too is related to the spinnnig and weaving of flax. That is because the revolving of the stars around the polar axis, in particular the wandering ones in the ecliptice, reminds some one of a spinner at work. The layed out yarns form something similar to a celestial grid, containing all the important astronomical circles and points. The spindle represents the polar axis. And the net is the whole universe. In German fairy-tales Bertha and Mother Hulda show similar attributes.

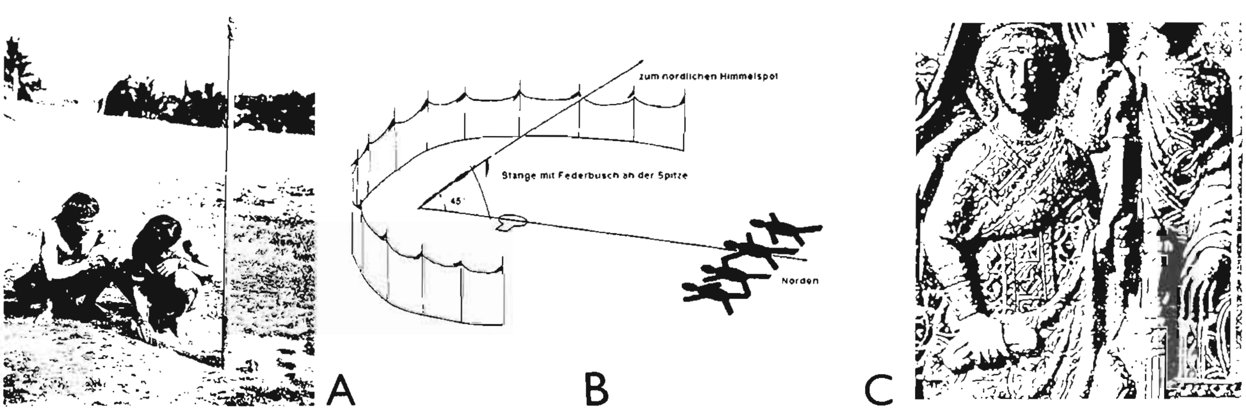


Figure 4: (A) The Kendayan-Dayak at Borneo (Kalimantan) determine the high of the sun with a shadow-stick, crowned by a sculpture (M. Rappenglück, op. cit. (ref. 2), 184, fig. 169) / (B) During Waxthexe xigithe, the "ceremonial of renewing", Waxthexe, the "holy post" of the Omaha-Sioux is inclined and aligned to the northern sky pole (after E. C. Krupp, op. cit., 285) / (C) Consul Magnus (Eastern Roman Empire, 518 CE) holds a bird-sceptre in his hand (M. Rappenglück, op. cit. (ref. 2), 242, fig. 240).

All over the world the Big Dipper which in some epochs is a polar constellation is identified with a one-legged animal:[7] In Egyptian and Sumerian myths it is the sole thigh of a bull (Egyptian: meshketiu), or the entire animal narrowing into a pole (ill. 4, C). The god Mithras of the mysteries shoulders or brandishes a haunch from a bovine. Once again it is the constellation of the Big Dipper. In China it is a one-legged ox without horns, the monster k´weihsung or k´uei. Comparable to ajá ekapâda it arises from the water and makes the clouds, the rain, and the thunder. The beast is killed – that´s the sacrifice in the beginning of the cosmos. From its skin, depicting the vault of heaven, a drum is made. That is clearly a shamanistic conception. The same idea is handed down by the Sumerians. The native people in Northern Asia, Northern America, and the Arctic recognize the constellation of the Big Dipper as a single leg of an elk, stag or reindeer. These animals, especially their big skins, were partly related to the today constellation Cassiopeia partly to the Big Dipper by the indigene people of Asia. The Sumerians and Babylonians located there a stag ^{mul}LU.LIM. At that place the Norse saw there the antlers of Eikthymir, the gigantic cosmic stag. Some natives in Northern America and Northern Asia put the head and antlers, with, or without the skin of a stag, on a post. That is a symbol of the polar axis with the primordial fire and light whirling round, the course of the year (connected with the solstices and equinoxes), the cardinal directions, the creation and creator. The origin of this concept may be dated back to paleolithic times: The cranium with the antlers of a reindeer placed on a pole was found at Stellmoor, Germany (about 12,000 BC). Not least in Northern America, Northern Asia and Northern Europe the bear takes over the place of the other animals mentioned above. Sometimes it is also a horse that is put on the post.

There are also monopod gods, often injured in a battle, like the Norse Völunde, the Indian Drhuva or the Aztec Tezcatlipoca embody the Pole Star or the polar constellation, mostly the Big Dipper.[8] The natives of South America tell of similar unipods: The Yaruro hero Pettipuni ("lost leg") came down from heaven to earth to drink water from a river. There a crocodile bit off one of his legs. Pettipuni returned to the sky. There he was seen as today's constellation of the Big Dipper. In North America the Kato (Dene) god of thunder stood on a sole leg and foot during the creation of the universe. In Central America the monopod Aztec god Black Tezcatlipoca ("smoking mirror"), corresponding to another god Mictlan-Tecuhtli ("cloud serpent"), the lord of the underworld, came into existence in the centre of the cosmic cave. He represents and rules the northern night sky. There all things and living beings are created. Tezcatlipoca lost his left feet battling with the earth monster cipactli ("crocodile"). The stump ends in a smoking mirror, or a serpent. Tezcatlipoca is turning around his amputated leg, which is fixed to the centre of the northern sky, the Pole Star or the polar constellation. Usually the god is associated with today's constellation of the Big Dipper. Sometimes Tezcatlipoca is repesented by only one leg inserted in an articular cavity and a head showing a small, smoking fire-socket. The rotating leg causes smoke, rain, and storm. Tezcatlipoca then takes the fire-drilling gods place, who lives in the centre of the cosmos. The leg turning in the socket corresponds to the drilling of an shaft or reed in a wooden board.

Finally rites, myths, and pictures of people all over the world show that a pole crowned by a bird refers to the star, or constellation at the sky pole of a given epoch.[9] The huruqan tucur of the Qu'iche and Cakchiquel in Central America is the "one-legged owl and soul of the sky", related to the underworld, the polar axis and constellation. This monopod bird causes the heavy cyclons, the Hurricanes, which are named after him. The Natives in South America also know one-legged birds, related to the constellations, in particular such near the poles of the sky. The Kadiueu, for example, tell of the single leg of a bird Agô-nagêna (the "missing leg"), which in primeval time was ripped off: It is to be localized in today's constellation Southern Cross. In Asia the Buriats shaman spirit-helper is the ongon, a bird topped on a staff, looking like a monopod bird. This chimera is related to the stars near the northern sky pole. The hitherto eldest example of such a one-legged polar being, a "bird-stick", is to be found in a rock-picture in the Lascaux Grotto in France (Figure 3, A). My detailed analysis, presented in my doctoral thesis but to extensive to be explained here, proves, that at the Magdalenian epoch 16,500 BP the pictured monopod bird pointed to the star 18 · δ Cygni, which at that time was an excellent Pole star. An impressive three-dimensional bird-sceptre coming from Mas d´Azil (Figure 1, B) grotto substantiates the paleolithic origin of the concept of the one-legged polar beings.

As shown before, the polar axis can be represented by only one colossal leg and foot, the pivot leg.[10] It is part of the body of a gigantic celestial creature. Often the leg could be substituted by a column, a cross, a human being, a mountain, a mushroom, a nail, a phallus, a pillar, a pole, a plug, a rod, a sceptre, a temple or a tree, always crowned by the beast, mostly a bird. The animal on top of the staff may be represented abstractly, by a part of its body, for example tufts of feathers instead of the bird itself. The examples of figure-posts are numerous. They are often aligned with the cardinal directions, in particular with the meridian line. They are frequently set at an inclination, so that the top points in a straight line to the sky pole, as an example from the Omaha in North America shows. The monopod cosmic beeing is a framework of the universe, possessing cosmologic and cosmogonic functions.

One-legged figures and dances are typical of shamanistic cultures.[11] The proper name for such kind of rod is "hobbyhorse". This figurative expression very well illustrates shamanistic traditions, as the archaic background of the one-legged polar beings since paleolithic times. The shaman puts the sculpture or the real body of an animal, in that case of a a horse, on top of a staff. It will be his spirit-helper. While in a state of ecstasy, the shaman´s soul turns itself into an animal, often a bird. Then with this spirit-helper he travels along the polar axis and between the various connected regions in the cosmos to the poles of the sky. There the shaman finds the place, where the creation of the cosmos had begun, where all energy is concentrated and by drilling of the axis spreads helical up and down. The areas of the space are filled with primordial fire and water, manifesting itself as lightening and thunder, clouds, rainbow and Milky Way. They hold the universe in rotation and changing. In the uppermost region the shamans meet the original lords of beasts, a kind of cosmic totem animal, regarded as celestial archetypes of all living beings or objects on earth, represented in the constellations nearby or at the pole. These cosmic totem beings give them advice on problems, which the members of their community have to overcome. The Pole Star itself was considered to be a mighty lord of animals and a supreme divinity. Like the stars circling around the pole star, human beings rotate around the center of creative energy, as represented by a religious and political ruler such as a shaman, a priest, a chief or a king. Shamans view the pole star and the circumpolar constellations, showing the rotating sphere of heavens. With the help of this impressive picture, they could meditate on the changing cosmos and concentrate their powers. Worldwide Shamans and sovereigns used the animal-staffs to contact the supreme powers at or nearby the pole of the sky.

The one-legged polar being pin points the origin of a reference system, which encompasses all the phenomena in the universe. Setting the leg establishes the cosmic structure, breaking it off, causes damage to the whole cosmos. That is why all over the world the monopod beings are often denoted as guardians of the world axis. [12] There exists the conception of eight such constellations, which turn and govern the sky pole in the course of the millennia . In the course of the epochs the stars and constellations at or near the northern and southern sky pole change because of the precession. So in terms of an archaic conception different celestial beings, mostly animals, succeeded one another above the apparently immovable polar axis, which appears to impale them. Therefore, the ruling guardians are established and deposed in the course of time. Often astral hunting scenes explain this overthrow. A big celestial animal, a bear, a bird, a bull, an elk, a horse, a stag, a reindeer, sometimes a human being representing the specific constellation at the sky pole and therefore the entire universe is killed. His body is torn in pieces, which are scattered near the sky pole and the ecliptic. That is a hint on the meaning of some of the amputated constellations at the sky. With this sacrifice the creation and recreation of the world and of human culture is associated. All things grow from the parts of the animal's or man's body. To preserve the cosmos, shamans worldwide, at the turn of the year, immolate animals at the foot or top of the cosmic post.

Finally, what then is the background of the one-legged polar beings? The solution may be, that since palaeolithic times the traditions of the people have handed down a mythical encoded, astronomical instrument, a sundial, in particular in its polar version. In this case all discussed elements of the cosmic monopods make sense: The shadow-stick crowned by a figure (Figure 4, A) and pointing to the pole of the sky represents the single leg with the polar constellation. Around this the whole cosmos and the sun are whirling, expressing the procreative power of cosmic fire. So the one-legged polar beings really establish and maintain the framework of the universe.

NOTES AND REFERENCES

1. M. RAPPENGLÜCK, *Cosmic Turtles and Tortoises - An Ancient Symbol of Cosmology, Cosmogony and of Human Evolution.* Paper presented on the Vth SEAC Meeting "Astronomy and Culture", 2-5 September, Gdansk (Polonia), 1997 (1); *Eine Himmelskarte aus dem Eiszeitalter? Ein Beitrag zur Urgeschichte der Himmelskunde und zur paläoastronomischen Methodik, aufgezeigt am Beispiel der Szene in "Le Puits", Grotte de Lascaux, Com. Montignac, Dép. Dordogne, Rég. Aquitaine, France* (Frankfurt a. M., Berlin, New York, Paris, Wien, 1999) (2).

2. J. LINDSAY, *The Clashing Rocks. A Study of Early Greek Religion and Culture and the Origins of the Drama.* London, 1965, 332-333; BÄCHTHOLD-STÄUBLI (Eds.) "Artikel Fuß", in *Handwörterbuch des Deutschen Aberglaubens* (Berlin, Leipzig, 1927-1942), Sp. 224-227 and Artikel Pertha, Sp. 225-226, 1478-1486.

3. For references reloting to ajá ekâpada see A. SNODGGRASS, 1985 The Symbolism of the Stupa (New York, 1985), 146, 166, 167; P. HORSCH, "Aja ekapâd und die Sonne", *Journal of the American Oriental Society* 53 (1933): 1-31; G. DE SANTILLANA and HERTHA VON DECHEND, *Die Mühle des Hamlet: Ein Essay über Mythos und das Gerüst der Zeit.* (Berlin, 1993), 144-145 and 213, Fn. 25

5. W. HARTNER, *Die Goldhörner von Gallehus: Die Inschriften - Die ikonographischen und literarischen Beziehungen - Das Entstehungsdatum* (Wiesbaden, 1969), 63; B. L. VAN DER WAERDEN, Erwachende Wissenschaft. Band 2: Die Anfänge der Astronomie (Basel, Boston, Stuttgart, [2]1980), 297.

6. HORSCH, op. cit., 25; RAPPENGLÜCK, op. cit. (ref. 2).

7. For references relating to this paragraph see RAPPENGLÜCK, op.cit. (ref. 2), 107 and Fn.247; BÄCHTHOLD-STÄUBLI (Eds.), op. cit., Sp. 225-226, 1478-1486; N. NAUMANN *Die Mythen des Alten Japan* (München, 1996), 176, 183; O. ZERRIES, *Wild- und Buschgeister in Südamerika - eine Untersuchung jägerzeitlicher Phänomene im Kulturbild südamerikanischer Indianer* (Wiesbaden, 1954), 279.

8. For references relating to this paragraph see RAPPENGLÜCK, op. cit. (ref. 2), 14-155; Ch. ZHENG, *Mythen des alten China* (München, 1990), 80; DE SANTILLANA and VON DECHEND, op. cit., 126, 294, 294 (Fn. 116) and Appendix 34; I. LUCHTERHAND, *Der Kosmos – ein Spiel? Gespielter Kosmos: Symbolik im kosmischen Sonnenjahr mit dem Welthaus des Menschen* (Horn, Kassel, Wien, 1994), 232; HARTNER, op. cit., 53-54, 58, 107, 237; VAN DER WAERDEN, op. cit., 71, 73, 75, 295; W. MÜLLER, *Die Religionen der Waldlandindianer Nordamerikas* (Berlin, 1956), 142-155, 265, 274-275, 288-294, 320-321 (1), *Amerika - die Neue oder die Alte Welt?* (Berlin, 1982), 95-105 and Tafel 21, 3/4 (2); H. MÜLLER-KARPE, *Handbuch der Vorgeschichte. Erster Band: Altsteinzeit* (München, [2]1977), 306 (Nr. 208) and plate 199, 45.

9. For references relating to this paragraph see NUTTALL, 1902: 495-496; DE SANTILLANA UND VON DECHEND, 1993: 126, 294 and Fn. 116; W. KRICKEBERG, *Märchen der Azteken und Inkaperuaner. Maya und Muisca* (Düsseldorf-Köln, 1968), 284; M. MILLER and K. TAUBE, *The Gods and Symbols of Ancient Mexico and the Maya. An Illustrated Dictionary of Mesoamerica Religion* (London, 1993),114, 164-165, 286-287; H. WIRTH, 1936 *Die heilige Urschrift der Menschheit. Symbolgeschichtliche Untersuchungen diesseits und jenseits des Nordatlantik. Band I: Text.* (Leipzig, 1936), 280, 762; E. C. KRUPP, *Beyond the Blue Horizon: Myths and Legends of the Sun, Moon, Stars and Planets* (New York, 1991), 70-71; W. MÜLLER, "Raum und Zeit in Sprachen und Kalendern Nordamerikas und Alteuropas. Der altmexikanische Kalender", *Anthropos 74* (1979), 455, 457; ZERRIES, op. cit., 280-282, 327.

10. For references relating to this paragraph see RAPPENGLÜCK, op. cit. (ref. 2) ; J. OZOLS, "Zur Frage der paläolithischen Lochstäbe", *Kölner Jahrbuch für Vor- und Frühgeschichte.* (1974), 9-16; KRICKEBERG, op. cit., 127; W. DANCKERT, "Musikgötter und Musikmythen Altchinos", *Zeitschrift für Ethnologie*, 88,1 (1963), 31; Z. NUTTALL, *The Fundamental Principles of Old and New World Civilizations: A Comparative Research Based on a Study of the Ancient Mexican Religious, Sociological and Calendrical Systems* (Salem, Massachusetts, 1901), 401; H. WIRTH, *Der Aufgang der Menschheit. Untersuchungen zur Geschichte der Religion, Symbolik und Schrift der atlantisch-nordischen Rasse* (Jena, [2]1928), 160, ZERRIES, op., cit., 282; B. Péret, *Der Mond der Zapparo: Mythen und Märchen Amerikas* (Hamburg, 1994), 23-24.

11. For references relating to this paragraph see J. C. COOPER, *Illustriertes Lexikon der traditionellen Symbole.* (Wiesbaden, 1986), 23; RAPPENGLÜCK, op. cit. (ref. 2); J. D. W. STAAL, *The New Patterns in the Sky. Myths and Legends of the Stars.* (Blacksburg/ Virginia, 1988), 88.

12. LINDSAY, op. cit., 333; U. HARVA, *Die religiösen Vorstellungen der altaischen Völker* (Helsinki, 1938): 334-345; M. ELIADE, *Schamanismus und archaische Ekstasetechnik* (Frankfurt a. M., 1975), 430-433; D. EVERS, *Felsbilder arktischer Jägerkulturen des steinzeitlichen Skandinaviens* (Wiesbaden, 1988), 67 and "Från stav med djurhuvud", *Adoranten* (1994), 17-23.

13. For references relating to this paragraph see RAPPENGLÜCK, op. cit. (ref. 2), 184-188, 269-270; A. V. GOLOVNEV, "From one to seven. Numerical Symbolism in Khnaty Culture (translated by Sergei Khan)", *Arctic Anthropology* 31, 1 (1994): 69; M. R. FRANK, "Hunting the European Sky Bears: When Bears Ruled the Earth and Guarded the Gate of Heavens", in *Astronomical Traditions in Past Cultures: Proceedings of the First Annual General Meeting of the European Society for Astronomy in Culture (SEAC) Smolyan, Bulgaria, 31. August - 2. September 1993* ed by D. Kolev and V. Koleva (Smolyan, 1994), 116-142. "Hunting the European Sky Bears; the Vision, Quest, Ritual, Landscape and Ceremonial Path-way of Little Bear Hartzkume" in *Summaries of the Invited Discourses and Oral Presentations. 5. Congreso Internacional "Astronomia en La Cultura", (SEAC) Salamanca, Spain, 3 - 6 September 1996*, 16-17; M. R. FRANK and J. ARREGI, "Ethnological Approach to the Origin of the Non-zodiacal Constellations", in *Summaries of the Invited Discourses and Oral Presentations. 5. Congreso Internacional "Astronomia en La Cultura", (SEAC) Salamanca, Spain, 3 - 6 September 1996*, 5-6; DE SANTILLANA und VON DECHEND, op. cit.; N. ELIADE, *Die Religionen und das Heilige. Elemente der Religionsgeschichte* (Frankfurt a. M. 1986), 154; W. MÜLLER, op.cit. 265, 275, 323-324; A. F. ANISIMOV, *Kosmologische Vorstellungen der Völker Nordasiens.* (Hamburg, 1991), 16-20, 25

FINDING THE DIRECTION TO MECCA WITH FOLK ASTRONOMICAL METHODS: QIBLA SCHEMES IN A MEDIEVAL YEMENI TEXT BY AL-FĀRISĪ

Petra G. Schmidl
Institute for the History of Science, Frankfurt University, Germany

1. INTRODUCTION

The qibla, the sacred direction towards the Kaaba in Mecca, is of paramount importance in the religion of Islam[1]. Over the centuries several methods were developed for finding it, some of them very sophisticated and exact, some of them more simple and practical[2]. One of the latter is the folk astronomical one described in so-called qibla schemes[3]. In this article a text written by a 13th century Yemeni astronomer named al-Fārisī will be discussed[4].

To understand these schemes it is necessary to describe the basic elements of the folk astronomical method in the following sections.

1.1. The Astronomical Orientation of the Kaaba

The Kaaba in Mecca is the physical focus of the Islamic worship[5]. It is astronomically orientated. The four corners of the rectangular edifice roughly face the four cardinal directions. Its major axis is aligned with the rising point of Canopus, its minor axis with sunrise at the summer solstice[6].

1.2. The Kaaba and the Four Cardinal Winds

In Arab tradition each of the four sides of the edifice is associated with one of the four "cardinal" winds[7]. For al-Farīsī the east wind, the *ṣabā*, blows to the south-east side of the Kaaba; the south wind, the *janūb*, to the south-west side; the west wind, the *dabūr*, to the north-west side; and the north wind, the *shamāl*, to the north-east side of the Kaaba. There are both etymological explanations of this association and astronomical ones[8].

For these winds have astronomically-defined limits also described in al-Fārisī's text. The east wind, the *ṣabā*, blows from between sunrise at the equinox and the rising point of Canopus; the south wind, the *janūb*, from between the rising point of Canopus and sunset at the equinox; the west wind, the *dabūr*, from between sunset at the equinox and the setting point of the three stars in the handle of the Plough; and the north wind, the *shamāl*, from between the setting point of the three stars in the handle of the Plough and sunrise at the equinox[9].

1.3. The World around the Kaaba

Around the Kaaba as the centre of the world the regions of the inhabited world are arranged in sectors. In the Islamic literature from between the ninth century and the 16th century there exist some twenty different schemes with eight, twelve and up to 72 sectors[10]. Al-Fārisī himself uses only twelve-sector schemes, but presents three different examples.

1.4. The Qibla in the Comprehension of the Mathematical and the Folk Astronomical Tradition

The direction to Mecca, the qibla, is defined in the folk astronomical tradition as if one were standing in front of the appropriate segment of the perimeter of the Kaaba, even if one is in a far distant region or city[11]. This is different from the definition in the mathematical tradition, in which the angle between the meridian of any locality and the great circle passing through this locality and Mecca defines the qibla[12]. It is significant that the folk tradition focuses on an edifice, the mathematical tradition on a city defined by its geographical co-ordinates.

2. AL-FĀRISĪ AND HIS WORK

Muammad ibn Abī Bakr al-Fārisī was one of the leading astronomers in the Yemen at the end of the 13th century[13]. He worked for the Rasulid Sultan al-Muẓaffar to whom he dedicated an extensive set of astronomical tables extant in a unique manuscript in Cambridge (*al-Zīj al-Mumtaḥan al-Muẓaffarī*)[14]. Beside this work he wrote a book in the folk astronomical tradition extant in the Biblioteca Ambrosiana in Milan (*Kītab Tuḥfat al-ghārib wa-ṭurfat al-ṭālib fī taysīr al-nayyirayn wa-ḥarakāt al-kawākib* ["The Book of the Curiosity of the Demanding and the Novelty of the Requesting on the Revolutions of the Both Luminaries and the Motions of the Planets"])[15].

This folk astronomical treatise is divided into twelve chapters. They contains information on calendars, on the zodiacal signs and the lunar mansions, the determination of the positions of sun and moon on the ecliptic, and of the ascendant, on time keeping and the determination of prayer times, on first visibility of the lunar crescent, and on the determination of the qibla, the sacred direction of Islam[16].

3. THE QIBLA SCHEMES BY AL-FĀRISĪ

Al-Fārisī's treatise contains three qibla-schemes, two illustrated, and one described in words. The illustrations looks like rosettes with the Kaaba in the centre and every direction on one of the petals[17]. The textual scheme is articulated in short segments. Each sector in these schemes, represented whether petal or segment, represents a single qibla direction, and gives the following information: the cities or regions served by the sector, the qibla direction defined by stars or by winds, and the corresponding segment of the perimeter of the Kaaba.

4. EXPLANATION OF THE METHOD WITH REFERENCE TO TWO SPECIFIC GEOGRAPHICAL AREAS

Two sectors out of the twelve are here chosen to demonstrate how information in these schemes could be used. The specifications given in these three qibla schemes for one sector differ a little, but on the whole they correspond[18].

4.1. Sector I: Parts of Iraq, Iran, and Uzbekistan

The first is for cities al-Fārisī mentions in Iraq: al-Kufa, Baghdad, Hulwan, Qadisiyya, in Khorasan: a part of Iran, Nahawand, Hamadan, Rayy, Nishapur, and, in Uzbekistan: Buchara, Farghana, Tashkent. But only al-Kufa, Baghdad and Hulwan are mentioned in all three qibla schemes.

For this sector the following arrangement of the stars is described in the text and the second qibla scheme: The Pole Star is at the right shoulder, and the rising point of the Plough at the right ear. The text continues: the lunar mansion al-Hanᶜa is between the two shoulders. The first qibla schemes says: the Pole Star is at the right ear, and the rising point of Capella at the spine.

For the winds al-Fārisī says: The east wind, the *ṣabā*, is at the left shoulder.

Further this sector is associated with the north east wall of the Kaaba, from Adam's prayer place to the door. This information yields a qibla direction roughly to the south west. (For a better understanding of this data, see fig. 1).

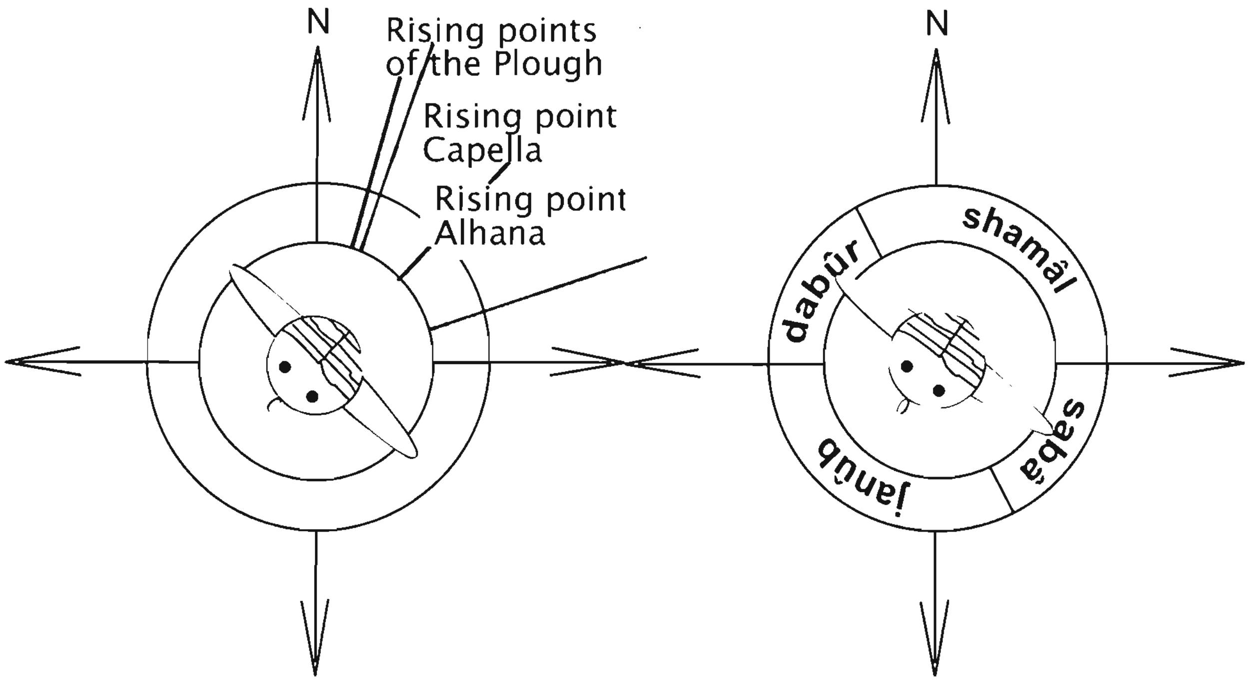


Figure 1. Arrangement of the stars and winds for sector I (parts of Iran, Iraq and Uzbekistan).

To investigate the direction ascertained by folk astronomical methods we can compare it with other textual sources or the mosques and their prayer niches orientated in the qibla. For example al-Bazdawī, a judge in Samarqand in the 11th century, states that the qiblas used there are due west, due south and one towards winter sunset. The Great Mosque in Samarqand is aligned 35° south of west[19].Both correspond with a qibla to the south west find out by al-Fārisī's qibla scheme.

4.2. Sector II: Egypt, North Africa, al-Andalus

The Second is for Egypt, especially Cairo, Aswan, Fustat, Mahalla, Alexandria, and Damietta, a part of North Africa, especially Barqa, Tripolis, and the coast, Sicily, and al-Andalus, and regions in this same direction.

For this sector the text and the second graphical scheme say to the arrangement of the stars: The Pole Star is at the left ear, the rising point of the three stars in the handle of the Plough at the left shoulder. The first graphical scheme says: The rising point of the Pleiades is at the left eye, the setting point of the three stars in the handle of the Plough at the spine.

The arrangement of the winds is described as follows: The north wind, the *shamāl*, is behind the left ear, the west wind, the *dabūr*, behind the left shoulder, and the south wind, the *janūb*, at the right eye.

This sector is associated with the part of the Kaaba which is from the western corner to the golden water-spout, in the middle of the north western wall. This data gives a qibla direction roughly to the south east. (For a better understanding of this data, see fig. 2).

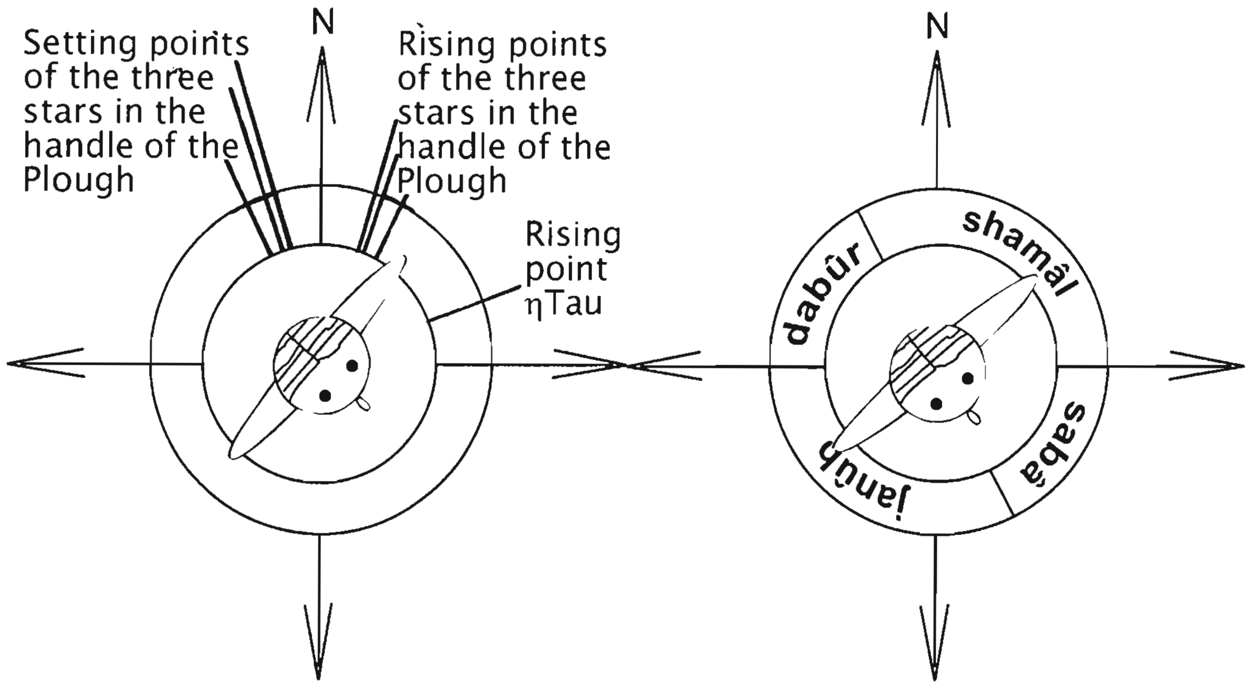


Figure 2. Arrangement of the stars and winds for sector II (Egypt, North Africa, Al-Andalus)

For the purposes of comparison other textual and architectural sources will be useful. al-Maqrīzī, an Egyptian historian of the 15th century, mentions for Cairo a "qibla of the Companions of the Prophet" towards winter sunrise, 27° east to south and a "qibla of the astronomers", 37° east to south. The Mosque of Fustat and the Great Mosque in Alexandria are aligned according the "qibla of the Companions of the Prophet", the Azhar mosque in Cairo and the mosque of al-Ḥākim in Cairo according the "qibla of the astronomers". The Ibn Ṭūlūn Mosque in Cairo uses another direction, 51° east to south[20].

For al-Andalus and the Maghrib we shall find similar statements. A 12th century author al-Murādī mentions for the qibla of Cordoba winter sunrise, 30° south of east. A medieval sundial from Cordoba, now preserved in Granada uses south east for the qibla[21]. The Great Mosque in Cordoba is aligned at 60° south of east, that is parallel to the axis of the Kaaba[22].

For the Maghrib, for example the Saqyah mosque of Marrakesh is orientated due east, the Great Mosque in Tlemcen due south. Further there exists a 14th century sundial from Tunis, which gives the qibla precisely south east[23]. All these statements together support the folk astronomically ascertained qibla to south east, though Egypt, the Maghreb and al-Andalus cover a wide region their qiblas correspond.

5. SUMMARY

Al-Fārisī, one of several authors, describes in his text a folk astronomical method for finding the qibla. He gives basic information on the astronomical orientation of the Kaaba, its association with the four cardinal winds, and the limits of the winds. For finding the qibla he uses rising and setting points of prominent stars, and other well known astronomical phenomena. His method does not use highly developed mathematical knowledge, and it is not so exact. But it is easier to use. This method elucidates another aspect of Islamic astronomy besides the better known mathematical tradition, to a tradition with the Kaaba as the centre of the world, with the various regions arranged in sectors around it. To find the qibla anywhere in that world the schemes – one example is described in this article – uses the winds and horizon phenomena. And unlike other (pre-)historical traditions of which we have only archaeological remains we have in the Islamic tradition not only the mosques, many of them astronomically aligned, but also the texts which tell us why.

NOTES AND REFERENCES

1. This importance is based on the Qur'ān, sura II, verse 136[142]-139[144]: see A. J. WENSINCK, "Ḳibla. I Ritual and Legal Aspects", in *The Encyclopaedia of Islam. New Edition* (Leiden, 1960ff), vol. V, 82f.

2. On methods to determine the qibla see below (note 12).

3. On folk astronomy in general see D. A. KING, "Folk Astronomy in the Service of Religion: The Case of Islam", in *Astronomies and Cultures. Papers derived from the Third "Oxford" International Symposium on Archaeoastronomy* [...], Ed. by C. L. N. Ruggles and N. J. Saunders, (Colorado, 1993), 124-138; on qibla schemes see below (note 10).

4. On al-Fārisī see below (note 13).

5. See A. J. WENSINCK [J. Jomier], "Kaᶜba", in *The Encyclopaedia of Islam. New Edition* (Leiden, 1960ff), vol. IV, 317-322.

6. See D. A. KING and G. S. HAWKINS, "On the Orientation of the Kaᶜba", *Journal for the History of Astronomy*, 13 (1982), 102-109 (reprinted in D. A. KING, *Astronomy in the Service of Islam*, (London, 1993), XII, 102-109).

7. See M. FORCADA, "Rīḥ", in *The Encyclopaedia of Islam. New Edition* (Leiden, 1960ff), vol. VIII, 526f; see also E. W. LANE, "Janūb, in *An Arabic-English Lexicon* (London, 1863ff), vol. II, 467; *ibid.* "Dabūr", vol. III, 847; *ibid.* "Shamāl", vol. IV, 1600f; *ibid.* "ṣabā", vol. IV, 1650.

8. In the medieval sources there are two associations of the winds with the Kaaba one at 90° to the other: see P. G. SCHMIDL, "Zur Bestimmung der Qibla mittels der Winde" in *Der Weg der Wahrheit. Aufsätze zur Einheit der Wissenschaftsgeschichte. Festgabe zum 60. Geburtstag von Walter G. Saltzer*. Ed by P. Eisenhardt, F. Linhardt, and K. Petanides (Hildesheim et. al., 1999), 138 and 142. To the etymological explanations see *ibid.*, 141.

9. Further limits of the winds are given in D. A. KING, "Maṭlaᶜ", in *The Encyclopaedia of Islam. New Edition* (Leiden, 1960ff), vol. VI, 839f (reprinted in D. A. KING, *Astronomy in the Service of Islam*, (London, 1993), XI, 839-840); E. W. LANE, *op. cit.* (note 7); P. G. SCHMIDL, *op. cit.* (note 8), 139f.

10. For examples see D. A. KING, "Makka. 4. As the Centre of the World", in *The Encyclopaedia of Islam. New Edition* (Leiden, 1960ff), vol. VI, 180-187 (reprinted in D. A. KING, *Astronomy in the Service of Islam*, (London, 1993), X, 180-187); D. A. KING, *A Survey of the Scientific Manuscripts in the Egyptian National Library*, (Winona Lake, Indiana, 1986), 269; D. A. KING and R. P. LORCH, "Qibla Charts, Qibla Maps, and Related Instruments", in *The History of Cartography*, ed. by J. B. Harley and D. Woodward, (Chicago, London, 1987ff), vol. II, 189-205.

11. See D. A. KING, *op. cit.* (note 10), 182.

12. See D. A. KING, "Ḳibla. II Astronomical Aspects", in *The Encyclopaedia of Islam. New Edition* (Leiden, 1960ff), vol. V, 83-88 and the literature there cited (reprinted in D. A. KING, *Astronomy in the Service of Islam*, (London, 1993), IX, 83-88).

13. See C. BROCKELMANN, *Geschichte der arabischen Literatur*, (Leiden, 1943) vol. I, 474 and *ibid.*, suppl. I, 866f; H. SUTER, "Die Mathematiker und Astronomen der Araber und ihre Werke", *Abhandlungen zur Geschichte der mathematischen Wissenschaften mit Einschluß ihrer Anwendungen* X (1900), 139 and 218, footnote 72; H. SUTER, "Nachträge und Berichtigungen zu 'Die Mathematiker und Astronomen der Araber und ihre Werke'". *ibid.* XIV (1902), 175 (reprinted in H. SUTER, *Beiträge zur Geschichte der Mathematik und Astronomie im Islam. Nachdruck seiner Schriften aus den Jahren 1892-1922*, ed. by F. Sezgin, (Frankfurt, 1986)); D. A. KING, *Mathematical Astronomy in Medieval Yemen*, (Malibu, 1983), S. 23-26.

14. To this manuscript (Cambr. 508) and its content see S. LEE, "Notice of the Astronomical Tables of Mohammed Abibekr Al Farsi [...]", *Transactions of the Cambridge Philosophical Society* I (1822), 249-265; E. S. KENNEDY, *A Survey of Islamic Astronomical Tables* (Transactions of the American Philosophical Society. New Series 46/2), (Philadelphia, 1956), 132, no. 54. A further manuscript in Sanaa is

mentioned in KING, *op. cit.* (note 13), 25.

15. To the Milan copy (Ambros. X 73 sup. [Griffini 37]) see O. LÖFGREN and R. TRAINI, *Catalogue of the Arabic Manuscripts in the Biblioteca Ambrosiana*, (Vicenza, 1975), vol. I, 142, no. CCLXX, A. To the fragment in Berlin (Ahlwardt 5731 = Glas. 163) where the two illustrated schemes are missing, see W. AHLWARDT, *Die Handschriften-Verzeichnisse der königlichen Bibliothek zu Berlin. Siebzehnter Band: Verzeichnis der arabischen Handschriften*, (Berlin, 1893), 190. Further works of al-Fārisī – with partially doubtful authorship – are mentioned in BROCKELMANN, *op. cit.* (note 13); KING, *op. cit.* (note 13); G. P. MATVIEVSKAJA and B. A. ROZENFEL'D, *Matematiki i astronomy musul'manskogo srednevekov'ya i ih trudy (VIII-XVII vv.)*, (Moskow, 1983), 376f.

16. To the content see KING, op. cit. (note 13), 23f. The beginning of the chapter on the determination of the qibla is translated in King and Hawkins, *op. cit.* (note 6), 103f.

17. For pictures see the literature cited above (note 10).

18. An evaluation of all directions and all three schemes separately will appear in my doctoral thesis currently being prepared at Frankfurt University.

ASTRONOMY AND BASQUE LANGUAGE

Henrike Knörr
University of the Basque Country
Vitoria-Gasteiz, Euskadi, España
E-mail: fvpknboe@vc.ehu.es

Many years ago, at the beginning of a clear-sighted article on Basque names for days of the week[1], the great Basque linguist Luis Michelena wrote concisely but very precisely about the problem that those people who deal with this kind of thing and other Basque-language related activities have to face up to, and that is simply that as Basque is a language which has neither near nor distant relatives, one is really working in the dark when it comes to drawing conclusions, since there are limited sources and because written texts in and on Basque only appear very late. And yet, I also remember the other, no less true, words spoken by Telesforo de Aranzadi, famous Basque anthropologist: "El vasco no es ningún cuerpo extraño de la Europa Occidental", words that were also adopted by Antonio Tovar.[2]

Both of these ideas, the one referring to the comparison difficulties which arise from a lack of languages or language families that are related to Basque, and the other the evidence that Basque belongs to Europe's cultural wealth, come to the fore when we deal with the vast subject that I shall examine. That is why I fear that the title of this article may have raised greater expectations than it will be able to meet. But let us get to the heart of the matter, although I should like to point out that I will not expand upon dialectal points, nor, except on a few occasions, on evident European parallels.

DAYS. THE BASQUE WEEK

Day is *egun* in Basque. Quite possibly its ancient form was *egu*, a word that there are only traces of today. In the eastern part of the Basque Country *egun* also means "today" although in the rest of the Basque Country *gaur*, originally meaning "tonight", is more widely used. A few years ago I suggested that this *egun* be interpreted as *egu-n*, i.e. with the inessive meaning "during today"[3]. This inessive has become almost totally established and gives the noun. Later, I will show how *egu* goes to make up words such as *Eguberri* "Christmas", or literally "new day", *eguzki* and *eki* "sun" and *ekaitz*, "storm", literally "bad day". José Miguel Barandiaran wrote that *egu* probably at one time meant "light" and "sun"[4]. It is interesting that "to dawn/to get light" and other weather-related verbs are mainly transitive in Basque, for example *argitu du* "(it) has dawned". Similarly it is common to say *elurra ari du* "(he) is exercing snow", etc.

"Week" in Basque is *aste*. Generally, the verbal noun *hasi* "beginning" is recognised, although that is not definite sure, since in ancient Basque this verbal noun is *hatse*. It is commonplace to relate the Basque names for days of the week, and perhaps even this word for "week" as well, with the divisions of the lunar month. I will explain more about this below.[5]

Just as in many other languages, the names for the days of the week vary from one place to another. In the list below, the first version that appears is the one recommended by the Basque Language Academy, it is also the most commonly used form. The list does not include all possible variants.

Monday: *astelehen, ilen*

Tuesday: *astearte, martzitzen*

Wednesday: *asteazken, eguazten*

Thursday: *ostegun, eguen*

Friday: *ostiral, bari(a)ku, egubakoitz*

Saturday: *larunbat, zapatu, egubakoitz, neskenegun*

Sunday: *igande, domeka*

When commenting upon this, a couple of important things should be said:

Aste, as I have already said, means "week". *Astelehen* would therefore mean "the first in the week", *astearte* "the one in the middle of the week" and *asteazken* "the end of the week". What conclusions can we draw from all of this? Are we to suppose that the Basques had a three-day week? Much has been written about this problem without a satisfactory solution being reached. Bausani (1982), reflecting a widespread idea in the Basque Country, tried to prove that the names for the days of the week in central and eastern areas of the Basque Country, i.e. *astelehen* (*lehen* = first), *astearte* (*arte* = in the middle) and *asteazken* (*azken* = last) actually do indicate a three-day week. Basauni also believes that these central and eastern Basque names, together with the remaining words for the days of the week are actually even older than the western words. This may well be so, but it is still surprising to see the unaltered and evident nature of the three words; they might be "modern"..

In the western part of the Basque Country, the word *ilen* also exists alongside *astelehen.* Michelena takes (quite correctly, the way I see it) this to mean *(h)il* + *egun*, i.e. "day of the moon", which exactly correlates to *Monday* with the inclusion of the word for "day" (*egun*).

In the same western area the word *martitzen* (< *martitz* + *egun),* meaning the "day of Mars" exists alongside *astearte*. This, like *ilen,* is probably a more recently-coined word and arises from contact with neighbouring languages.

Wednesday. Once again in the western Basque country *asteazken* exists alongside *eguazten*, *(egu(n)* "day" + *azken* "last"), "the last day", the same idea, therefore, as expressed by *asteazken*. Hence, I do not think that Gorostiaga, who initially explained this word to mean "day of lightening" (1947:55) and subsequently "day of station" (1959:89), is right.

Thursday. The first part of the words that are most widely used in Basque to mean "Thursday" and "Friday" include *ost* (or its variant *ortz),* which no longer exists as an independent word, but which used to mean "sky" and which appears in words meaning "lightening" and "storm". It is striking to see the parallelism with other European languages. According to Bähr (1931: 403) *ostegun* means "day of thunder" or "sky". In the Biscay dialect, the word *eguen,* from *egu-egun* is used to means something like "day of day" or "day of light".

Friday. In *ostiral, ost* appears once again, although we do not know what the second part of the word means. Bähr (1931:403) wonders whether *ostiral* might not mean "day of the rainbow", something which Gorostiaga also supported in 1947, to go on in 1959 to support the combination of *ost* and the Latin term *stella* or *stellare*. The western Basque dialect provides us with the interesting word *bari(a)ku*, which undoubtedly stems from *abari-ba(ge)ko*, i.e. "(day) without supper", a name which has several parallels in European languages. In western and central areas there is also the word *egubakoitz*, which would seem to mean "unique day", although this explanation is not entirely satisfactory.

Saturday. *Larunbat*, which some people have taken to mean *laur(d)en* "a fourth", is more likely the result of *lagunen*, the genitive plural of *lagun* "friend" + *bate*, an ancient verbal noun literally meaning "meeting", so that the word would originally mean "meeting of friends"[6]. Alongside *larunbat* there is also the word *egubakoitz* for "Saturday", which, as we have already said, means "Friday" in western and central areas, as well as *neskenegun* "girls' day". As far as these two terms, *larunbat* and *neskenegun,* we should not forget that it used to be customary in some parts of the Basque Country for boys to go and spend the evening at their girlfriend's house and have dinner which the girlfriend would prepare.[7]

Sunday. *Igande* is taken to mean "(moon) rising/ascent" and some people have even taken it to mean "resurrection", because of the significance of Sunday, from the word *igan* "to rise", like the Russian *voskreséne'e,* previously "Easter Sunday" and before that "resurrection"[8]. I cannot decide on that one, although I do feel that a verbal noun would be more likely to require the form *iga(i)te*. The western dialect also has the form *domeka, (dies) dominica*, which, by the way is feminine, unlike in Spanish and Catalan (remember the *die dominico* from the municipal charter of Cáceres, for example).

THE MONTHS

"Month" is *hil* or *hilabete* (this one meaning something like "the complete month"). There is absolutely no doubt that this is the same word that used to be used for "moon", which meant that, just like in the rest of Europe, the Basque Country had a lunar calendar. However, a great deal of debate also surrounds whether this word could also be related to the word meaning "death". I believe this to be rather difficult, although Caro Baroja and others accept it.

As you can see from the list below, almost all the months have the word *hil*, "month" at the end.

January: *urtarril, urteil, ilbeltz, beltzil, loil*

February: *otsail, zezeil, barantaila*

March: *martxo, marti, epail.*

April: *apiril, jorrail, ope, opeil*

May: *maiatz, hostoil, hostaro, orril, lorail*

June: *ekain, udail, errearo, bagil, arramaiatz, garagarril*

July: *uztail, garagarril*

August: *abuztu, agorril, dagonil.*

September: *irail, buruil, garoil, agor*

October: *urri, urril, urrieta, bildil.*

November: *azaro, hazil, gorotzil, zemendi, lastail, lehen abendu, abendu txiker.*

December: *abendu, lotazil, neguil, beltzil, hotzaro, bigarren abendu, loil, gabonil.*

A few remarks should be made on the above.

January. *Urtarril* is undoubtedly comprised of *urte* + *berri* + *hil* "the month of the new year". *Urteil* means "the month of the year". *Ilbeltz* means "black month", and *beltzil*, which is probably a creation of the Jesuit Larramendi (18th century) means "the month of blackness". Finally, *loil* is the "month of sleep", perhaps in the sense of hibernation.

February. *Otsail* means "month of the wolf", with several parallels all over Europe. *Zezeil* probably means "month of the bull". In both cases, but especially in the latter, we do not actually know the reason behind the name. According to Juan Gorostiaga[9] *barantaila* is related to the Latin *parantalia*.

March. *Martxo* is obviously of Romance origin. As well as this, in Vizcaya you have the word *marti*, without palatalization, where we can imagine that there is the presence of the Latin adjective, *martius,* which may simply come from the genitive: *mens Martii*. The Basque old word *epail* means "month for cutting" and Gorostiaga mentions the Spanish word *marcear* "shear during this month"[10]. However, it is doubtful whether this month is the most appropriate for shearing (at least in the Basque Country).

April. *Apiril* is the most widely-used word. You would have expected *apirile* to have been more common (Latin *aprile)* but in stead we have *apiril* as an analogy to the other months of the year that end with the word *(h)il* at the end.

Jorrail means "month of the hoe". *Ope* and *opeil*, both of which are words from the western part of the Basque Country are thought to come from the word meaning pie or tart *(ope)*. Gorostiaga translates it as "the month of pies/tarts", probably thinking of the *solmonath* of the Angles and at the same time quoting Beda. [11]

May. *Maiatz* is the most commonly-used word for "May". Together with this word which would seem to be a verbal noun *(*maiatze*, "May-kind of weather"?), we find several other month-related words such as *hostoil* "month of leaves", *hostaro* "time of leaves", *orril* "month of the leaf" and *lorail* "month of flowers"

June. *Ekain*, the most widely-used word means "sun up high" and very probably refers to the summer solstice (*egu* "day" + *gain* "high/above"). In Zuberoa, we find a Romance term, *arramaiatz* which means something like "re-May". At the same time, there are month-specific/descriptive words such as *udail* "month of summer", *errearo* "time of burning", *bagil*, form *baba* "bean" + *hil* "month" and finally *garagarril*, "month of barley", which in other parts of the Basque Country is used for July. I hardly need to remind you of the parallels here with Germanic languages where the names of the months are directly related to barley-cutting.

July. *Uztail* means "month of harvest". I have already explained *garagarril* in the previous paragraph.

August. *Abuztu* is clearly the Romance word. It would seem to be a word which was borrowed in former times. Together with this word, you can also find *agorril* "month of drought" and *dagonil*, which perhaps, as Michelena suggests[12], simply means "the month that is here", since if we suppose that it is a contraction of *udagoien* "autumn" + *hil* "month", it hardly fits in with the meaning of August.

September. *Irail* means the "month of the fern", as does *garoil*. It is difficult to find an explanation for *buruil*, one of the other words used for September, where you have the word *buru*, meaning head. Gorostiaga suggests that it is "month of capitation (poll tax)" since in Rome it was the month that marked the tax year[13]. *Agor* is the same word that appeared before meaning "dry". There is not enough space to examine other interesting dialect forms such as *autuno* (like the Spanish *otoño*) and *urri lehenengo* "first October", etc.

October. *Urri* is very probably an adjective meaning "scarce". The same root appears in the dialect forms *urril* and *urrieta*. The word *bildil* "month of harvest" has also been registered. Similarly *urri bigarrengo*, "second October" can also be found.

November. *Azaro* means "sowing season", which once again has numerous parallels in other languages. The first part of the word, although with aspiration, is in *hazil* "sowing month". *Gorotzil* is "month of manure". The word of Romance origin *zemendi* means "seed" without the addition of the word *hil* "month", as habitually occurs in other languages. Other forms include *lastail* "month of straw", *lehen abendu* "first December" or "first Advent" and *abendu txiker* "little December" or "little Advent".

December: *Abendu* is of course connected with the Latin *adventu*. *Lotazil* is interpreted by Gorostiaga to mean "noviembre de la cuarta témpora"[14]. *Neguil* means "month of winter". *Beltzil* I have already spoken about as a word which in some places is taken to mean "January". *Hotzaro* means "cold season". *Bigarren abendu* means "second December" or "second Advent" (see *Anderwinter* mentioned by Nilsson[15]). *Gabonil* means "the month of Christmas".

THE SEASONS OF THE YEAR

The seasons of the year (*urtaro* from *urte* "year" and *aro* "season") are expressed in the following way.

Spring. *Udaberri* means "new summer". Together with this word, there are other, less well-known words such as *udalehen* "first spring", *udahaste* "the beginning of summer" and *bedats* which possibly means "*the beginning of grass*".

Summer. *Uda* means "summer". However the root of this word is unknown. Variants of it include *udara*, which is simply a morphological variant and *udaro* meaning "summer season".

Autumn. The most usual word for Autumn is *udazken* "end of summer". Other words which appear include *larrazken* "end of grazing", *udagoien* "late summer", *udondo* and *udaraitze* "after-summer", *ihartze* "drying of vegetables", *negulehen* and *neguaitzin* "pre-winter", *neguantz* "similar to winter" and other words in which *urri* meaning "scarce" (and which we saw before when talking about the month of October) appears, such as *urri* on its own, *urriaro* "season of scarcity" and *urrite* "time of scarcity".

Winter. *Negu* is "winter". This is another unexplained word. Perhaps we could speculate that the end of the word is –*egu* meaning "day".

We cannot avoid the impression, also mentioned by other researchers, that in the traditional Basque way of thinking there were only two seasons: *uda* "summer" and *negu* "winter".

Throughout the whole of the Basque Country the word used for "year" is *urte*. Usually, this word is taken to be comprised of *ur* meaning "water" and –*te* meaning "time/season". In support of this theory there are a series of songs such as the one sung on New Year's Eve with lyrics which go *"Ur goiena, ur barrena/Urteberi egun ona"* ("water from above, water from below/good New Year's day").[16]

SOLSTICE. EQUINOX

Summer solstice is *udaburu* "height of summer" and winter solstice is *neguburu* "height of winter". These do not seem to be words which are steeped in tradition, and as far as we know there are no traditional words for "equinox" . We could perhaps suppose that the words for " summer solstice" was *ekain* (which literally means "the height of the sun"), today "June" (vide supra) and the one for "winter solstice" *Eguberri,* which literally means "new day" and nowadays "Christmas". *Eguzkimuga,* "solstice", literally "sun's limit" would seem to be an invention of Larramendi dating from the 18th century.

COMPASS POINTS

North is *ipar.* Michelena suggests that this word perhaps comes from *ibar* meaning "valley" and in doing so refers to Romance expressions such as the French *vent d'aval*, the Catalan *vent d'avall*, and the Souletin *peko-aide* "northern wind" or literally "wind from below".[17]

South. The word for south is *hego*. It is difficult to know whether it is pure coincidence or not that *hego* also means "wing". There do not seem to be any parallels outside the Basque language. There is also *eguerdi*, which literally means "mid, day", i.e. "noon".

East. *Ekialde*, the word for "east" is comprised of *eki* "sun" and *alde*, "part". Other forms of this word include *eguzki-alde*, with *eguzki* meaning "sun", *eki-jalki alde*, from *eki* or *eguzki* "sun" + *jalki* "to go out" + *alde* "part"; *eguzki-ilkitze* is made of *ilkitze* "the going out", *sortalde* with *sort-* from the verb which means "to be born", *goiz-alde* with *goiz* "tomorrow" and *goiz herri* , i..e. "the land of the morning".

West. *Mendebal* comes from the Romance word *vendabal*. There are also old Basque words such as *arratsalde* from *arrats* "the afternoon" + *alde* "part" and *eguzki-sartze*, which literally means "sun's entrance". *Sartalde* "place of entrance" would seem to be of more modern origin.

THE SUN. THE MOON

There are two words for "sun": *eguzki* and *eki*, the latter of which appears in the most eastern part of the country. Undoubtedly both words come from the primitive *egu* meaning "day". In the first case we should perhaps simply suppose a second element with an instrumental suffix, plus the particle *ki*, "thing":*egu-z-ki*. The word *eki* is the result of adding the same particle without the instrumental suffix: *egu + ki = eki*.

It is interesting to see how in many towns there is a difference between *eguzki* "sunlight" and *eguzki-begi* "star" or quite literally "sun's eye"[18]. Some verses have also been found in which people address the sun as a feminine object, by calling it "grandmother". The following is an example of this: *"Eguzki amandrea / juan da bere amagana / bihar* etorriko *da/ Denpora ona bada"* ("Grandmother sun / has gone to her mother/ tomorrow she will come / if the weather is good")[19]. Azkue found in Navarre two expressions for saying goodbye to and greeting the sun: *"Adios, amandre, bihar artio"* ("Goodbye grandma, see you tomorrow") and *"Ongi etorri, amandre"* ("welcome grandma")[20].This means that, just as in many other languages, Basque has traditionally considered the sun a feminine object (as Basque is a language without gender, it is this and other kinds of forms of address that help us realise that). There does exist, however, a saying in which the sun is called *Joanes* "John", which may well be of more recent coinage (see the Spanish *Lorenzo*). It is also curious to note how the sun is also a feminine object for Basques. What is more, as anthropologists have already noted, both the sun and the moon return to the earth (their mother).

There are several words meaning "moon" in Basque.

Ilargi, probably means "month light", even though the word is traditionally explained as meaning "light of the dead". From the same word we also get *iretargi, iletargi*, where there may well be a verbal noun and which means something like "light from the moonshine". There is also the ancient word *il*, which is perhaps the same as the word meaning "month". This word appears in *ilgora* "first quarter", literally "moon above", *ilbe(he)ra* "last quarter", literally "moon below", *ilberri* "new moon" and *ilbete* "full moon". Azkue adds a synonym to this last term: *ilzar* "old moon".[21]

Another word for "moon" from the extreme eastern part of the Basque Country is *argizagi* or *argizari*. Some scholars have explained this word as coming from *argi + izari*, i.e. "measure of light", whilst others see the word *argizagi* as being comprised of *argi* "light" + *zagi* "wineskin". This is true for Azkue who writes "*argizagi*" (literally "odre de luz", that is "winskin of light")[22]. Neither of these explanations is satisfactory[23]. As Bähr wrote, if we assume the presence of *izari* "measure" in *argizari* then we come up against the difficulty that *argi* appears traditionally in compound words as *art-*[24]. What is more the element *zagi* is doubtful since it cannot be found as an independent word.

A third word, which is rather less widely found is *ilaski*, the end part of which is difficult to explain. Another, from the Roncal area, is *goiko*, which quite literally means "the one above".

The moon is also feminine and just like the sun is greeted by people *"Ilargi amandrea / Zeruan zer berri?"* ("Grandmother moon / what's new in the sky?").[25]

Uhlenbeck put forward the idea that there was a certain "word taboo" attached to the word for "moon" and the one for "sun", meaning that both had their own specific names, which should be avoided. Caro Baroja supported this idea[26]. This may even explain the case of the word from Roncal, *goiko* (meaning "the one above") that we mentioned previously.

ATMOSPHERIC PHENOMENA

We could now perhaps mention some atmospheric phenomena. You will see again how many of them contain the element *ost-*, *ortz-*, which is probably the remains of an independent word meaning "sky".

Rainbow: *ortzadar, ostadar*. This literally means "sky horn" or, according to other writers, " sky arch". Bähr noted how in the Gipuzkoa dialect there is a predominance of the word *ostrailaka* and this is probably due to some kind of crossing with the Spanish word *estrella* (meaning "star"). In fact, according to Bähr, this phenomenon is called *estreila* in places such as Ormaiztegi. He also quotes the word *estreilaje* from Guipuzkoa to mean "milky way" (obviously from the Spanish word *estrellaje)*. If this is true, we still have to find an explanation for the *–ka* which appears difficult to assimilate to an adverbial element denoting action (e.g. *jo-ka*, "hitting"). As for *ostadar*, Iñaki Camino told me that in Aezkoa the word *otsadar* is used for "rainbow". It literally means "wolf's or wolves' horn".

Together with this word there are others which include the Romance word *arku* "arch", such as *San Juaneko arku* "arch of Saint John", *Jainkoaren paxea* "sash of God", *ostarku* from *ost* + *arku* and others. There is also the traditional world *uztai* "arch" and *uztarri* "yoke", the latter of which appears in the word *uztargi* "light of the yoke".

In many other words and expressions we find *zubi* meaning "bridge", such as *zubiadar* "bridge horn", *Erromako zubia* "bridge to Rome", *Santiago zubi* "Santiago bridge", *zeruko zubi* "bridge to heaven", *San Migelen zubia* "Saint Michael's bridge", *San Nikolasen zuibi* "Saint Nicholas's bridge" and *Frantziako zubi*, "bridge to France".

Although this is not a complete list, other word forms for rainbow include *euriadar* "rain arch", *(b)uztarri* "yoke", *Jainkoaren gerrikoa* "sash of God" and *ostalebi ostebi* amongst others, containing the element *euri* meaning "rain". *Euriadar* meaning "rain arch or horn" is also found[27]. Bähr also found *Santiagora bide* "road to Santiago" and *Santiago zubi* for "rainbow". Similarly, Bähr draws our attention to the word *intxearka* and variants of it, where he claims to see *intze-arka* "arch of?". He (1931:405) also mentions *Jainkoaren mandataria* "messenger of God". *Azerien boda* "wedding of foxes" is the name given in some places to the "double rainbow": see the comments made by Bähr (1931:408-409).

Itsas adar, literally "sea horn", is a curious term. It reminded Caro Baroja of the belief which exists in the province of Asturias that rainbows drink sea water[28]. Bähr had also remarked on this and after quoting the passage written by Plauto "bibit arcus pluet hodie" and by Ovidio "Nuntia Junonis varios induta colores / Concipit Iris aquas alimentaque nubibus adfert", mentioned the belief that the rainbow has its feet in a well or stretches from one well to another or from one river to another[29]. There is also a popular belief amongst Basque people that if you walk underneath a rainbow you will change sex.[30]

There are several words for "thunder". The element *ortz-, ost-* appears, once again in many of them. Such is the case of *ortzantz*, a haplology of *ortz* + *azantz*, meaning "thunder", i.e. "heavenly thunder"[31] and *oztots* or *ostots* "sky's noise", with *hots* meaning "noise". The Romance form *trumoi* is also very widespread. There is also an onomatopoeic word *tximist* which Pío Baroja used to christen one of his characters, Captain *Chimista* which more recently has appeared as a brand of batteries.

The word for "lightening" also contains the element *ost-, ortz-* in words such as *orzpin*, which no doubt comes from *ortz* + *bini* , i.e. "tongue from the sky" and also *ozminarri*, with the final element *harri* meaning "stone" in other words "stone of the tongue from the sky". Other compound words have an unidentified first element: *igortziri, iruntziri*, etc. the second part of which is probably *ziri, zihi* "ridge, pin". However I cannot work out what lies behind another word *oinastura* and variations of it. The presence of *ortz-, ost-* is also traceable in words such as *ozkarbi,* "serene sky", with the second element being *garbi* meaning "clean" and *ostarte* "clear patches in the sky", or literally "spaces in the sky".

STARS. SOME PLANETS

I should like to finish my paper with a few brief notes about stars and constellations.

"Star" is *izar*, undoubtedly an old traditional word. *Izar ozar*, literally "daring star" is how a shooting star is said in Basque.

Great Bear*: bost izarrak* "the five stars"; *sei izarrak* "the six stars"; *zazpi ohoinak* "the seven thieves", *oilo txitoak* "the hen and her chicks", *artzain* "shepherd", *artzaina makoarekin* "the shepherd with his crook"[32], *itzain* "oxherd", *itohoin* "ox thief". Look at the tale told by Cerquand. Look also at the works by Frank on *Harzkume*, literally "bear cub" and its relationship with Europe's primitive vision of the cosmos.

Little Bear: *zazpi izarrak*, "the seven stars", *zazpi ohoinak* "the seven thieves", *zazpi ahuntzak* "the seven goats".

Orion: *Soldadua* "the soldier"; *Hiru lapurrak* "the three thieves".
Cassiopeia: *Mariaren baratzea* "Mary's garden"
Andromeda: *Hiru ahizpak* "the three sisters"
Leo: *Zaldia* "the horse"
Regulus: *Zaldi-oina*, "horse foot"
Eagle: *Arranoa*, id.
Altair: *Begi-ederra* "beautiful face or eye".
Antares: *Izar gorria* "red star" or *Izar odoltsua* "bloody star".
Oxherd: *Itzaina,* id.
Athur: *Lehen izarra* "first star"
Lyra. *Bandera* "the flag"
Vega: *Begi urdina* "beautiful eye or face"
The Waggoner: *Bost kantoinak* "the five corners"
The goat: *Ahuntza*, id.
The dog: *Izarrora* "the dog star"
Sirius: *Begi distira* "the shining eye"
Taurus: *Zezena*, id.
The fountains: *Iturriak*, id.

Pleiades: *Oiloa koloka txitekin,* "the broody hen with her chicks", *Oiloa txitoekin* "the hen with her chicks". *Izar molkoak* "groups of stars"

Cancer: *Argimarra* ("strip of light"). But it seems created by Larramendi, s.u. *cáncer,* by mistake with article *(arguiamarra).* Aizkibel, who always followed Larramendi, mentions the word.[33]

Venus: *Artizarra* "light star" *argi* "light" + *izar* "star". Both elements are quite clearly represented and let us not forget the uncontracted form *argizar*[34]. *Dendari-izarra* "seamstresses' star" has also been found[35]

Milky way: *Esnebidea* comes from *esne* "milk" and *bide* "path/way"; *Erromako bidea*, "path to Rome" *Erromesen bidea* "pilgrimme's way"; *Jondoni Jakobeko* bidea, "Santiago way"[36], or using the saint's name in its Castilian version, which is already generalised in the southern Basque provinces, *Santiago bidea* and *Santiago kaminoa*, also have the same origin. *Josafaten bidea* meaning "Josafat way" has also been found.

Planet: *izarbel* which literally means "black star", with the peculiarity that it has an ancient form of the word for black *bel,* which nowadays is *beltz*.

ACKNOWLEDGEMENTS

I would like to thank my colleagues Iñaki Camino and Ricardo Gómez for their comments.

NOTES

1 Michelena 1971:94.

2 Tovar 1959:62.

3 Knörr 1990:128.

4 Barandiaran 1972:72.

5 See Caro Baroja 1948, above oll 61-64.

6 Michelena 1990:501. Something like that had had proposed by Garate 1957:50.

7 See d'Abbadie 1998:40. This part is commented by Thalamas 1977:117-118.

8 Michelena 1971:98.

9 Gorostiaga 1958:52 relates *otsail* to the Roman lupercalia.

10 Gorostiaga 1958:53. The Dictionary of the Spanish Academy says: "*Marcear.* Esquilar las bestias, operación que en algunos climas suele hacerse en el mes de marzo".

11 Gorostiaga 1958:53.

12 Michelena 1987:305.

13 Gorostiaga 1958:54.

14 Gorostiaga 1958:54.

15 Nilsson 1969:290.

16 Satrústegui 1974:66-68.

17 Michelena 1988:171.

18 Barandiaran 1960:110.

19 Caro Baroja 1948:42.

20 See the quotation by Caro Baroja 1948:42.

21 Azkue 1959:162.

22 Azkue 1959:162.

23 Caro Baroja 1948:47.

24 Bähr 1929:534.

25 Caro Baroja 1948:48.

26 Uhlenbeck 1928:560 and Caro Baroja 1948:47. Caro Baroja 1995:220 quotes Strabon, who informs about the worship of the Celtibers and tgeir northern neighbours towards an nameless God in full moon nights.

27 Azkue 1959:165.

28 Caro Baroja 1995:36.

29 Bähr 1931:407.

30 See, por exemple, Azkue 1959:166. In my childhood in Vitoria the believe was very common.

31 Uhlenbeck 1928:559.

32 Cf. also *artzai-makoa,* the group of the Three Kings, literally "shepherd's crook".

33 Garate 1948:36. But Aizkibel didn't include the word in his own dictionary.

34 See the word in tow ancient poems, Michelena 1990:83 and 96-97.

35 Azkue 1969:287.

36 Lhande, 1926, s. u. *jondane*.

REFERENCES

ABBADIE, Madame d' (Marie Coulomb).1998. *Causeries sur le Pays Basque*. Bayonne, Elkarlanean. First edition:1909. It is a pity that the second edition didn't take in account Lacombe's review, *Revista internacional de estudios vascos* 4, 1910, 328- 331.

R. M. de AZKUE, 1959. *Euskalerriaren yakintza. Literatura popular del País Vasco*. Vol. I. Second ed., Madrid, Espasa Calpe.There is a third ed., Euskaltzaindia-Espasa Calpe, Bilbao 1989.

R. M. de AZKUE, 1969. *Euskalerriaren yakintza.. Literatura popular del País Vasco*. Vol. III. Second ed.,Madrid, Espasa Calpe. See third edition above.

G. BÄHR, 1929. «M.G. Ramos, De astronomástica vasca» (review). *Revista internacional de estudios vascos* 20, 534-535.

G. BÄHR, 1931. «El arco iris y la vía láctea en Guipúzcoa». *Revista internacional de estudios vascos* 22, 397-414.

J. M. BARANDIARAN, 1960. *Mitología vasca*. Madrid, Minotauro, There is a second edition, San Sebastian, Txertoa, 1979.

J. M. BARANDIARAN, 1972. *Diccionario ilustrado de mitología vasca*. Obras completas. Tomo I. Bilbao, La gran enciclopedia vasca.

A. BAUSANI, 1982. "The prehistoric Basque week of three days: archaeoastronomical notes". *The Bulletin of the Center for Archaeostronomy* (Maryland), V:2. 16-22.

J. CARO BAROJA, 1995. *Los pueblos del Norte de la Península Ibérica*. Lur, San Sebastián, I, 121-240. First published in 1948 in Madrid, Instituto Bernardino de Sahagún.

J. CARO BAROJA, 1995. «Sobre la religión antigua y el calendario del pueblo vasco». Lur, de San Sebastian, II, 31-64. 1948. Madrid, First published 1948, Madrid, Trabajos del Instituto Bernardino de Sahagún, VI, 9-94.

J. F. CERQUAND, 1878. «Tradiciones vascongadas. La Osa Mayor (dialecto suletino)». *Revista Euskara* 1, 76-77.

R. FRANK, 1996. "Hunting the European sky bears: when bears ruled the earth and guarded the gate of heaven", in V. Koleva and D. Kolev, eds. *Astronomical traditions in past cultures*. Institute of Astronomy/National Astronomical Observatory Rozhen, Sofia, 116-142.

R. FRANK, 1997. "Hunting the European sky bears: the grateful eagle, little bear, Amirami and Prometheus", in C. Jaschek and. Atrio, eds., *Actas del IV Congreso de la SEAC, Astronomia en la cultura*, Salamanca, 55-68.

J. GARATE, 1932. "Astros y meteoros en vascuence". *Revista internacional de estudios vascos* 23, 139-142.

J. GARATE, 1948. "Apuntes acerca de José-Francisco Aizkibel". *Eusko Jakintza* 2, 23-36.

J. GARATE, 1957. "Séptima contribución al diccionario vasco". *Boletín de la Real Sociedad de Amigos del País* 13:1, 44-53.

J. GOROSTIAGA, 1947. "La semana vasca. El sistema y los nombres de los días". *Gernika-Eusko Jakintza* 1, 51-56.

J. GOROSTIAGA, 1958. «Los nombres vascos de los meses». *Euskera* 3, 51-55.

J. GOROSTIAGA, 1959. "Los nombres vascos de los días de la semana". *Euskera* 4, 87-92.

H. KNÖRR, 1990. «Luis Michelena, *Palabras y textos*» (review), *Fontes linguae vasconum* 22, 128.

P. LHANDE, 1926. *Dictionnaire basque-français*. París, Beauchesne.

L. MICHELENA, 1971. «Egunak eta egun-izenak» [«The days and the days' names»]. First published in *Munibe* (San Sebastian) 23, 583-591. Alson in *Palabras y textos*, Bilbao, Universidad del País Vasco, 1987, 269-282, and in *Mitxelanaren euskal idazlan guztiak* [«The complete works of Michelena in Basque] (VII), San Sebastian, Euskal Editoreen Elkartea, 1988, 93-110.

L. MICHELENA, 1987. «Nombre y verbo en la etimología vasca». *Palabras y textos*. Bilbao, Universidad del País Vasco, 282-309.

L. MICHELENA, 1988. «Las antiguas consonantes vascas». *Sobre historia de la lengua vasca*, San Sebastián, Diputación de Guipúzcoa, I, 166-189.

L. MICHELENA, 1990a. *Fonética histórica vasca*. Second ed., San Sebastian, Diputación Foral de Guipúzcoa.

L. MICHELENA, 1990b. *Textos arcaicos vascos*. Second ed., San Sebastián, Diputación Foral. First ed.: 1964, Minotauro, Madrid.

M. P. NILSSON, 1920. *Primitive time-reckoning*. Lund. Second ed., Malmö 1960. .

M. G. RAMOS, 1928. *De astronomástica vasca*. Tarragona. Also in *La gran enciclopedia vasca* 3, 1968, 474-478 y 584-602.

J. M. SATRÚSTEGUI, 1974. *Solsticio de invierno.* Pomplona, *Diario de Navarra.*

J. THALAMAS LABANDIBAR, 1977. "Itxas-mendi" ("See and earth"). *Anuario delSeminario de Filología Vasca Julio de Urquijo* 11, -128.

A. TOVAR, 1959. *El euskera y sus parientes.* Madrid, Minotauro. Uhlenbeck, Cornelius. 1928. «Quelques observations sur le mot *illargi*». *Homenaje a Carmelo de Echegaray.* Son Sebastián, Diputación de Guipúzcoa, 557-560.

X.X. «Noms basques relatifs aux étoiles».1970. *Gure Herria* 42, 97-98.

THE CALENDAR IN MEDIEVAL BULGARIA

Vesselina Koleva
National Astronomical Observatory "Rozhen",
Bulgarian Academy of Sciences, Sofia, Bulgaria

INTRODUCTION

The most significant sources about the Bulgarian medieval calendar are the written records that have survived to the present day. These were created during the periods of remarkable cultural bloom in 9th-10th and 13th-14th centuries by educated Bulgarian writers who mostly translated older Byzantine literature which in turn had preserved a lot of the antique and Hellenic heritage. These Bulgarian manuscripts in many cases have reached us through subsequent translations in Russian, Serb, or Moldavian, dated as late as the 18th-19th centuries[1]. Various natural scientific records by different individuals, ethnographic and folklore data and also the well-known wooden calendars - "raboshes", are also sources of specific information about calendar and astronomical lore. Though fragmentary, these sources give some idea about the calendars that were used before and after the foundation of the Bulgarian state (AD 681) and the Conversion (AD 866). The use of these older calendars continued together with that of the official Christian calendar throughout the Middle Ages and even later on.

THE HERITAGE OF PRE-CHRISTIAN CALENDAR TRADITIONS

The Bulgarian people was formed in the period between 7th and 11th century from three main ethnic groups - Slavs, proto-Bulgarians and the Romanized local Thracian population. Those groups possessed an astronomical and calendar lore of their own[2].

The calendar of the ancient Thracians was luni-solar and was kept in agreement with the lunar phases by means of appropriate corrections. It is supposed that two-, four- and eight-year cycles have been used[3]. The Thracians celebrated the birth of the new Sun on the day of the winter solstice as a beginning of the solar year; the first lunar month in the civil calendar was celebrated around the time of the vernal equinox. Major celebrations were the so-called *Calendi, Brumalii, Dionisii* and *Rusali*[4]. It appears highly likely that, similarly to the Greek calendar, the Thracian months were named after the more important holidays celebrated within them. This tradition is preserved also in the folk calendar of Bulgarian Christians: for example, June is called *Rusalski* ("month of the Mermaids"), after the above-mentioned Thracian celebration[5].

Most of what is known about the Slav calendar comes from old Bulgarian manuscripts that have preserved the Slav names of the months: *prosinec, sechenj, suhij, brezenj, trevenj, izok, chervenj, zarev, ruenj, listopad, grudenj, studenj.* In gospels, menologions and prophetic books these names (with certain variations) sometimes appear together with the corresponding Greek and Latin names, which shows that they were used in the Middle Ages too[6]. A comparison of these names shows their common origin. They are based on certain seasonal changes as well as on farming activities carried out in a given month. In the folk calendar in Bulgaria, some old-Slavonic names of months are preserved even to this day: *Big Sechko* for January, *Little Sechko* for February, *Cveten* for May and *Ruen* for September[7]. Researchers believe that initially the old Slav calendar was lunar but later became luni-solar[8]. The year began with the first spring lunar month. In the Middle Ages the calendar was corrected seven times every 19 years by adding an intercalation month which most probably took the name of the preceding month. Thus the name *Grudenj* (referring to the frozen wheel-tracks on winter roads) sometimes stood for November and sometimes for December. Czechs, however, used this name for the additional 13th month in the lunar calendar[9]. This is a direct proof of the luni-solar nature of the calendar and of the introduction of an additional month in December. In my opinion the repetition of the name *sechenj* (sechko) as *Big Sechko* and *Little Sechko* for January and February in the Bulgarian folk calendar testifies to such an intercalation practice in the past. The old names of months are preserved in some Slav languages but some of them are shifted compared to the old-Slavonic name order: for example, *Listopad* in old-Slavonic corresponds to October, and in present-day Polish and Ukrainian - to November, *Grudenj* - to November or December respectively. This shift of the months' names resulted from the substitution of the old luni-solar calendar with the Julian solar calendar, which was adopted by the different Slav states at different times and in different ways.

Proto-Bulgarians used a calendar and chronology of their own along with the adopted Byzantine traditions. The proto-Bulgarian calendar has been studied extensively but there is still no commonly accepted interpretation of it. The main source is "The List of the Bulgarian Khans" probably written in the first centuries after the foundation of the Bulgarian state[10]. It is preserved in three old-Russian transcripts from 15th and 16th centuries. The old-Slavonic text contains pairs of words which can be deciphered by means of the ancient Turkic and some Altaic languages, and whose meaning refers to dates of events of proto-Bulgarian history. They have not been translated into Slavonic because, evidently, they have been used in the official chronology of the Bulgarian state in their original form. The first word in these pairs is the name of an animal and the second is an ordinal numeral. Comparison to the ancient eastern calendars shows an almost complete correspondence with the names of the years in the Chinese 12-year animal cycle[11].

The very few double datings of well-known historical events are of great importance to the reconstruction of the proto-Bulgarian calendar and chronology. For example, in two different sources the date of the Conversion is given as *Eth Behti* (means "year of the dog - fifth month") and as 6374 since the creation of the world[12], which corresponds to AD 866. In another inscription on a stone pillar from the time of Khan Omurtag (816-831)[13] the date *Shegor Alem* ("year of the cow - first month") is doubled with *the 15th indiction*. They correspond best to AD 821 (year of the cow) and AD 822 (year of the tiger) respectively. A possible explanation of the discrepancy here is that "alem" should not be interpreted literally as "initial", "first" but as an intercalation month at the end of the year of a luni-solar calendar[14].

In the beginning of the 19th century, during the Bulgarian National Revival, the dating by means of the proto-Bulgarian calendar became popular again. On the walls of churches and houses and on fountains next to the Julian date there was also an image of the respective animal from the 12-year cycle of the Eastern calendars[15].

THE CHRISTIAN CALENDAR AND CHRONOLOGY

With the official acceptance of Christianity the Julian calendar was introduced in Bulgaria. The proto-Bulgarian calendar practices were replaced with the official Byzantine calendar and chronology. Together with the Julian calendar and its four-year cycle a number of year cycles and "eras" became popular[16]. In medieval Bulgaria the Byzantine, or Constantinople, era was officially used but in some earlier monuments and in translations of Greek chronicles the Alexandrian era occurs too. The Byzantine "world era" and the indiction were applied in the September style, which means that 1 September became the beginning of the year. According to medieval manuscripts, in Bulgaria the January and March styles were used as well. The usage of the Christian era (Anno Domini) was very rare in medieval Bulgaria until the 17th century. The earliest known such use occurs in a stone inscription from the time of Khan Omurtag, before the Conversion: "...in the year 820 since the advent of the true God and 6328 since the creation of the world..."[17].

The beginning of the Julian year in the Byzantine calendar is shifted from 1 January (in the Roman calendar) to 1 September. The months kept the Roman names but the days were marked with serial numbers and not the Roman "calends", "ides" and "nones". Some days of the week were also given Slavic serial names similar to those in the Greek, Arabian and other traditions, all of which in turn are believed to have come from the ancient Babylon. The first day of the week in the Bulgarian calendar was *nedelja* (Sunday, presently the last day of the week). The name means "Don't-work day"[18]. A similar meaning bears also the name of the last, seventh day *sabota* (Saturday) which comes from the ancient

Babylonian *shabbat* ("peace, calm"). The second day of the week is *ponedelnik* (Monday) which literally means "After Don't-work day". The third is *vtornik* which actually derives from the word "second" but should be interpreted as "the second day after Sunday". The next day, *sryada*, means "the middle". It is followed by *chetvartak* meaning "fourth day", and *petak* meaning "fifth day". These names have subsequently found their way from Bulgaria into some other Slav countries[19].

Bulgarian writers in the Middle Ages participated in promoting the acceptance of the calendar reform. The first theoretical knowledge about the newly introduced Julian calendar is found in the works of Joannes Exarch "Hexameron" and "Heavens", in Tsar Simeon's "Miscellany" from 1073, and in the "Dialogues" by Pseudo-Caesarius[20].

Beside the Julian solar calendar, some of the most popular luni-solar calendars are described in several sources. In "Miscellany", a list is given of names of months used by the Romans, Judeans, Hellenes, Egyptians and Macedonians. In fact, the Macedonian names are not of months but of zodiacal signs transliterated from Greek. The translation of Joan Damaskin's article about Macedonian months is illustrated with pictures of zodiacal signs in the margins. Scholars find some influence of the proto-Bulgarian calendar in the unusual order and look of these signs[21].

Recent research provides new data about the calendar included in the "Interpreting Palea", preserved in a small number of copies from 15th to 17th century[22]. It is supposed that it was based on a protograph written in the old Slavonic script - "glagolitsa", probably at the end of the 9th and the beginning of the 10th century. The calendar text is incorporated within the text about the creation of the world on the fourth day of the biblical week. The lunar months ("moons") in every lunar year ("circle") are named after the official months in the Julian calendar and their beginning and end are indicated by Julian dates. The intercalation month is called simply a "moon". (In "Miscellany"[23] it bears the name *vlaznyi* which translates as "intercalation".) It was added after different calendar months of the second, fifth, eighth, tenth, thirteenth, sixteenth and eighteenth cyclic year. In the first lunar year the first lunar month begins on 21 December, ends on 1 January, and is called January Moon. In the nineteenth lunar year "January moon" begins on 1 January, and "March moon" - on 1 March. "December moon" ends on 20 December.

In fact, it is a short and clear description of a Metonic cycle: it applies the Byzantine nineteen-year cycle in "January style". The lunar months begin at new moon and are distributed in nineteen "circles". The numbers of these circles are less by three compared to the corresponding Golden numbers of the years in the Alexandrian nineteen-year cycle.

Proof of the use of a similar luni-solar calendar in the Middle Ages is given by three wooden, stick-shaped calendars (called *rabosh*) from the History Museum in Kyustendil, which have been interpreted earlier by the author[24]. Besides the twelve full lunar months which they contain, at a certain time during the Metonic cycle a thirteenth month has been added periodically. In our opinion the places of these corrections are clearly marked in the middle and the end of the lunar year.

Of special interest for this review is a calendar sketch drawn by Mincho Hadzhipopnedev - a village priest from Central Bulgaria - on the flyleaf of his Gospel[25]. In this drawing (Figure 1), dating presumably from the second half of the 19th century, next to the familiar Julian years we see the names and images of two animals: yet another indication for the continuity of the proto-Bulgarian calendar tradition.

In the centre is a circle containing an anthropomorphic full-face image of the sun combined with a left half-face image of the moon, and surrounded by a crown with 12 rays. Around this centre, signs and years (***лѣто*** -"leto", means year in old-Bulgarian) are arranged in seven concentric circles and eight radial columns. The two outermost circles contain fourteen Julian years. The earliest year is 1836. Above it is the year 1837, and below it J. Valchev and P. Dobrev make out respectively the word ***петелъ*** ("petel" means rooster in Bulgarian) or ***хелувъ*** ("heluv" means rooster in some ancient Caucasus languages). Follow the letter ***а*** ("A") and a three-peaked crown or a rooster's comb. In the lower part of the sketch there is an image of a snake. Under it there are a small circle (one of seven such circles), the word ***змия*** (snake), and two years.

Taking the upper column with the years 1836 and 1837 as a starting point, we can transform the circular sketch into a table (Table 1). Its left half contains the years of the inner circle and the right half - the years of the outer circle of the sketch. The table gives the corresponding years in the Chinese 60-year calendar cycle (starting in 2637 BC), the numbers of the years in two presumable "Bulgarian" cycles (12- and 60-year), and the numbers in the solar cycle, Meton cycle, and indiction (28-, 19- and 15-year respectively) in the Byzantine chronology whose "world era" starts in 5508 BC.

In the inner circle there are eight years spaced twelve years apart. Between the first (1836) and the last (1920) year there are 84 (7x12) Julian years and exactly three full solar cycles (3x28=84). The year 1836 is "year of the fire and the monkey". In the outer circle there are six years standing ten years apart. The year 1837 is "year of the fire and the fowl" (further in the text we shall refer to the "year of the fowl" as "year of the rooster") in the Chinese calendar. Between the years 1837 and 1887 there are 50 (5x10) Julian years. If the two circles are closed by going back to their beginning points by adding respectively twelve and ten years to the last year in each circle, then the inner will have 96 (8x12=5x19+1) and the outer circle - 60 (6x10=5x12=4x15) years. The so obtained presumably following years - 1932 and 1897, are also included in the table.

For comparison, we give the data for the year of the Birth of Christ (25 December 1 BC) - "year of the metal and the monkey", and of the next year AD 1 - the initial year of the Christian era, "year of the metal and the rooster". This could explain the presence of the letter "A" below the word "rooster" next to the Julian years 1836 and 1837. (The numeric equivalent of A in the old-Bulgarian alphabet is 1.)

TABLE 1

Inner circle	Chinese 60-year calendar cycle (2637 BC)		Christian chronology					Outer circle	Chinese 60-year calendar cycle (2637 BC)		Christian chronology				
Julian Year	Terrestrial Branch	Celestial Stems	12-year cycle	60-year cycle	28-year cycle	19-year cycle	15-year cycle	Julian Year	Terrestrial Branch	Celestial Stems	12-year cycle	60-year cycle	28-year	19-year	15-year
1 BC	monkey 9	metal 57	12	60	20	17	3	AD 1	rooster 10	metal 58	1	1	21	18	4
↓								↓							
1836	monkey 9	fire 33	12	36	8	10	9	1837	rooster 10	fire 4	1	37	9	11	10
1848	monkey 9	earth 45	12	48	20	3	6	1847	sheep 8	fire 44	11	47	19	2	5
1860	monkey 9	metal 57	12	60	4	15	3								
1872	monkey 9	water 9	12	12	16	8	12	1857	snake 6	fire 54	9	57	1	12	15
1884	monkey 9	wood 21	12	24	28	1	12	1867	hare 4	fire 4	7	7	11	3	10
1896	monkey 9	fire 33	12	36	12	13	9	1877	ox 2	fire 14	5	17	21	13	5
1908	monkey 9	earth 45	12	48	24	6	6								
1920	monkey 9	metal 57	12	60	8	18	3	1887	pig 12	fire 24	3	27	11	3	10
↓								↓							
1932	monkey 9	water 9	12	12	20	11	15	1897	rooster 10	fire 34	1	37	13	13	5

Till the year 1836, exactly 153 twelve-year cycles have passed since the start of the new era, and 612 such cycles since the creation of the world; till the year 1920, 32 and 48 60-year cycles have elapsed since the two eras respectively. If the "year of the rooster" is the beginning of these cycles, then the numbers of the years in them will be bigger by three compared to the corresponding numbers in the 60-year Chinese cycle (see Table 1). If these "Bulgarian" cycles pertain to a luni-solar calendar, then on the sketch, there might be some instruction of how to make corrections. As was mentioned above, the word "alem" ("first") probably indicated also an "intercalation" at the end of a certain year. If the place of correction is marked with "A" in priest Mincho's calendar, we can assume that it is made at the end of "year of the monkey" - "bichin", before the beginning of "year of the rooster" and this date, according to the proto-Bulgarian calendar, is called "bichin alem".

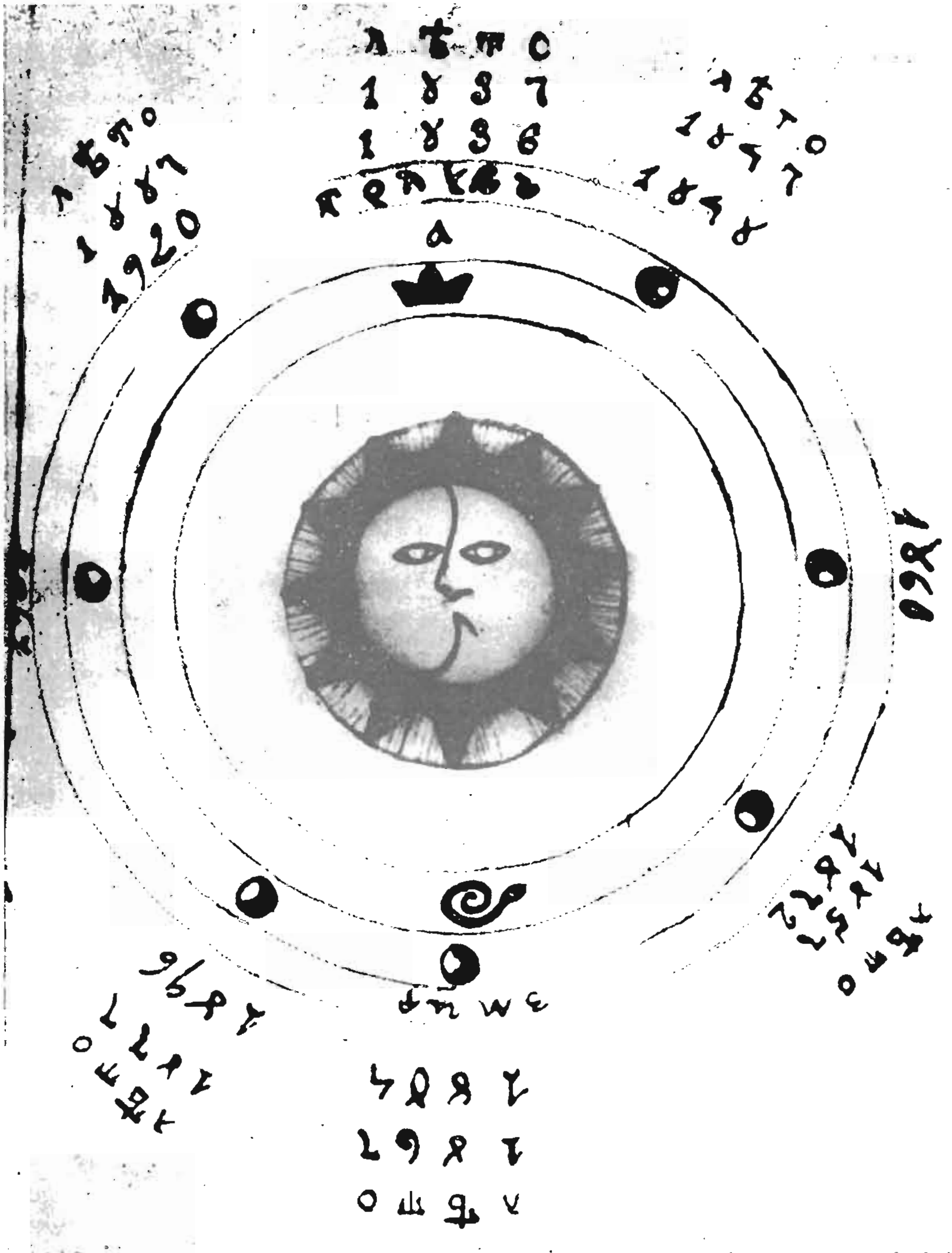


Figure 1. Calendar sketch drawn by priest Mincho Hadzhipopnedev

The terrestrial and celestial symbols on the sketch bear significant calendar information and emphasise the role that the sun and the moon play in the calendar systems. The image of the snake, too, may be related to the Christian chronology. It turns out that 5500 BC and 5499 BC are respectively "year of the dragon" and "year of the snake". Therefore, the snake here can indicate the year 5500 BC from the biblical "creation of the world", when god created the first man, Adam.

It can be concluded that the author of the calendar sketch possessed of good theological learning, as well as deep theoretical and practical knowledge about the chronology. Priest Mincho knew very well the structure of the 60-year Chinese calendar which in turn was very close to the proto-Bulgarian calendar, as its investigators have often pointed out. The calendar drawing in his Gospel could be yet another evidence that the ties between proto-Bulgarian and Christian calendar and chronology were known of and applied. It confirms the fact that the clergy took care of the preservation of the calendar and of its proper application both in the official festive rites and in the folk traditions. This is an example of a practical guide for calendar calculations using two different systems.

Other such examples are the so-called Easter tables, or *paschalii*. The oldest Glagolic table of the Easter full moons is found in a manuscript from the 12th century[26]. In later old-Russian manuscripts from the 15th and 16th century is found a set of hand-shaped Easter tables: Joan Damaskin's hand, Joan Bogoslov's hand and a Judean hand. In Bulgaria, calculations of the Easter date by hand as a supplement to using a calendar stick are mentioned in some ethnographic studies, but unfortunately there is no detailed description of how this was done.

Finally it should be noted that the Gregorian "new style" was introduced in Bulgaria in 1916, quite late as typical of eastern-Orthodox states. However, the traditional festive system continued until recently to use the liturgical Julian calendar adopted by the church, as well as even older practices whose roots are to be sought far back in pre-Christian, pagan times.

CONCLUSIONS

From this brief review can be seen that the Julian solar calendar, officially adopted by the church, was the dominant calendar in medieval Bulgaria. However, the old luni-solar traditions continued to co-exist with the new calendar. Their symbiosis was reinforced in part by the need for paschal calculations necessary to the religious cult. The calendars of some other Slav peoples were also influenced by the calendar practices in medieval Bulgaria. For all these reasons they have an important place in the cultural heritage which has reached us.

REFERENCES

1. TS. CHOLOVA, *The Natural-Scientific Knowledge in Medieval Bulgaria* (Sofia, 1988), 15-35 [in Bulgarian]; A. MILTENOVA, *Old Bulgarian Literature, vol. 5, Natural Sciences*, ed. by A. Miltenova (Sofia, 1992), 6, 12-14 [in Bulgarian].

2. R. SEFTERSKI, "Calendars and Calendar Changes in Bulgaria from the 7th to the 13th Century and the Zodiacal Shift in 1073 Miscellany of Simeon and Svetoslav", *Interdisciplinary studies*, XVIII (1991), 104-119 [in Bulgarian].

3. D. POPOV, *The God with Many Names* (Sofia, 1995), 185-203 [in Bulgarian].

4. I. VENEDIKOV, *The Copper Threshing-Floor of the Proto-Bulgarians* (Sofia, 1983), 95-266 [in Bulgarian]; G. LITAVRIN, *How did the Byzantines live* (Sofia, 1984), 150-160 [in Bulgarian]; V. GERASIMOVA-TOMOVA, Calendar, Dates and Dating, *Interdisciplinary studies*, XVIII (1991), 80-83 [in Russian]; A. MILTENOVA, *op. cit.* (ref. 1), 297-298.

5. D. MARINOV, *Selected works, vol. 1, Folk beliefs and religious customs*, (Sofia, 1981) 637-650 [in Bulgarian].

6. R. SEFTERSKI, *op. cit.* (ref. 2); A. MILTENOVA, *op. cit.* (ref. 1), 303-312; Tsv. CHOLOVA, *op. cit.* (ref. 1), 167-168.

7. D. MARINOV, *op. cit.* (ref. 5), 381, 487, 623; St. RAJCHEVSKI, "Rhodope folk calendar", *Rhodopi*, no. 9 (1990) 34-35 [in Bulgarian].

8. D. SVJATSKIJ, "The Calendar of our Ancestors", *Mirovedenie*, vol. 6, no. 6 (30) (1917), 283-292 [In Russian]; S. SELESHNIKOV, *History*

of the Calendar and Chronology (Moscow, 1972), 153-157 [In Russian].

9. D. SVJATSKIJ, *ibid.*

10. M. MOSKOV, *List of the Bulgarian Khans (New Interpretation)* (Sofia, 1988), 15-18 [in Bulgarian].

11. N. NIKOLOV, V. HARALAMPIEV, *The Astronomers in Antiquity* (Sofia, 1986), 138-139, Table VII [in Bulgarian].

12. V. BESHEVLIEV, *Proto-Bulgarian Inscriptions* (Sofia, 1979), 139-140, Fig. 78 [in Bulgarian].

13. V. BESHEVLIEV, *ibid.*, 200-209, Fig. 142-148.

14. M. MOSKOV, *op. cit.* (ref. 10), 106-115.

15. J. VALCHEV, *The Calendar and the Word* (Sofia, 1986), 174-187 [in Bulgarian].

16. TS. CHOLOVA, *op. cit.* (ref. 1), 175-185; I. DOBREV, "On the Alexandrian and the Moravian - Pannonian Chronology and On Some Dates in the Old Slavonic Literature", *Annual of the Sofia University*, vol. LXIX, no. 2 (1977), 123-174 [in Bulgarian].

17. V. BESHEVLIEV, *op. cit.* (ref. 12), 77, 165-169, Fig. 112-113.

18. TS. CHOLOVA, *op. cit.* (ref. 1), 174.

19. S. SELESHNIKOV, *op. cit.* (ref. 8), 168 [in Russian].

20. J. EXARCH, *Hexameron* (Sofia, 1981); A. MILTENOVA (ed.), *op. cit.* (ref. 1), 40-46, 53-54, 329-331, 332-333.

21. I. DOBREV, "The Order of the Zodiacal Signs in the Miscellany from 1073", *Old-Bulgarian Literature*, no. 5 (1979), 101-105 [in Bulgarian]; E. MUSAKOVA, "The Order of the Zodiacal Signs in Simeon's Miscellany (Svetoslav's Copy from 1073) - An Attempt for Reconstruction", *Palaeobulgarica*, XVI, no. 2 (1992), 123 - 132 [in Bulgarian].

22. T. SLAVOVA, "On an Old-Bulgarian Luni-Solar Calendar", *Palaeobulgarica*, XVI, no. 3 (1992), 23-36 [In Bulgarian].

23. A. MILTENOVA (ed.), *op. cit.* (ref. 1), 331.

24. V. KOLEVA, "Three Wooden Calendars from Western Bulgaria", in *Proceedings of the Second SEAC Conference, Bochum, 1994 (Bochum,* 1996), 163-173.

25. J. VALCHEV, *op. cit.* (ref. 15), 113-114, 176, Photo [In Bulgarian]; P. DOBREV, *The re-discovery of the proto-Bulgarian calendar* (Sofia, 1994), 158-162 [in Bulgarian].

26. I. KLIMISHIN, *Calendar and Chronology* (Moscow, 1985), 263-274 [In Russian].

COPERNICAN ICONOGRAPHY IN MICHELANGELO´S *LAST JUDGMENT*: THE IDEA OF THE CENTRE OF THE UNIVERSE[1]

Valerie Shrimplin
University of Luton, United Kingdom

In the midst of all assuredly dwells the Sun. For who would place this luminary in any other or better position from which he can illuminate the whole at once? Indeed, some rightly call Him the Light of the World, others, the Mind or the Ruler of the Universe .... So indeed the Sun remains, as if in his kingly dominion, governing the family of Heavenly bodies which circles around him.

Lines which appear to be descriptive of Michelangelo's *Last Judgment* (1541, fig. 1) were in fact written by Nicolas Copernicus in *De Revolutionibus* (1543, book 1, chapter 10) in his exposition of the heliocentric universe. Much comment has been made on Michelangelo's unusual depiction of Christ like an Apollonian sun-god, as ruler of the universe in the centre of a dramatic and cosmic circular composition. A leading authority, Charles de Tolnay, discussed the possible influence of Copernicus' heliocentric theory on Michelangelo's fresco, but he eventually dismissed the idea because Copernicus' book was published in 1543, two years after Michelangelo's *Last Judgment* fresco was completed in 1541. Tolnay thus concluded that the artist could have arrived by himself at 'a vision of the universe which surprisingly corresponds to that of his contemporary Copernicus' and commented that heliocentrism was 'rejected by the official theology of the sixteenth and seventeenth centuries'. Because of the discrepancy in dating, the idea of any direct Copernican influence on the fresco has always been discounted, including in scientific publications, but innumerable descriptions of the fresco as 'cosmic' have persisted, without any detailed examination of the fresco in the context of sixteenth century cosmology having been made.[2]

During the Renaissance, cosmology was inextricably linked with theology and philosophy, and also widely reflected in literature. The intellectual influences on the works of Michelangelo are complex, including in particular Catholic Reformation theology which placed a significant emphasis on light and sun symbolism (Malachi 4:2, Psalm 84:11, John 8:12, Revelation 1:16); the Italian literary tradition, especially Dante (c 1265-1321); and neoplatonic philosophy and cosmology as transmitted through the writings of the philosopher Marsilio Ficino (1433-99). Set against this background, Michelangelo's *Last Judgment* fresco was commissioned in 1533 by Pope Clement VII Medici (1478-1534) and completed under Pope Paul III Farnese (1468-1549), and a careful examination of the chronologies of the fresco and Copernicus' discoveries, shows that at the time of the creation of the *Last Judgment*, Michelangelo was quite definitely in a position to have known of Copernican heliocentricity.

Although concepts of the beginning and the end of the universe are now more often considered in terms of the big bang and gravitational collapse, in the Judao Christian tradition, emphasis was placed on these perennial questions as the Biblical Creation and Last Judgment. These are overriding themes in the Sistine Chapel, with the well known *Creation* cycle painted on the ceiling (1508-12) and the *Last Judgment* (painted 1536-41) over the altar. Of cosmological interest also is the unusual reverse orientation of the chapel, with the altar curiously sited in the west, owing to the Christian reuse of an ancient site associated with sun-worship. The Last Judgment itself was based on complex Christian dogma concerning death, judgment, heaven and hell and, as such, it was the one subject in Christian iconography where the three key parts of the universe (heaven, earth and hell) were depicted together. A long tradition existed of the iconography of this scene in relation to the overall view of the universe with heaven above and hell beneath the surface of the earth. In fact, the format for the Last Judgment was always 'cosmological', based on the overriding idea that the Good go 'up' to heaven while the 'bad' go down to Hell, according to the biblical view of the flat earth covered by the 'dome' of heaven.

Interestingly, a very early drawing of the universe in the *Christian Topography* of Cosmas Indicopleustes (sixth century) is accompanied by a drawing of the *Last Judgment* in the same manuscript and the correspondence is obvious. [3] Order was given to the complex scene by arranging it in accordance with the view of the universe, in a strict hierarchical system of saints angels, sinners and damned with Christ depicted in majesty at the top. Versions of the *Last Judgment* during the Byzantine and medieval period almost invariably follow this format, so the rendering of the very complex scene was ordered by relating it to the structured view of the universe.

By the time of the early Renaissance, some variation started to occur in visual images of the universe in line with the gradual acceptance of the idea that the earth was actually spherical, as had been known to the ancient Greeks. Clearly understood by educated persons including Dante, the view of the universe as spherical yet geocentric raised problems in terms of the Biblical concept of movement upwards for heaven and downwards to hell. The concept worked very well in the flat earth scenario but when it was combined with a spherical, geocentric system, then hell becomes the centre of the universe. As Aristotle had pointed out in *De Caelo* (1.2.1358a), the centre of the earth and the centre of the universe were the same. The problem was partly overcome by placing Jerusalem at the centre of the earth's surface according to Ezekiel 5:5, as shown in early maps of the world (such as the so-called T-and-O maps). Reluctant to place hell in the centre of his system, Dante placed Jerusalem in a central position on the surface of the northern hemisphere. He solved the wider issue by arranging the terrestrial universe in concentric circles around Lucifer in the innermost circle of hell in the earth's centre (*Inferno* 34),[4] while at the same time he introduced another circular system of the celestial universe, centred on a specific point of light in the Empyrean around which the heavens revolved (*Paradiso* 28). Dante does not specify, in a proto-Copernican way, that the central point of light which is the pivot of the circular scheme of the Heavens is the physical sun but, in many illustrated manuscripts of the *Divine Comedy*, artists like Botticelli and Giovanni di Paolo certainly appear to read Dante's 'Point' as equivalent to the sun at the centre of the celestial system.[5]

Consideration of cosmological systems, was also heightened at this time by the work of the neoplatonist Marsilio Ficino who, like Michelangelo, enjoyed the patronage of the Medici family in Renaissance Florence. In line with the writings of Plato, Ficino laid great emphasis on sun and light symbolism, and the concept of circular cosmology and his writings and translations of the platonic and hermetic writings became a key source for the analogy between the Sun and Deity in Renaissance literature and philosophy. In his *Commentary on Plato's Symposium* and *On the Sun,* Ficino describes God as the Sun and as the centre of the circles of the universe and acknowledges Plato's *Republic* (Book 6) as the source for the symbolic identification of Sun and Deity.[6] Ficino discusses the neoplatonic concepts of perfection and harmony in the universe and places special emphasis on the central point of the circular system of the universe: 'God is rightly called the centre of all things' (*De Amore,* II, 3). The central point of the circle is 'The greatest wonder in Nature...the middle point of all that is, the chain of the world, the face of all and the knot and bond of the universe' an idea re-echoed by ancient Hermetic writings.[7] Ficino's works were not only popular in Italy, but circulated as far as Kracow in Poland, and it has convincingly been argued that Copernicus was influenced by the writings of Ficino and neoplatonic sun-symbolism in the formation of his theory.[8] Copernicus would no doubt also have been familiar with scriptural light and sun symbolism since he remained a Catholic and credits God with the creation of the universe, albeit a sun-centred one.

Copernicus' outline of his heliocentric theory (*De Revolutionibus Orbium Coelestium*) was published in 1543 so, strictly speaking, it is correct to say that Michelangelo could not have read the book before he completed his fresco. In fact, since *Revolutions* was so highly technical, it would have been unlikely for Michelangelo to have read the complete work even if it had already been published. However, it was not necessary (either then or now) for Copernicus' detailed thesis to be read in order to grasp the heliocentric idea. *De Revolutionibus* is a complex work, but its enormous impact was due to the fact that the details were less important than the basic underlying idea of the sun-centred universe. Reading *Revolutions* and hearing about heliocentricity were, and still are, two very different things. In addition, as is well known in scientific circles, the date of publication of *Revolutions* actually coincided with Copernicus' death at the age of seventy, so this date obviously had little to do with the date of origin of the author's ideas. In his own Preface to *Revolutions* (not to be confused with that added by the publisher Osiander), Copernicus acknowledged his debt to previous proponents of the heliocentric theory in the ancient world (such as the Pythagorean philosophers) and, interestingly, knowledge of the ancient heliocentric theory as proposed by Aristarchus of Samos was transmitted by Vitruvius in his famous *Ten Books on Architecture*, with which Michelangelo was undoubtedly familiar. Copernicus also acknowledged that his writings drew on the work of his more recent predecessors, such as Jean Buridan (1297-1358), Nicholas Oresme (1323-82) and Cardinal Nicholas Cusanus (1401-64) who believed that God was 'an infinite sphere whose centre was everywhere and whose circumference was nowhere.' The heliocentric idea thus originated well before the Renaissance, in the midst of an increasing amount of cosmological speculation, and Copernicus' own ideas were formulated, discussed and even circulated well before the publication in 1543. Nor were such ideas always regarded as heretical by the Catholic Church at this time, as is sometimes implied. Copernicus addressed his Preface to Pope Paul III, to whom the book was dedicated - the very same Pope who acted as patron for Michelangelo's *Last Judgment* [9].

The heliocentric view of the universe clearly originated well before the time of publication of Copernicus' book and his death in 1543. His ideas were made public and circulated in manuscript form from the beginning of the sixteenth century and as he states, he kept them lying concealed 'not merely until the ninth year but by now the fourth period of nine years.' Copernicus had been widely recognised as a leading astronomer for decades. He had been invited by the Fifth Lateran Council to assist in calendrical reform in 1514 and reports of his research had been circulating in the *Commentariolus*. The actual publication of his work had been eagerly awaited for some time but his theory was not published, almost certainly because of fear of ridicule by the masses rather than fear of persecution by the church.

Copernicus and Michelangelo were almost exact contemporaries (Copernicus was born in 1473; Michelangelo in 1475), and Copernicus actually spent seven years studying in Italy, moving in similar circles of learning as Michelangelo and becoming influenced by the current intellectual trends of the day. Both Michelangelo and Copernicus were in Bologna in 1496[10] and they also were both in Rome in 1500, when Copernicus gave some public lectures. Neoplatonism acquired in centres like Bologna is evident in Copernicus' attitude to ideas of mathematical harmony as well as the sun itself, which he almost deifies. Actual quotations from Plato are quite common in Copernicus' writings, and were also of interest to members of the Papal court since both popes involved with the commission of the *Last Judgment*, Clement VII and Paul III, had grown up alongside Michelangelo in the Medici household in Florence. In fact the Protestants, such as Martin Luther (in 1539) and Melanchthon (1541), were far more opposed to the theory than the Catholics, ruling out any idea that the acceptance of Copernican ideas could be linked with Protestant heresy. In the years leading up to the commission of the *Last Judgment*, more and more evidence can be found that Copernicus' ideas were popularly known, that his book was eagerly awaited, well before it was actually published, and that neither the Pope nor anyone else in Rome seemed to be shocked by the proposed system which made swift progress amongst learned circles.[11] The key feature of the Copernican system, namely that the earth lost its central place and was simply a planet travelling around a stationary sun, had immense theological implications and challenged traditional scriptural concepts about God's creation, the place of mankind in the universe and the location of Heaven and Hell. This eventually caused great anxiety, but the real storm did not break until the experimental work of Galileo and Kepler in the next century. The strict phase of the Counter Reformation with the Inquisition and the *Index of Prohibited Books* was not instigated until after 1542 (notably *after* the completion of Michelangelo's fresco), and even then both *Revolutions* and the *Last Judgment* survived the severe Counter Reformation period. Michelangelo's fresco survived the Council of Trent in spite of opposition during the 1550s, and *Revolutions* was not banned until 1616, seventy-three years after its publication and the death of its author.

What is more, and what shows that it was neither impossible nor heretical for Copernicus' ideas to have influenced Michelangelo's design for the *Last Judgment*, is the fact that Clement VII, who inaugurated that commission and was a long standing close friend of Michelangelo, had also shown a high degree of personal interest in the heliocentric theory, long before its publication. In 1533 Clement VII actually requested that Copernicus' theory, of which he had evidently heard, should be explained to him and a number of other high dignitaries of the Catholic Church in the Vatican itself. This fact, evidently better known in scientific circles than in artistic ones, was documented by the lecturer Albert Widmanstadt, on the cover of a precious manuscript which was presented to him by the Pope to mark the occasion. This manuscript is now in the Staatsbibliothek, Munich, and the inscription clearly states that Widmanstadt had explained Copernicus' teaching to Pope Clement VII and others at a special lecture:

Clement VII Supreme Pontiff presented this codex to me as a gift A D 1533, in Rome, after I had, in the presence of Fra Ursino, Cardinal Joh. Salviati, Joh. Petrus Bishop of Viterbo, and Matthias Curtius, medical physician, explained to him in the garden of the Vatican, Copernicus' teaching concerning the motion of the earth.[12]

Of those present, Cardinal Orsini was related to the Medici family by marriage, and Bishop Johannes Petrus was from Viterbo (a focal point for the Catholic Reformation, and frequented by Michelangelo's companion Vittoria Colonna). More significantly, Cardinal Giovanni Salviati was the son of Michelangelo's longstanding friend Jacopo Salviati (married to a daughter of Lorenzo de' Medici), and the cardinal was of himself a close friend of Michelangelo, shown by his letter (1 July 1531) describing Michelangelo as 'amico nostro.'[13] Widmanstadt was also the 'disciple' and protégé of Giles, Bishop of Viterbo (d. 1533) who had been the theological adviser to Michelangelo for the *Creation* cycle on the Sistine Ceiling. Far from it being 'impossible' therefore for Michelangelo to have heard of the Copernican Sun-centred universe at the time of the commission of the *Last Judgment* fresco, it seems highly unlikely that he would have been ignorant of the theory. The precise timing of the meeting can be set between June 1533 when Johannes Petrus succeeded Giles as Bishop in Viterbo and September 1533 when Clement VII left Rome to negotiate a treaty in France. It seems likely that interest was precipitated by the appearance of a comet in mid June that year, so, taken with the '6.33' at the bottom of the manuscript, a date in June 1533 seems highly likely. Michelangelo was in Rome in 1533 until the end of June when he left for a visit to Florence. It is largely accepted that the commission was first discussed and decided upon at the meeting between Pope Clement and Michelangelo at S Miniato al Tedesco on 22 September 1533, so the discussion between Pope and artist about the commission thus took place a matter of weeks after Clement had had Copernicus' theory explained to him by a professional lecturer. It is thus possible to compile a concrete list of persons in Rome, within the higher reaches of the Catholic Church, who quite definitely knew of the theory and with whom Michelangelo came into close contact. Widmanstadt was associated with Theodoric of Radzyn, the representative of Copernicus' chapter of Varmia at Rome, so a direct contact through a chain of no more than five persons is traceable between Michelangelo and Copernicus in mid-1533, at exactly the time of the commission of the *Last Judgment* (namely, Copernicus - Radzyn - Widmanstadt - Clement and/or Salviati[14] - Michelangelo).[15]

After Clement VII died in 1534 and was succeeded by Pope Paul III Farnese (who had also known Michelangelo since his youth and interestingly was also at S Miniato in September 1533), the Vatican continued to show an interest in Copernican ideas. Assisted at first by Sebastiano del Piombo, the actual painting was undertaken by Michelangelo working alone, from April/May 1536.[16] Significantly, just a few months later, 1 November 1536, another Cardinal, Nicholas Schönberg, wrote a direct letter to Copernicus, urging him to publish his theory. The letter makes it absolutely clear that Copernicus' ideas had been regarded as common knowledge for several years, that his talent was recognised by the Catholic Church, and that the Vatican itself was anxious for him to publish and communicate his ideas as soon as possible: 'Some years ago word reached me concerning your proficiency of which everybody constantly spoke .... For I had learned that you had formulated a new cosmology. In it you maintain that the earth moves; that the sun occupies the most central place in the universe.... I entreat you to communicate this discovery of yours to scholars .... ' and so on.[17] Since the actual painting of Michelangelo's *Last Judgment* fresco had begun a few months earlier (summer 1536) Schönberg's letter could thus be viewed as an urgent request for further information as the fresco got underway. A possible relationship between Schönberg's request and the painting of the fresco appears particularly likely in view of Pope Paul's *motu proprio* forbidding Michelangelo to undertake any other work, which was dated the same month, 17 November 1536. Referring back to the attendees at the Vatican lecture, Salviati had been a close colleague of Schönberg (together negotiating the Treaty of Cambrai, 1529) and Widmanstadt had incidentally become secretary to Cardinal Schönberg by 1534. Schönberg was also personally acquainted with Michelangelo, since he commissioned a drawing from the artist in 1532 (now lost) and features in several of the Michelangelo letters and documents.[18]

In 1540, before Michelangelo's fresco was completed, the *Narratio Prima*, the 'first narration' of Copernicus' theory was published by Rheticus and no adverse reaction was forthcoming from the Catholic Church. Considering the implication of a dedication and the strict application of the papal imprimatur in publication at this time, the tacit approval of Pope Paul III is indicated, since he took no action which suggests 'approval' rather than mere 'knowledge' of the heliocentric theory in Vatican circles in the 1530's and early 1540s. Neither Clement VII nor Paul III was likely to have permitted the public expression in the Papal Chapel of ideas which they did not sanction.[19] Approval is also indicated by the fact that Pope Paul commissioned further major work from Michelangelo in 1541 and appointed a superintendent to care for the Sistine frescoes.

The idea that Michelangelo's revolutionary design for the traditional scheme of the *Last Judgment* in the Sistine

Chapel could be an expression of the revolutionary heliocentric cosmology of Nicholas Copernicus thus seems entirely plausible. During the years 1533-41 which saw the inception and completion of Michelangelo's *Last Judgment*, Copernicus' theory of the Sun-centred universe was not only well known in the Vatican, but quite simply not regarded as being in conflict with Catholic Church doctrine. The idea that the sun was central and immobile while the earth hurtled through space had been regarded as absurd, but the realisation that the earth was indeed merely a planet like many others that rotated around the sun in an apparently infinite universe, came increasingly under consideration and did eventually shatter theological understanding. Heaven and Hell could no longer be simply placed as 'up' or 'down' so the church then prohibited the teaching which placed the sun as the centre of the universe - but not at the time when Michelangelo painted the *Last Judgment*.

Seen against the tremendous interest in the sun - in theology, literature and philosophy - which served as background to Copernicus in the same way as to Michelangelo, the identification of God with the sun made the heliocentric theory the logical next step towards a solution of the anomalies of the haidocentric nature of the spherical geocentric system. The revelation of Copernicus' scientific theory seems to have acted as a precipitating factor to cause all these concepts to fall into their rightful place - a view which appears to have been expressed in Michelangelo's fresco with the due knowledge consent and approval of the popes concerned. The idea of placing God personified as the Sun in the centre of the universe solved the inconsistency in the Christian tradition of equating the Deity with the sun, which in earlier systems was merely a minor and fluctuating cosmological feature. Mankind, it is true, had been taken away from the central place in the universe; but God was far more logically placed there instead - so the traditional analogy between Sun and Deity was justified at last.

Michelangelo was nurtured on Ficino and Dante, then exposed to Catholic reform thought and commissioned to paint what was a traditionally cosmological subject at a time when Copernican heliocentricity was receiving a great deal of attention in Vatican circles. Evidence of papal interest in Copernican heliocentricity could well indicate a Copernican theme in the iconography of Michelangelo's painting. Conversely, of course, from the scientific point of view, Michelangelo's fresco may be taken as evidence of the early acceptance of the heliocentric theory within the upper reached of the Catholic Church - an argument notable for its perfect circularity. The depiction of Christ as the Sun in the centre of the circular format appears to indicate that Michelangelo was aware of Copernican heliocentricity, that his painting reflects it, and that at the time this was neither 'impossible' nor heretical. Just as before, the ordering of the complex scene was achieved by relating it to the contemporary view of the structure of the universe; it was simply the cosmological framework which had changed.

However, there are still some formal art historical problems to be addressed in the actual production of the fresco on a wall surface over 17 metres high. The Christ-centred circling design overrides the traditional layered format and fresco techniques which might have been used to achieve this in a work of this magnitude suggest the use of some device, such as a rotating plumb-line affixed to a point on the surface of the painting (as described by Cennini in his artist's handbook of 1437). In such a system, the selection of a specific central point would become necessary and would be likely to have special significance or meaning. The central point of the universe can be traced from ancient times: Delphi in ancient Greece, the omphalos in the Dome of the Rock in Jerusalem (7th century), in T-and-O maps and in Dante's two points for his terrestrial and celestial systems. Ficino's circular cosmology is firmly deocentric. The central point was also, of course, emphasised by Copernicus. Simply because of the method necessary for the fresco's construction, Michelangelo would have to choose a very precise 'single, indivisible and stationary point' (Ficino) on which 'depend the heavens and the whole of nature' (Dante), not simply the figure of Christ. By the manipulation of transparencies marked with circles on a large scale reproduction, the arrangement in inner and outer circles around Christ becomes clear and it is possible to locate the precise centre of the circular composition. The centre does not appear to be at Christ's head (suggesting mind or intellect), heart (suggesting emotion) or right hand (suggesting judgment) as might perhaps be expected, but the focal point is lower down, centred on the drapery in the exact centre of Christ's right thigh as the pivotal point of the whole design - reinforced by a great deal of diagonal movement in this direction. A precise mark or nail hole in the centre of the thigh where a constructional device such as a rotating or hinged plumb-line could have been affixed is clearly visible at this point. Amongst all the theological, literary and philosophical references that might have inspired Michelangelo's selection of the specific point as the pivotal centre of the entire cosmological fresco, *Revelation* is the most probable source - and the description here of the Christ of the Judgment reads 'And he hath on his vesture and on his thigh a name written, KING OF

KINGS AND LORD OF LORDS' (Revelation 19:16). It does not seem to be mere coincidence that this text is immediately followed in the Bible by a reference to the Sun-symbol: 'And I saw an angel standing in the sun...' (v. 17). In the Sistine *Last Judgment*, Christ is thus depicted (theologically, neoplatonically and scientifically) as Michelangelo viewed Him: as King of Kings and Lords of Lords, the Sun, the centre of the Universe.[20]

NOTES AND REFERENCES

1. This paper has been adapted from my PhD thesis *Sun-symbolism and Cosmology in Michelangelo=92s Last Judgment* 1991 (and my book of the same title, vol. 46 of Sixteenth Century Essays.

2. For example, CHARLES DE TOLNAY, *Michelangelo*, (Princeton, 1943-60) vol. 5, 49, 120; B. BIENKOWSKA, ed., *The Scientific World of Copernicus* (Dordrecht, 1973), 104.

3. Owing to limitations of space, works referred to could not be illustrated here, but will be found reproduced in works cited in note 1 above.

4. The precise centre is the middle of Lucifer's body, specifically his thigh ('coscia') *Inferno* 34:76-77.

5. See P. BRIEGER, M. MEISS and C. S. SINGLETON, *Illuminated Manuscripts of the Divine Comedy*, 2 vols. (London, 1970). Dante discussed but dismissed the heliocentric idea (Convivio 3, 5).

6. See M. FICINO, *Commentary on Plato's Symposium on Love*, transl. S. Jayne (Dallas, 1985) 47-48, 134; Arturo B. Fallico and Herman Shapiro eds., *Renaissance Philosophers: The Italian Philosophers* (New York, 1967), 118-41 (especially 132: 'the sun sits as if occupying a rock in the centre, in the manner of a king...'). The importance of Plato's cosmological work *Timaeus* at this time is confirmed by the fact that Plato is depicted in the Vatican *School of Athens* bearing the volume under his arm.

7. M. FICINO, *Theologia Platonica* (1469-74) book 3, caput 2. See R. MARCEL, *Marsile Ficin. Théologie Platonicienne*, tome 1 (Paris, 1964), 142.

8. See ARTHUR KOESTLER, *The Sleepwalkers. A History of Man's Changing Vision of the Universe*, (Harmondsworth, 1984); T. S. KUHN, *The Copernican Revolution. Planetary Astronomy in the Development of Western Thought* (Cambridge, 1957).

9. See TOLNAY, op. cit., 122; L. STEINBERG, 'Michelangelo's *Last Judgment* as Merciful Heresy,' *Art in America* 63 (1975) 49-63 (Christ is described as 'Sunlike, Copernican'). The Catholic Church decree that the idea of the sun as central and immobile was 'foolish and absurd, philosophically false and formally heretical' did not follow until 1616.

10. Michelangelo was in Bologna between 1493 and late 1496 He left in 'winter' 1496 (i e January/February or November/December 1496). Copernicus arrived there in 'autumn' 1496 (L. PROWE, *Nicolaus Coppernicus*, vol. 1 (Berlin, 1883) 233). Michelangelo's patron in Bologna was Gian Francesco Aldovrandi, while Prowe notes Pietro Aldovrandi as among the 50 professors at Bologna with whom Copernicus would have studied (*ibid.*, 234).

11. A. KOYRÉ, *The Astronomical Revolution* (London, 1973), 65; B. BIENKOWSKA, *op. cit*; SHRIMPLIN, *Sun-symbolism and Cosmology*, chapter 8.

12. Translation of Codex Graecus *Monacensis*, 151, Bayerische Staatsbibliotek, Munich.

13. P. BARROCHI, *Il Carteggio di Michelangelo*, vol. 3 (Firenze, 1973), 315.

14. The involvement of Cardinal Salviati is of interest since Galileo later enjoyed the patronage of Filippo Salviati 1582-1614 (whose aunt Isabella was married to the cardinal's nephew; see P. HURTUBISE, *Une Famille-Temoin: Les Salviati*, Vatican, 1985, 496-499). Galileo also chose the name Salviati for the interlocutor in his *Dialogues* (1630). The link between the attendee at the Vatican lecture, Galileo's patron and choice of the name Salviati has not, to my knowledge, previously been drawn, and suggests long term support for the new astronomy (*ibid.*, 297).

15. Copernicus' reference (in his preface written in 1542) to his suppression of publication 'for 9 years' could well be further reference to the 1533 meeting at the Vatican.

16. Sebastiano had written excitedly to Michelangelo 17 July 1533 with news that the Pope was to provide Michelangelo with a commission ' for such a thing as you have never yet dreamed of ...'. And Sebastiano had recently been working on the completion of Giorgione's astronomical painting of the *Three Philosophers* (one allegedly a portrait of Copernicus). Two early drawings for Michelangelo's *Last Judgment*, the 'Bayonne' drawing (1533) and the 'Buonarroti' drawing (1534) have cosmic allusions since the former outlines the

composition with circular lines, while the latter depicts Mary 'with the moon at her feet' (Revelation 12:1). For documentation on the fresco, see TOLNAY, *op. cit.* and L. MURRAY, *Michelangelo: his Life and Work and Times* (London, 1984).

17. Schönberg's letter is reprinted in KOESTLER, *op. cit.*, 154-55. See also A. FANTOLI, *Galileo: for Copernicanism and for the Church*, trans. George V. Coyne (Vatican, 1996).

18. TOLNAY, *op. cit.* 5: 20-21; Barrochi, *op. cit.* vol. 3, 301, 328. 340.

19. Opposition to Copernicus in the Vatican in 1544 has been discussed by E. ROSEN, *Journal of the History of Ideas*, 36 (1975) 531-542, but *Revolutions* was still left untouched which surely demonstrates Papal support at this time (which in any case postdates complation of the fresco).

20. Short of the discovery of a hand written declaration by the artist that he was a card-carrying Copernican, it is difficult conclusively to prove the present hypothesis, but the recent cleaning of the fresco (resulting in the removal of centuries of grime and the previous 'dark desperate atmosphere') reinforces the perception of an emphasis on light and sun-symbolism.

THE SUBARCTIC HORIZON AS A SUNDIAL

Thorsteinn Vilhjálmsson
Physics Dept. Science Institute
University of Iceland, Reykjavik, Iceland

ABSTRACT

In the Arctic and the Subarctic the diurnal circle of the sun is quite oblique. The azimuth of the sun is thus an approximate measure of time through the day, which it is not when you go further south. In the Old Norse world it was customary to divide the horizon into octants (eyktir) and find markers in the landscape corresponding to each of them, as seen from a given farm (eyktamörk). Solar motion relative to these markers would then be taken as a measure of time, indicating the meals and other specific jobs to be done during the day. More specifically, this was e.g. used in order to determine when to finish work on Saturdays in accordance with Church regulations.

Other means for measuring time during the day seem not to have been present. People might even go so far as giving the azimuth of the sun instead of the time of day in a more direct way as we are used to.

Now, in the subarctic zone the "azimuth clock" as defined in this way will vary its speed both during the day and during the year. In the paper, this will be demonstrated in graphs and figures, depending on the latitude. Also, the strengths and weaknesses of the azimuth clock will be discussed.

A sundial can be used when travelling in unknown lands, given that you can e.g. observe the Polar Star. In a similar way the «azimuth clock» can be used when you observe for instance the culmination of the sun. In the reports of the Viking voyages to America there is a famous comment on the solar motion at winter solstice. The interpretation of this passage will be discussed in the paper.

INTRODUCTION

From the long history of astronomy and culture two instruments stand out as the pre-industrial "clocks" for measuring time during the day, the sundial and the water clock (clepsydra). For most purposes of pre-industrial society these instruments have been satisfactory in terms of precision. However, from the point of view of subarctic rural society they had some drawbacks which may not have applied elsewhere in the world. For instance, when travelling in the northern summer you can not use the altitude of the Polar Star to adjust the sundial because of the bright nights. And the water clock would presumably demand more attention than you could afford on a more or less isolated farm in the rural Old Norse society.

THE OLD NORSE

The so-called Old Norse period in north-western Europe may for the present purposes be taken to have lasted from around 800 until 1300. Thus we may take it to begin with the Viking raids in the British Isles in the late 780s, and end with the decline of saga writing in the 13th century in Iceland. Until around 1100 there was no writing in Old Norse society. But at that time people in Iceland started writing in the vernacular and on recent events from their history.

We have many kinds of sources on life in Old Norse society. The presently most prolific field of sources is that of archaeology. As to Old Norse knowledge of scientific matters, astronomy and navigation, our sources consist of various kinds of texts and artefacts. But we also have the historical fact of the settlement of the Atlantic islands, e.g. Iceland and Greenland, and the fact of the voyages to North-America. The settlements involved organised transoceanic traffic over one of the most hostile ocean areas of the world. Thus you needed, among other things, knowledge and skills to be able to find your way over the vast stretches.

As far as we can see from the various sources the Old Norse used very few and simple instruments for their timekeeping and navigation. There is for example no evidence that they knew a sundial or a water clock. As for the sundial we will argue that they had little reason - at least less reason than others - to produce and use such an instrument.

SOME TEXTUAL SOURCES

We now focus on the characteristic features of the methods used by the Old Norse for measuring time during the day. The most famous medieval Old Norse "astronomer" is Star-Oddi Helgason from the middle of 11th century. In a saga text he is described as a man well versed in time reckoning and wise in many other respects.[1] In a text on calendar and astronomy from the later part of the 12th century part of his knowledge is described like this:

> So thought Star-Oddi, who was the wisest of all people who have been in our country on the appearance of the motion of the heavenly bodies, that upon a leap year in the spring solstice would be in the following summer *in the middle of Southeast* on the day of Vitus' mass; that is nine days before the mass of John the Baptist, but in the following winter *in the middle of night* at the second night after Lucia's mass; then there are ten days to Christmas Day. The second summer *in the middle of Southwest*, still on Vitus' mass, but in the following winter solstice is *in the middle of east* ten days before Christmas Day. In the third summer solstice is *in the middle of Northwest* after Vitus' mass in the evening. But the winter after that *when the Sun is in the middle of south* on the tenth day before Christmas Day. The fourth summer *in the middle of Northeast* the next morning after Vitus' mass, but in the following winter solstice is *in the west* after the tenth day before Christmas Day. Then the counting does not proceed because then Vitus' mass will be a night later than it would seem until then, since a leap year has come in, and then the solstice will be *in Southeast* on Vitus' mass as in the beginning.[2]

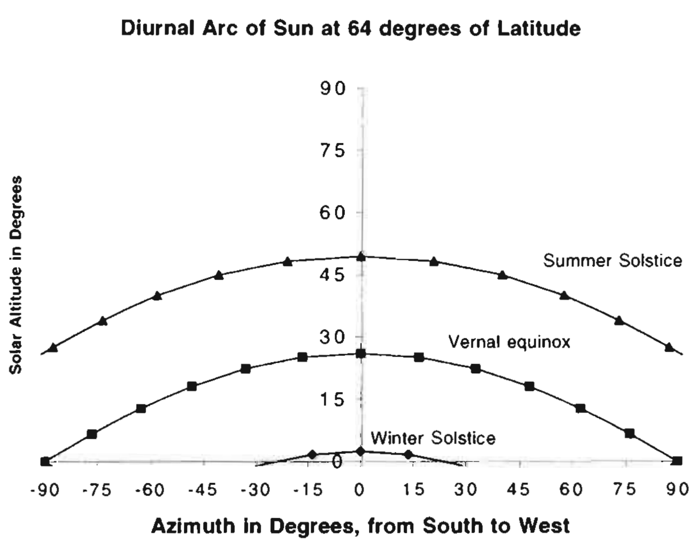


Figure 1. The diurnal arc of the Sun at 64 degrees of latitude for three different times of the year. *The triangles, squares and diamonds mark integer numbers of hours from local noon.*

Apart from the dates of the equinoxes, this text is probably not to be seen as describing real observations. Rather, it is an exercise in the Julian calendar which had recently been introduced in Iceland. However, this is not so much our concern as the meaning of the words which have been italicised. What does it mean to say that solstice is in the middle of Southeast? From the text it is clearly an abbreviation for the sun being in Southeast. This of course, in a given day, happens at a certain time of the day. But why does Star-Oddi then not just tell us the time in hours?

The first thing to remark is that he would not have used hours at all, although they were being introduced in his society at his time. This society, however, traditionally used the time unit "eykt" which was approximately 3 hours or one eighth of the 24 hours day. Correspondingly, we find in texts that people refer to a kind of unit for angles at the horizon which they call "átt" or octant. In some manuscripts the time unit of "eykt" and the azimuth angle unit of "átt" clearly mix.

When Star-Oddi gives us the timing of solstices through the azimuth of the sun he is pretty close to the tradition of eyktir. The main point is that he uses the *motion of the sun along the horizon as a measure of time*. Most readers will realise that this would not be a good measure if he had been living in the Canary Islands. So, he is utilising the peculiarities of the solar motion at his subarctic place of living, where the celestial pole is pretty high and the diurnal path of the sun is quite oblique, such that its speed along the horizon may not be too far from constant. Another knowledgeable person, from the 13th century, thus states without further ado:

> The Sun passes through nearly an octant [of direction, i.e. 45 degrees] in three hours, but in six hours through two octants, twelve through four, but 24 through eight, i.e. around the whole world.[3]

This use of the azimuth clock is in fact a tradition which has survived in Iceland up to the present day, in the so called *eyktamörk* or octant marks. Each farm or small village may thus have some points defined in the landscape at the horizon, a mountain, a pass or something similar, for marking the horizon position of the sun at the octant times of the day. This is what the title of the paper refers to: The motion of the sun along the horizon is being used as a (rough) measure of time.

QUESTIONS OF PRECISION

Now, it is natural for modern people to look into the precision of this method. We can take the latitude of Reykjavík, 64 degrees N, as a typical example. *Figure 1* shows a graph of the visible diurnal solar motion between east and west at summer solstice, equinox and winter solstice. We can see that the sun is clearly not above the same horizon point at the same local time on these three days of the year. The maximum difference is of the order of 10 degrees in azimuth. Thus the clock obtained this way (the "azimuth clock") is often wrong by 2-3 quarters of an hour. This may, however, have been quite tolerable for a pre-industrial, rural and agricultural society.

For comparison, *Figure 2* shows how this would work out in a more southerly place, at 40 degrees N. From the figure we quickly see that the azimuth clock is totally unusable in this case. Hence, we understand why the subtropical people rather quickly took the step from the gnomon to the sundial. We can also see this as an example of how astronomy, at least its more practical branch, may depend on latitude.

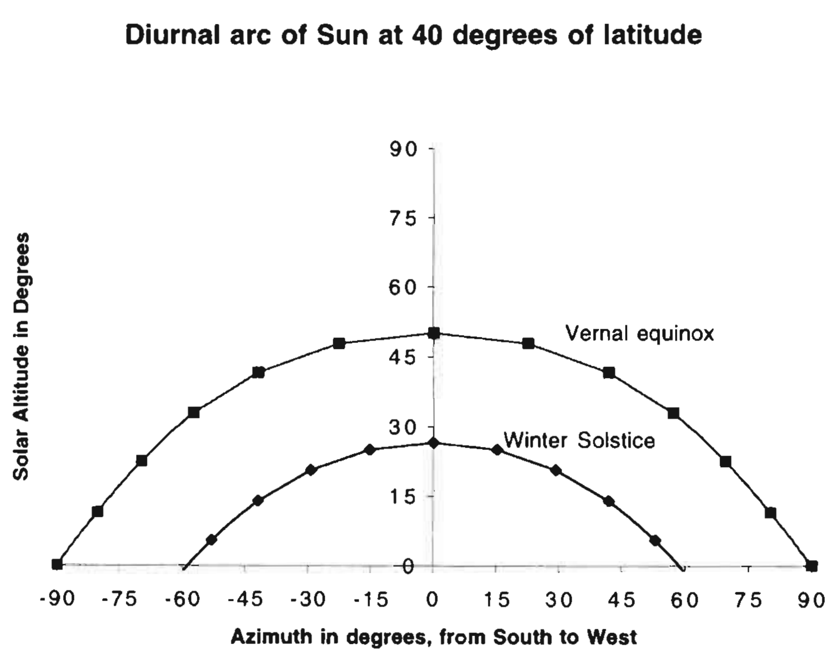


Figure 2. The diurnal arc of the Sun at 40 degrees of latitude for two different times of the year. *The arc of summer solstice is too high to have any relevance here. You can see from the variable distances between the markings on the curves that the "azimuth clock" works badly at this latitude.*

THE EMPHASIS ON THE SUN

The general impression from Old Norse texts and other sources is that Old Norse navigators emphasised the Sun in their observations. This has to do with the invisibility of the fixed stars at the time of year they were sailing, because of the bright nights in the north. In the Norwegian *King's Mirror* from around 1260 the writer is describing circumstances in the region around Trondheim in Norway. The father says to the son:

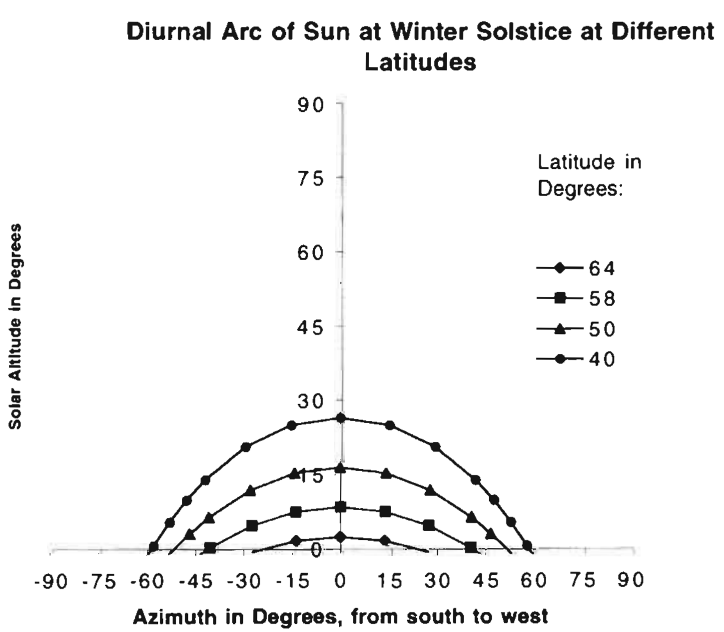
> You know that here in the winter we have little day and solar motion, so that the sun does not have larger course than that of rolling through one octant [45 degrees], and this holds only where the power of the sun is fairly good.[4]

Besides this the writer gives a good description of the visible solar motion in Helgoland (Halogaland), which is mostly north of the Polar Circle.

The Old Norse pilots used this kind of knowledge of the solar motion for their navigation. Many of them knew a considerable area of the earth, say for instance from the southern tip of Norway at 60 degrees north to the Polar Circle in Norway, Iceland or Greenland. Some of them even covered a much larger area. But even those who made do with the North Atlantic clearly noticed how solar motion changes in the area. One of the simplest ways of seeing this is by comparing solar motion at winter solstice in various places. If you are for instance at around 58 degrees north the solstitial Sun will almost reach the mark of rising in Southeast and setting in Southwest, see *figure 3*. The author of the *King's Mirror* would have stated this in the terms that the Sun "rolls through two octants". This is conspicuously more than it does in the Trondheim area or in Iceland. On the other hand, when you go south of 58 degrees this azimuth extension of the solstitial solar motion increases somewhat but not very much.

The people who navigated the Viking ships all the way to the American continent a thousand years ago clearly had this kind of knowledge at their power. At a certain place in the 12th-13th century reports we find the following description of a place in America:

> Night and day were more equal there than in Greenland or Iceland; the sun passed the octant marks at Southeast and Southwest in the shortest days of the year.[5]



As already mentioned, and shown by the figure, the solstitial sun passes through the octant points at around 56 degrees of latitude. This is further south than most of the Wineland explorers had presumably been in Europe. They have therefore noticed this and found it worth reporting. Another reason for noting this is that they have found the relation between solar motion and climate different from what they were used to from the domain of the Gulf Stream. The winter was colder than they expected from the solar motion which they described so succinctly.

Figure 3. The diurnal arc of the Sun at winter solstice at four different latitudes. *You can see that the length of the azimuth arc varies strongly with latitude when you are far north. When you get further south the variation becomes less conspicuous. Thus, the maximum angle of the sunset point is only 66,5 degrees, at the equator.*

However, as to the exact locality of this observation, we can only conclude that it was made south of 56-58 degrees of latitude, which is about that of Newfoundland. From the report on the observation we can, on the other hand, not conclude how far south of this it was made. Thus, since we know from the archaeological excavations at L'Anse aux Meadows in northern Newfoundland that the Old Norse came there, this observation reported in the text does not give us any extra information with respect to the extension of Old Norse travel in America. Its message to us is methodological rather than factual.

CONCLUSIONS

The Old Norse were skilled navigators who initiated organised regular traffic over the North Atlantic, one of the most adverse ocean areas of the world. This ocean is so large that they would often not see land for several days or weeks. Hence they would try and look for other signs in the surrounding nature, among them the signs from the sky. Since they were sailing in the period of bright nights in the north, the motion of the Sun was the most useful celestial phenomenon for their navigational efforts. This in fact also holds for the subarctic farmer in his most important season, the summer.

Among other things the Old Norse found out that for their pre-industrial purposes they could use the azimuth of the Sun as a measure of time during the day. They also used related knowledge of solar motion for many purposes in travelling and navigating. This can be seen as an example of the flexibility and diversity of uses of astronomical knowledge for the various purposes of people in different places of the Earth.

NOTES AND REFERENCES

1. TH. VILMUNDARSON (ed.), "Stjörnu-Odda draumr", *Íslenzk fornrit* [Icelandic Medieval Literature], *XIII* (Reykjavík, 1991), 451.

2. N. BECKMAN and KAALUND (eds.), *Alfrœði íslenzk II* [Icelandic Encyclopedic Literature] (Copenhagen, 1914-1916), 48-50. - My translation and italics.

3. N. BECKMAN and KAALUND (eds.), *op. cit.*, 94. - My translation.

4. L. HOLM-OLSEN (ed.), *Konungs Skuggsjá* [King's Mirror] (2nd edn., Oslo, 1983), 12. - My translation.

5. E.O. SVEINSSON and M. THORDARSON (eds.), "Grænlendinga saga". *Íslenzk fornrit IV* (Reykjavík, 1935), 251. - My translation. Cf. another translation in M. MAGNUSSON and H. PÁLSSON (eds.), *The Vinland Sagas: The Norse Discovery of America* (Harmondsworth, 1965), 56.

PRE-COLUMBIAN ASTRONOMY IN CENTRAL AREA OF THE PERÚ

Elena Ortiz García
Dpto. Física Teórica
Universidad Autónoma de Madrid, Spain

ABSTRACT

This study is part of a multidisciplinary project intended to achieve a comprehensive vision of the Central Region of the Perú.

These first results are based on the analysis of several chronicles: mainly the *Manuscript of Huarochirí*[1] and the complementary data from the *Carta Annua of 1609*[2]. A comparison with other Andean areas, mainly from Cuzco and Titicaca, has been carried out, according to data from *Nueva Corónica y Buen Gobierno* of Guaman Poma de Ayala[3], *Historia del Nuevo Mundo* of Bernabé Cobo[4], *Comentarios Reales* of Garcilaso de la Vega[5] and *Errores y Supersticiones de los Indios* of Polo de Ondegardo[6].

THE MANUSCRIPT OF HUAROCHIRÍ

The importance of the *Manuscript of Huarochirí* lies on the fact that it is the only indigenous source, written in Quechua, which deals with pre-Columbian traditions in the Central region of Perú. The Manuscript was written in the early post-conquest time, between 1598 and 1608. The author is unknown, but must be from the Checa community of San Damián[7]. Our study is based on the Taylor's Quechua-Spanish version, published by the Instituto de Estudios Peruanos in 1987. Despite other versions are available, from our point of view this is the most confident to the original.

Essentially two chapters are relevant for our work: chapters 9 and 29. The first is about solar observations carried out with a calendaric purpose and the second describes with detail some astronomical objects worshipped in the area, in particular the so-called *dark constellations*.

Figure 1. Location of Huarochirí region in Perú

GEOGRAPHICAL DATA

The region of Huarochirí, between 12° and 13° S of latitude - i.e. in the tropic region - and at around 77° W of longitude, is enclosed by the Chillón and Mala rivers. It includes the valleys of the Lurín and the Rímac. Despite this region does not strictly extend to the coast, the author of the Manuscript clearly states that *Pachacámac* and other villages along the coast had the same traditions. In fact, the commercial and cultural exchanges were continuous in the area[8].

The population in 1540 has been estimated in around 30000 habitants. *Yuncas*, who was the autochthonous population of Huarochirí and Chaclla-Mamaq regions, had been in part displaced and in part absorbed by the *Checa* from the high land at the beginning of 16th century, as the Manuscript of Huarochirí and the testimonies collected by Spaniards at their arriving state. The *Yunca* that stayed in the area acquired the invaders' traditions, particularly the cult to *Pariacaca*[9], and even the specialised priests were *Yunca*.

SOLAR OBSERVATIONS

As we have remarked above, the author of the Manuscript points out that solar observations were carried out in order to determine the beginning of at least two of the three main celebrations[10]. These observations were made by specialists called *yañcas*. This office was hereditary, probably because of the deep and secret knowledge required for the local rites.

"...nunca se elige el Yañac, que esta dignidad no se da sino a quien le viene por succesión siendo de la Tribu o ayllo de los Sacerdotes y es officio perpetuo"[11]

In fact, despite the rituals were in honour of gods imported to the region by the *Checa*, the *yañcas* were of the *Yunca* community. This could be explained if one of their main functions were the astronomical observation, which the autochthonous people had likely been carrying out for long time in the region. Therefore their knowledge of the sky made them essential for the invaders.

Observational Method

The most interesting point in the Manuscript for future archaeological work is the description of the observational method used to determine these special dates. However, contradictions appear comparing the two main written sources. The Manuscript of Huarochirí states the use of a wall, built with precise rules, as a gnomon. The shadow that the sun casted on the wall marked the day of the celebration.

> *"...estos hombres observan el paso del sol desde un muro construido según reglas muy precisas. (Esto es la sombra que va haciendo la pared con el sol) Cuando alcanza el muro en cuestión, dicen a la gente que ha llegado el día o que será el día siguiente"* [12]

However, the Carta Annua tells about a hill used as a horizon marker for that date.

> *"...se assienta el Yañac en cierta parte y aguarda al salir del Sol. Y mira si comiença a asomar por cierta parte de un cerro que ya tiene marcada. Y en llegando el Sol a la señal da aviso a los oficiales"* [13]

The comparison with other chronicles reflects that both methods were also used in other Peruvian regions. Garcilaso de la Vega mentioned the use a column erected in the middle of a square in front of Sun temples as a gnomon. The officers marked the E-W direction with a line. When the shadow casted by the column went along this line, the equinox had arrived.

> *"...Para verificar el equinoccio tenían colunas (...) puestas en los patios o plaças que havía ante los templos del Sol. Los sacerdote (...) tenían cuidado de mirar cada día la sombra que la coluna hazía (...) Echavan por hilo, de oriente a poniente. (...) Por la sombra que la coluna hazía sobre la raya veían que el equinoccio se iva acercando; y cuando la sombra tomava la raya de medio a medio, desde que salía el Sol hasta que se ponía."* [14]

Guaman Poma mentions the use of windows with similar functions[15]. Hills and pillars as horizon markers are also described in several chronicles. For example, Bernabé Cobo and the Anonymous chronicler relate the existence of a *huaca* called **Sucanca** - a set of columns - used as horizon markers in Cuzco[16].

Dates of Observation

In order to carry out further research in the Huarochirí region, in particular the searching of such architectonic constructions - columns and walls -, we need to establish with some precision the dates of those main celebrations. However, again contradictions appear comparing the Manuscript of Huarochirí and the Carta Annua. The first celebration was in honour of *Pariacaca* in the time called *Ausquina* – for our father -. According to the Manuscript of Huarochirí, Ausquina corresponds to June, but the author says that it is celebrated in Resurrection - between 22nd of March and 25th of April, i.e. around the equinox -, although *Corpus Christie* is erased in the original[17]. Later he points out that in some villages was celebrated around Resurrection and other around Pentecost - between 10th of May and 13th of June -, but again *Corpus Christie* is erased in the original[18]. In the Carta Annua of 1609, however, Ausquina is said to take place in April[19]. This could reinforce the date of around Resurrection given in the Manuscript. It is possible that the author of the Manuscript had made a mistake in dates because of the existence of three main celebrations taking place in three different epochs of the year: in honour of *Pariacaca* in April, in honour of *Chaupiñanca*[20] in June and in honour of *Tutayquire*[21] in November, around S. Andrés[22].

The other main celebration that was determined by solar observations was in honour of *Chaupiñanca* in the time called *Chaycasna* – for our mother -, which would be celebrated in June around Corpus Christi, according to the Manuscript[23]. In this case, the data from the Carta Annua, which points out that Chaycasna took place 40 days after Ausquina[24], are in agreement with those from the Manuscript.

Our hypothesis is that *Ausquina* could have been determined with help of a gnomon and/or horizon markers marking some date around the March equinox, while *Chaycasna* was likely celebrated around the June solstice. Future research will be devoted to search those architectonic elements. We will also try to determine if the observations were made independently in every important village or transmitted to everywhere from an only place, since these rituals were celebrated in the same way all around the Yunca region[25] from the Chillón river to the Mala river. The author points out that before the arriving of the Spaniards all the people went to the Pariacaca´s sanctuary.

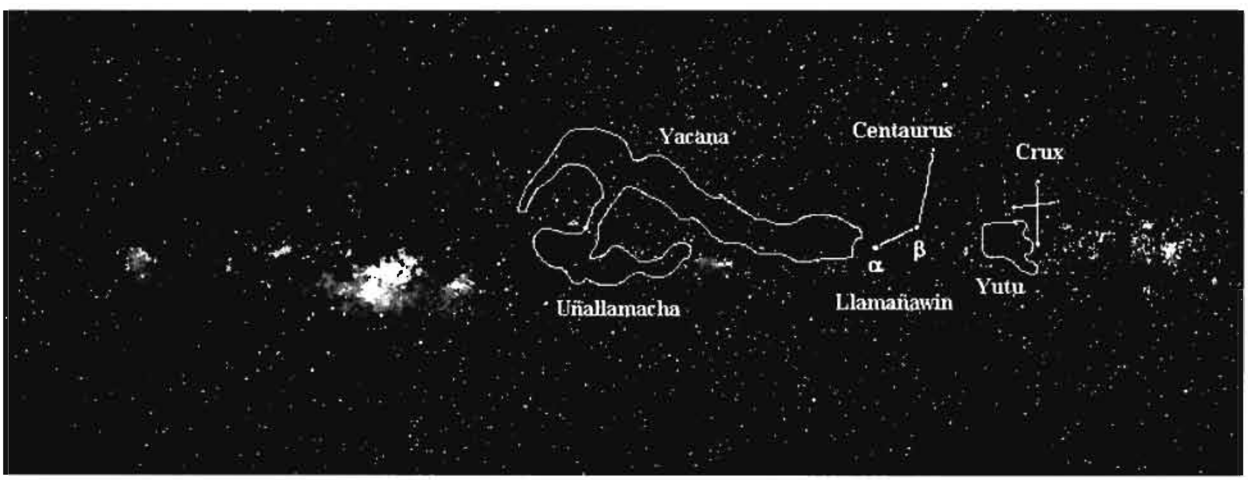


Figure 2. Identification of the dark constellations over the image of the Milky Way

The time of *Ausquina* could have also marked the beginning of the year in the central region of Perú, as can be inferred from the Manuscript of Huarochirí[26] and confirmed in the Carta Annua of 1609[27]. Other chroniclers mention different dates for these event: Polo de Ondegardo gives the date of December[28], Betanzos January when the Orejones ritual[29], the Anonymous chronicler March[30] and Molina June[31]. Those contradictions could be understood if each region celebrated the beginning of the year in a different date, as can be inferred from the fact that, according to the Anonymous chronicler, one Inca fixed the year to be equal everywhere[32].

OTHER ASTRONOMICAL OBJECTS

The Manuscript of Huarochirí also provides information about some astronomical objects worshipped in the Central region of the Perú. The chapter 29 is completely devoted to this aspect. Other authors[33] have previously analysed it. We will only give a brief summary and remark some relevant questions.

The Manuscript of Huarochirí is the one in which the so called *dark constellations*[34] are better and in more detail described. The scarcity of references to these constellations in other chronicles is likely due to the small attention received in Europe until that moment, because they are remarkably less prominent than in the Andean area. According to the description offered in the Manuscript these constellations must correspond to the dust regions along the Milky Way. The best described is *Yacana* – the vital source of llamas -, probably because of the importance of these animals in the economic context of the Andes.

"La [constelación] que llamamos Yacana, el ***camac*** *de las llamas, camina por medio del cielo.*
Nosotros los hombres la vemos cuando llega toda negra
*la Yacana anda en medio de un río /***Mayu***/*
Es de veras muy grande.
Viene por el cielo poniéndose cada vez más negra. Tiene dos ojos y un cuello muy largo."[35]

The ethnographic study of Urton[36] in Cuzco and its surroundings yielded him to identify *Yacana* with the dark zone in the Milky Way between Scorpio and Centaurus. a and b Centauri would be its eyes – *Llamacñamin* -. *Yacana* is described in the Manuscript of Huarochirí as a female llama with his son. It is related not only with llamas of different colours but also with water from sources as well as from the sea.

"...la Yacana solía beber el agua de cualquier manantial y, si un hombre en su suerte tenía ventura,
caía encima de él.
Mientras con su enorme cantidad de lana. Aplastaba al hombre, otros hombres arrancaban su lana.
Este fenómeno acontecía de noche.
Al amanecer del día siguiente veían la lana que habían arrancado
Esta lana era azul, blanca, negra, parda; había toda clase de lana..."
"...A medianoche, sin que nadie lo sepa, esta Yacana bebe toda el agua del mar.
De no hacerlo, inmediatamente inundaría nuestro mundo entero"[1]

This association llama-water is common to all the Andean regions[2]. For example, in aymará *Havi* means wet and wool[3].

Another constellation, *Urcochillay*, worshipped in Cuzco, presents similarities with *Yacana*: worshipped by herdsmen, related with llamas and water[4]. However, important differences are evident. *Urcochillay* is a stellar constellation with a T form, as stated by Bernabé Cob[5]o. Moreover, Polo de Ondegardo and Bernabé Cobo[40] locate it precisely in *Lyra*, which is around 90° in the sky far from *Yacana* (Sky). In addition, *Urcochillay* is a male llama – *urco* is used for male animals -, although is closed to other 2 stars – a female llama and its baby – called *Catachillay*. Therefore, following Bauer and Deaborn[6], we suggest that *Yacana* and *Urcochillay* are not the same constellation.

This suggests that, even though the llama cult and the worship of astronomical objects related with them is common to all the Andean region, the correspondence in the sky might follow different traditions in the different areas: Polo de Ondegardo and Bernabé Cobo are describing traditions in Titicaca and Cuzco and its surroundings (Zuidema y Urton 1982).

Bertonio[39] in his dictionary identifies *Catachillay* as a nebulous star in the Milky Way. However, it cannot be related to llamas without any additional information. In fact, the term *Catachillay* seem to be used for different stars or most probably as star in general. Gonçalez Holguín[7] relates that *Urcuchillay* and *Catachillay* were applied to a constellation with a cross form and Arte y Vocabulario[8] associates both terms to Venus.

In summary, all of these ambiguities point out that the comparison of astronomical data from different chronicles must be done carefully, taking into account the Andean area and traditions considered by the chronicler.

Near Yacana, the Manuscript placed another dark constellation: *Yutu*.

"...dan el nombre de Yutu a una pequeña [mancha] negra que precede a Yacana."[9]

It has been identified by Urton[34] with the Coal Sack, located SE to the Southern Cross. It rises around one hour before *Yacana*.

The other objects described are stellar: *Condor*, *Suyuntuy* and *Huaman*.

"...También hay tres estrellas que andan en línea recta.
A éstas les dan el nombre de Cóndor; de la misma manera, Suyuntuy (Gallinazo) y Huaman (halcón)".[10]

However, the only with a specific function were the *Pleiades* which appears with their Spanish name *Las Cabrillas*. They were used as meteorological predictors: when they were seen big, it would be a fertile year; when they were small, the year would be bad. This connection with meteorology may be based on the fact that atmospheric conditions are related with the apparent aspect of stellar objects and the importance of humidity in the region of Huarochirí, due to the scarcity of rain[8], specially around July, just after the heliacal rise of these stars.

Other stars are mentioned in the Manuscript: *Pocohuarac, Huillcahuarac y Canchohuarac*

"Hay otras estrellas que aparecen todas muy grandes.
A éstas dan el nombre de ***Pocohuarac, Huillcahuarac y Canchohuarac.***
En los tiempos antiguos sólo una parte de los hombres adoraba a estas estrellas por creer que animaban y formaban.
Los demás hombres decían a propósito de estos huacas que el hecho de adorarlos les haría prosperar. Y así adoraban a estas estrellas permaneciendo sin dormir la noche en que aparecían."[47]

These stars have not been identified. As can be deduced, they were considered creators and animators and were worshipped only by those interested in obtain something from them, as in other Andean Areas[48]. None of these astronomical objects had a calendaric function in the Central area.

CONCLUSIONS AND FUTURE WORK

1. Solar observations were carried out in the Central area of the Perú with calendaric purposes, that is to determine the date of the main celebrations. One of them – *Ausquina* – was probably related with the beginning of the year. The solar events observed could be around the March equinox and the June solstice. Further research will be devoted to the searching of architectonic structures in the archaeological sites of the area that might be used for those determinations.

2. The comparison of data about some celestial objects worshipped from Chapter 29 of the Manuscript of Huarochirí with other chronicles from different Andean areas suggests the importance in this kind of studies of taking into account the region and tradition from where the data come. It also points out the necessity of ethnographic work in the region to contrast data from the chronicles. In the future, the compilation and careful analysis of all the astronomical terms in chronicles and dictionaries of the early post-Conquest epoch must be done, in order to establish whether the differences are due to ambiguities and contradictions provoked by the own chroniclers or to real differences in the astronomical concepts of these communities. In addition, it is essential to compare systematically with ethnographic data from the present communities.

NOTES AND REFERENCES

1. G. TAYLOR, *Ritos y Tradiciones de Huarochirí. Manuscrito quechua de comienzos del siglo XVII*. Ed. Instituto de Estudios Peruanos e Instituto Francés de Estudios andinos, (Perú, 1987)

2. G. TAYLOR, "Cultos y Fiestas de la Comunidad de San Damián (Huarochirí) según la Carta Annua de 1609". Carta Annua 1609 del Fondo Gesuitico N° 1488 (Archivos de los Jesuitas, Roma), *Bulletin de l'Institut Français d'Études Andines*, (1987) Vol. 16 (3-4), 85-96

3. F. GUAMAN POMA DE AYALA, 1615. *Nueva corónica y Buen gobierno*, Fondo de Cultura Económica, (Perú 1993)

4. B. COBO, 1653. *Historia del Nuevo Mundo*, Biblioteca de Autores Españoles, (Madrid 1964)

5. GARCILASO DE LA VEGA, 1609, *Comentarios Reales de los Incas.*, Emecé Editores S.A., (Buenos Aires 1945)

6. J. POLO DE ONDEGARDO, 1585. *De los errores y supersticiones de los indios sacados del tratado y averiguación que hizo el Licenciado Polo*, Eds. H. Urteaga and C. Romero, (Lima 1916)

7. See G. TAYLOR, *op. cit.* (ref. 1), 17

8. See K. SPALDING, *Huarochirí. An Andean Society under Inca and Spanish Rule, Stanford University press*, Stanford, (California 1984).

9. *Pariacaca* was the main god in the provinces of Huarochirí and Yauyos at the arriving of the Spaniards. This deity is associated with the cult to *Huallallo Carchuncho*, who was exiled by Pariacaca from this region to the eastern, to *Huancayo*, after the invasion from the high land. He is also associated to *Pachacámac*. See G. Taylor, *op. cit.* (ref. 1)

10. G. TAYLOR, *op. cit.* (ref. 1), 171 and 199

11. G. TAYLOR, *op. cit.* (ref. 2), 93

12. G. TAYLOR, *op. cit.* (ref. 1), 171

13. G. TAYLOR, *op. cit.* (ref. 2), 93

14. GARCILASO DE LA VEGA, *op.cit.* (ref 5), Vol. 1 Chap. 2

15. GUAMAN POMA, *op. cit.* (ref. 3), 177 and 728

16. B. COBO, *op. cit.* (ref. 4), 173 and Anónimo, ca. 1570, *Discurso de la sucesión y gobierno de los Yngas*, Juicio de límites entre el Perú y Bolivia; Prueba peruana presentada al gobierno de la República Argentina, Ed. V.M. Maútua, Vol8 (Madrid 1906), 151. See also R. T: ZUIDEMA, "Catachillay. The Role of the Pleiades and of the Southern Cross and a and b Cantauri in the calendar of the Incas", in *Etnoastronomy and Archaeoastronomy in the American Tropics*, Ed. A. F. Aveni and G. Urton, (New York, 1982), 203-229.

17. G. TAYLOR, *op. cit.* (ref. 1), 173.

18. G. TAYLOR, *op. cit.* (ref. 1), 187.

19. G. TAYLOR, *op. cit.* (ref. 2), 93.

20. *Chaupiñanca* is the mother goddess and Pariacaca´s sister.

21. *Tutayquire,* Pariacaca´s son and hero of Checa community.

22. G. TAYLOR, *op. cit.* (ref. 1), 201.

23. G. TAYLOR, *op. cit.* (ref. 1), 199.

24. G. TAYLOR, *op. cit.* (ref. 2), 94.

25. G. TAYLOR, *op. cit.* (ref. 1), 189.

26. G. TAYLOR, *op. cit.* (ref. 1), 183.

27. G. TAYLOR, *op. cit.* (ref. 2), 93.

28. POLO DE ONDEGARDO, *op. cit.* (ref. 6), chap. 7.

29. JUAN DE BETANZOS, **1551**. *Suma y Narración de los Incas.* Bliblioteca de Autores Españoles, *Crónicas de interés indígena,* (Madrid 1968), chap. 15.

30. ANÓNIMO, *op. cit.* (ref 15), 156-160.

31. CRISTOBAL DE MOLINA (el Cusqueño), ca. 1575, "Relación de fábulas i ritos de los ingas", in *Fábulas y Ritos de los Incas,* Crónicas de América, Historia 16, (Madrid 1989), 66.

32. ANÓNIMO, *op. cit.* (ref 15), 150.

33. R. T. ZUIDEMA and G. URTON, "La Constelación de la Llama en los Andes Peruanos", *Allpanchis Phuturinga,* (1976), vol. 9, 59-119 and B.S. BAUER, D.S. DEARBORN, *Astronomy and Empire in the Ancient Andes,* University of Texas Press (Texas, 1995).

34. G.D. URTON, *At the crossroads of the earth and the sky: An Andean cosmology,* University of Texas Press (Austin 1981).

35. G. TAYLOR, *op. cit.* (ref. 1), 425.

36. G. D. URTON, *op. cit.* (ref 34). See also R. T. Zuidema and G. Urton, , *op. cit.* (ref 33), 61.

37. G. D. TAYLOR, *op. cit.* (ref. 1), 427

38. R. T. ZUIDEMA and G. URTON, *op. cit.* (ref 33)

39. LUDOVICO BERTONIO, 1612, *Vocabulario de la lengua Aymara,* Centro de Estudios de la Realidad Económica y Social (Bolivia 1984)

40. POLO DE ONDEGARDO, *op. cit.* (ref 6), chap. 1 and B. Cobo, *op. cit.* (ref 4), chap. 6

41. B. COBO, *op. cit.* (ref 4), chap. 6

42. B. S. BAUER, D.S., Dearborn, *op. cit.* (ref 33)

43. DIEGO GONZALEZ HOLGUÍN, 1608, *Vocabulario de la lengua general de todo el Perú llamada lengua Qquichua o del Inca,* Universidad Nacional Mayor de San Marcos (Lima 1989), 51

44. *ARTE y VOCABULARIO en la lengua general del Perú llamada Quichua y en la lengua Española* 1586, Facultad de Letras, Instituto de Historia (Lima 1951)

45. TAYLOR, *op. cit.* (ref. 1), 429

46. TAYLOR, *op. cit.* (ref. 1), 429

47. TAYLOR, *op. cit.* (ref. 1), 429-431

48. See e.g. B. COBO, *op. cit.* (ref 4)

UNE POSSIBILITÉ DE DATATION HISTORIQUE ABSOLUE DE LA TABLE DES ÉCLIPSES DU CODEX DE DRESDE PAR LE PASSAGE DES LÉONIDES

Arnold Le Beuf
Institut d'Histoire des Religions
Université Jagiellone de Cracovie, Pologne

Dans mon précédant article concernant la table d'éclipses du codex de Dresde[1], j'ai cru pouvoir montrer qu'elle représentait un modèle théorique de la prévision des éclipses en général. Celà n'empêche pas que ce modèle puisse aussi constituer une illustration ancrée dans un temps historique réel. La composition même du document nous permet sans grande difficulté de situer théoriquement très précisement les moments historiques pour lesquels toutes les éclipses mentionnées étaient réelles, qu'elles aient été visible au Mexique ou non. Il suffit pour cela de postuler que le 12-Lamat, se trouvant au milieu du groupe de jours du Tzolkin inscrits dans cette table du codex se situe idéalement sur un jour de passage du Soleil sur un des deux noeuds de l'orbite lunaire. Selon l'équation Ahau adoptée, on obtient différentes solutions.

Nous savons que la dérive du noeud dans le Tzolkin tous les 46 Tzolkins est de 1,67 jours, ou de 260 jours pour 5200 Tuns[2] , ou de 5,2 jours tous les 104 ans, ou encore de 21 jours tous les 416 Haab[3]. Puisque les 3 dates de passage du Soleil sur les noeuds sont équidistante dans le cycle de 260 jours[4], une situation telle que celle du Soleil au noeud un 12-Lamat, ne se peut retrouver que tous les 18 siècles, lorsque le noeud a dérivé de 87 jours dans le Tzolkin (260:3=87 jours). Le passage du soleil sur le noeud, occupe les mêmes jours du Tonalpohualli pendant 18 ans, après lesquels il faut attendre 1762 ans pour que le moment du passage du Soleil aux noeuds revienne aux mêmes jours du Tzolkin. Par exemple, si comme l'accepte A. Aveni[5] on doit se baser sur la corrélation GMT 584283, alors, le soleil ne peut passer sur les noeuds un jour 12-Lamat qu'entre les années -2386 et -2368; -623 et -605; 1140 et 1158[6]. Pour des raisons historiques et stylistiques, nous devons exclure les datations antérieures à l'ère chrétienne, il ne reste donc que la seule possibilité du XIIème siècle. Entre les années 1140 et 1158, lorsque le Soleil passait au noeud un 12-Lamat, la seule nouvelle lune tombant un 12-Lamat est au Samedi 3 Décembre 1155. Logiquement, nous pourrions donc situer la table des éclipses du codex de Dresde (en acceptant l'équation Ahau 584283), avec assez grande probabilité,

du: 12-Lamat , Jour Julien 2143251, Samedi 3 Décembre 1155

au: 12-Lamat , Jour Julien 2155211,Mercredi 31 Août 1188

C'était ma proposition de 1997, parce qu'alors, je n'avais traité tout le problème que selon sa logique interne, et cherché l'idéal théorique, mais qui nous dit que ce choix est le bon et que c'est le début de la table qui doit se situer en position parfaite d'un 12-Lamat en lune nouvelle lorsque le Soleil est sur le noeud? -Premièrement, la réalité historique du document peut s'écarter de quelques jours de la situation idéale telle que nous la calculons aujourd'hui, avec par exemple le Soleil à 2 jours de distance du noeud, d'un côté ou de l'autre. De même, il reste une petite incertitude de 2 à 3 jours sur la fixation de l'équation Ahau selon les auteurs. J'avais dans l'article de Salamanca (SEAC 1997) travaillé avec l'équation 584283, pour des raisons propres rattachées à certaines conditions concernant en fait le Mexique Central pour lequel cette solution semble la meilleure, mais je profite de la saine objection de Jesus Galindo Trejo pour accepter l'équation 584284 en ce qui concerne les traditions mayas (cet écart irréductible d'un jour entre la concordance des deux almanachs de 260 jours, le maya et le mexicain est bien connue). Nous reprenons donc le calcul avec pour nouvelle base l'équation 584284, ce qui fait sauter la concordance entre un 12-Lamat et une nouvelle lune au noeud de dix Tzolkins moins un jour, soit 2599 jours. Avec cette autre corelation, deux éléments d'information du Codex de Dresde apparaissent qui devraient nous permettre de mieux situer la table des éclipses avec quelque semblance de certitude, et de régler définitivement, me semble t-il, le problème de sa datation.

Revenons premièrement à la date 9.16.4.10.8, 12-Lamat 1 Muan. Cette date, qui correspond au Jour Julien 1997132 ou au 11 Novembre 755 Grégorien, outre le fait qu'elle introduit la table des éclipses, présente certaines particularités très apparentée aux conditions de la table de 405 mois lunaires. Cette date: 9.16.4.10.8 12-Lamat, est associée à celle du 10.19.6.1.8 12-Lamat. Ces deux nombres n'ont apparemment rien à voir avec le système des éclipses[7] puisque l'intervalle de jours qui les sépare: 166140 jours soit 639 Tzolkins, s'il est proche de 5626 mois lunaire[8], n'approche par contre d'aucun multiple de la révolution du noeud. Mais il reste malgrè tout, dans la première de ces dates deux indications associées au calcul des éclipses. Ce jour là, la lune est à 28 jours, c'est-à-dire un jour ou deux avant la conjonction, ce qui le situe à la première date possible notée dans la disposition en trois colonnes pour encadrer le jour idéal d'éclipse, d'autre part le noeud est alors situé à -18 jours, autre situation particulière qui revient à définir la première date à laquelle une éclipse de soleil est possible un 12-Lamat, le début de la période de 730 ans pendant laquelle le jour 12-Lamat pourra être marqué d'une éclipse[9], et par là-même, nous permet de connaître et mesurer la saison d'éclipses et sa période, et aussi de mesurer à n'importe quelle date la distance du noeud au 12-Lamat et donc de suivre sa dérive. Si c'est de ceci qu'il s'agit dans le choix de cette date, nous supposons alors qu'il s'agit bien là d'un ancrage pour les calculs: -par étapes de 405 et 5626 mois lunaires pour le cycle synodique, et un extrème pré-nodal pour le noeud. Logiquement, le début de la table de 405 mois devrait se situer quelque part à une distance multiple de 11960 jours de 9.16.4.10.8, 12-Lamat 1 Muan, lorsque la lune est proche de la conjonction, sur le noeud, un 12-Lamat, c'est-à-dire lorsque la distance au noeud se sera reduite à zéro. Ces conditions sont justement remplies lorsque l'on adopte l'équation Ahau 584284, et seulement dans ce cas. Onze tables de 11960 jours equivalent à 1315600 jours et nous reportent du 11 Novembre 755 au 23 Janvier 1116. La série qui va:

-du 23 Janvier 1116, Jour Julien 2128692, 12-Lamat 16 Zotz, 10.14.10.0.8. ,

-au 21 Octobre 1148, Jour Julien 2140652, 12-Lamat 16 Cumhu, 10.16.3.4.8.,

semble la meilleure.

La table commençerait alors avec une lune à 29.5 jours et le noeud à -1 et se terminerait avec une lune à 29.5 jours et le noeud a +1. Avec nous le voyons un équilibre parfait de la table autours d'un passage de la nouvelle lune au noeud un 12-Lamat, et cette solution serait excellente.

Toutefois, un détail des inscriptions glyphiques de cette table que nous révèle la traduction de Y. Knorozof nous apprend que le commentaire qui accompagne l'image précédant les dates 11-Cib; 12-Caban; 13-Etznab, au jour 6408 (somme cumulative écrite 17.14.8 en notation maya sur le codex) de la table du Codex de Dresde, se lit: «*Tourmente d'étoiles de feu*». Galina Ershova[10] avait posé à ce propos cette question très judicieuse: « *sachant que la pluie de météores nommés Léonides revient avec une périodicité de 33 ans, ne serait-il pas possible que le choix de la longueur de la table, elle aussi de 33 ans, fasse référence à ce phénomène?*» [11]

-La pluie de léonide revient avec un maximum d'intensité tous les 33-34 ans, lorsque la terre traverse les débris de la comète Teeple-Tuttle. Comme la période de révolution de cette comète est estimée à 33,25 années, et que son orbite, oblique à l'écliptique, coupe celle-ci en un point relativement stable, les conditions de rencontre de la terre et du noyau le plus dense de ces météores se situe actuellement vers le 15 Novembre grégorien et fait varier le nombre d'année entre deux maxima autours d'une moyenne évaluée actuellement à environs 33 années. Leur retour est attendu en 1999, ou 2000. En extrapolant au XI - XIIèmes siècles, nous obtenons ....; 1033-34; 1066-67; 1099-1100; 1133 ...etc...

La suggestion de Galina Yershova, selon laquelle la durée de 33 ans de cette table pourait rappeler la période de 33 ans de plus grande intensité des léonides, et avoir été choisie en considération de ce phénomène doit être rejetée, du fait que la longueur exacte de la table d'éclipses du Dresden est de 11960 jours, soit 33,745 années, et de ce fait, régresse dans l'année tropique d'environ un trimestre à chaque nouveau départ, alors que comme nous l'avons précédemment remarqué, en ce qui concerne les chutes de météores léonides, si la définition de l'année reste incertaine à deux ou trois ans près, par contre, les dates dans l'année, varient très peu, et nous ne pouvons espérer observer ce phénomène spectaculaire qu'à des dates groupées vers le 15 Novembre au vingtième siècle Les noeuds de l'orbite de ces météorites avec l'écliptique dérivent lentement et le moment de collusion de la terre avec son noyau le plus dense retarde chaque siècle. On compte environ 30 jours pour un millénaire, ce qui situerait ce phénomène vers mi-Octobre au XIème siècle[12]. Mais l'intuition de Galina Yershova reste toutefois très précieuse, en effet, du fait précisemment que nous ayons deux séries de durées proches mais différentes, l'une relativement stable dans l'année tropique alors que l'autre régresse significativement, nous allons pouvoir utiliser la technique du double comptage afin de pointer le moment ou les deux séries sont synchronisées. Nous notons tous les 11-Cib à intervales de 11960 jours après le premier 11-Cib situé 6408 jours après le 12-Lamat inscrit au début de la table et daté au 11 Novembre 755. Puis nous examinons s'il s'en trouve un qui tombe à proximite d'Octobre-Novembre d'une année dont le millésime se termine par 33;66;99 avec deux ou trois années de marge puisque tels sont les écarts qui apparaissent à l'examen des tables d'observations historiques connues. Nous voyons dans le tableau suivant que la seule possibilité se situe au 10 XI 1100 grégorien, dans la série de 405 lunaisons qui va:

-du 25 Avril 1083, Jour Julien 2116732, 12-Lamat 1 Chen, 10.12.16.14.8

-au 23 Janvier 1116, Jour Julien 2128692, 12-Lamat 16 Zotz, 10.14.10.0.8,

c'est-à-dire la série qui précède celle que j'avais d'abord retenue parce qu'elle aurait été idéale eu égard à la symétrie des dates autours du Soleil sur un noeud au 12-Lamat.

TABLEAU de la régression du 11-Cib indexé sur celui de la table de Dresde au 6408ème jour de cette table et reporté tous les 11960 jours (durée de cette table).

	28 V 773	24 II 806	23 XI 836
22 VII 871	21 V 904	17 II 937	16 XI 969
16 VIII 1002	15 V 1035	11 II 1068	**10 XI 1100**
9 VIII 933	8 V 1166	4 II 1199	3 XI 1231

Cette solution remplit toutes les conditions qui permettent de la retenir comme possible datation historique absolue de cette table:

- 1) Nouvelle Lune proche du noeud un 12-Lamat

- 2) Toutes les éclipses observables dans le monde sont notées dans la table pour cette datation.

- 3) La série qui va du 25 Avril 1083 au 23 Janvier 1116 se situe exactement a un multiple de la série de 11960 jours après la date initiale introductive 9.16.4.10.8, 12-Lamat 1 Muan, Jour Julien 1997132, 11 Novembre 755 Grégorien, date qui avait tant fait couler d'encre sans jamais trouver d'explication satisfaisante.

- 4) Seul cet accord place une possible pluie de Léonides assez proche du 11-Cib, au jour 6408 de la table, là où elle est clairement indiquée.

- 5) Elle confirme pleinement la datation du manuscrit par un des auteurs anciens les plus importants, Teeple: «*If* *we date it about 1100 A.D. or a little later we shall not be far wrong*»[13]. Cette datation à la fin du XIème et au début du XIIème siècle s'accorde bien avec les datations évaluées à partir de considérations autres, telles que stylistique[14].

Ces différents ancrages laissent peu de doutes que nous soyons enfin parvenus à dater très exactement cette partie du document et nous découvrons en outre une confirmation supplémentaire d'ordre symbolique et rituelle qui nous permet de comprendre les raisons qui auraient amenées les prêtres astronomes mayas à retenir cet période en mémoire plutôt qu'une autre pour servir de modèle. Dans le cas de figure, ou le jour 11-Cib du Tzolkin, 10.13.14.10.16 du Compte Long, tombe au 10 de Novembre 1100 grégorien, Jour Julien 2123140, il correspond dans le Haab au jour 4-Uayeb. La coïncidence d'une éclipse succédant à une pluie d'étoiles de feu aurait été d'autant plus impressionante pour les mayas que cette date du 4-Uayeb, est le dernier jour de l'année, le jour «terrible» du chaos sans nom ou l'on craignait précisemment la chutte des corps célestes, les Tzitzimime. Cette coïncidence aurait été sans aucun doute vécue comme particulièrement dramatique et notée dans les archives, surtout si cette date tant redoutée avait été précédée d'une tourmente d'étoiles de feu. Il y a donc une très forte probabilité pour que ce soit précisément cette série qui soit inscrite dans la table de Dresde, et cela devra rester notre proposition jusqu'à démonstration d'informations contraires qui viendraient l'invalider.

Maintenant, si cette datation est acceptée avec une corrélation 584284, il faut, pour faire entrer toutes les dates de la table du codex de Dresde, remplir les conditions suivantes minimum:

- Age de la lune: de 27 à 2 jours.

- Distance du soleil au noeud: de -21 à +16.

Que nous devions entrer un âge de 27 à 2 jours, c'est-à-dire 5 jours pour encadrer la nouvelle lune, confirme la justesse du choix de lecture de la table proposée dans mon article de 1997, à savoir qu'en début de table le 12-Lamat doit occuper le rang supérieur, avant 13-Muluc et 1-Oc, et le rang inférieur en dernière position, après 10-Cimi et 11-Manik. Si la table est vraiment prévisionnelle, il vaut mieux avertir un peu avant le moment de l'opposition, disons deux jours avant, soit au 27ème jour de la lune.

Plus curieux apparait le déséquilbre dans les limites du noeud. On attendrait plutôt -18 +18 ou quelque autre organisation des dates, plus proche de la symétrie. On peut expliquer la raison de cette situation: si nous examinons les dates de la table, nous voyons qu'il s'agit avant tout d'une table de prévisions, par le fait que les jours de nouvelle lune réelle ont tendance à tomber dans les deux rangs inférieurs des trois jours Tzolkins de chaque colonne, ce qui fait que le premier ou les deux premiers jours de chaque colonne sont des jours «blanc», des jours d'attente, d'observation et d'expectative. Nous remarquons aussi que seules les «têtes» d'éclipses sont prises en compte: ne sont notées que les éclipses de soleil «rentrantes» en zone d'éclipses prénodales. On suit cette éclipse de six en six mois, uniquement jusqu'au moment ou une nouvelle «tête» de série entre en zone prénodale après seulement cinq mois. Dès qu'une nouvelle série apparait, on abandonne le reste, ou «queue» de la précédante, même si elle n'a pas terminé sa course. Raison pour laquelle les dernières des éclipses après les séries de six mois ont des positions nodales de 6,15,9,7,16,10,7,12,10 jours après le noeud, alors que théoriquement on aurait pu les suivre jusqu'à +18 jours (dans le cas du 3-Akbal, au rang 354, qui se situe à +6 jours du noeud, on aurait pu noter deux autres segments de 177 jours de plus avant d'intercaler un segment de 5 mois, et le 6-Muluc vient ici trop tôt, à -21 du noeud. Ceci pourrait sembler illogique, puisque l'on note d'une part une date d'éclipse solaire à -21 du noeud qui bien loin dêtre visible sous les tropiques, ne l'est même pas aux pôles, et que d'autre part, on ne se donne parfois même pas la peine de noter une éclipse de soleil à une huitaine de jours du noeud et donc possiblement centrale même sous les tropiques. De même, on ne se donne pas la peine de noter les jours des éclipses de lune pourtant plus souvent observables et tout aussi redoutées que celles du soleil! - La raison en est que ce qui est apparemment important pour le prêtre-astronome maya, c'est de ne jamais être surpris par une éclipse qui n'aurait pas été prévue, c'est-à-dire une éclipse contre laquelle on n'aurait pas pris les précautions rituelles d'usage. Peu importe si l'on prévoit une éclipse qui n'aura pas lieu[15], par exemple à -20 ou -21 jours du noeud, parce que cette éclipse de soleil virtuelle (légèrement hors-limites) nous assure d'une éclipse de lune certaine 15 jours plus tard et d'une petite éclipse de soleil 29 jours plus tard. Toute nouvelle lune dans les limites de 18 jours de part et d'autre du jour conventionel du passage du soleil au noeud peut donner lieu à une éclipse virtuelle de soleil, toute pleine lune dans les limites de 18 jours de part et d'autre du jour conventionel du passage du soleil au noeud peut donner lieu à une éclipse de lune elle aussi virtuelle.

Nous avons écrit «jour conventionel» du passage du soleil au noeud, et «éclipse virtuelle» et ces termes demandent une explication. Il serait évidemment possible de déterminer avec une assez bonne exactitude, pour chaque réécriture de la table, le jour exacte du passage du soleil au noeud, simplement en notant toutes les éclipses observées dans les 33 années passées, et de faire la «moyenne» des jours notés, et d'éffectuer les corrections Ad hoc par glissement de toute la table dans le Tzolkin d'une quantité équivalente à la dérive observée, et il n'est pas impossible que les mayas aient agis ainsi. Mais il semble plutôt qu'ils aient voulu construire un système de comput à très long termes, qui permette la projection loin dans le futur et le passé. Et c'est ici que la table de Vénus leur servait à régler ce probleme de la dérive du noeud dans le Tzolkin à très long terme.

J'ai précédemment montré que lors des grandes cérémonies du Feu Nouveau tous les 104 ans, la congruence du cycle synodique de la planète Vénus et du noeud de l'orbite lunaire permettaient de suivre la dérive du noeud dans le calendrier, et de fixer très exactement les jours des passages du soleil sur les noeuds dans le Tzolkin. Lors de la Cérémonie du Feu Nouveau de 1142, le Soleil devait atteindre le 12-Lamat au moment de son passage sur le noeud. Cette situation était parfaitement prévisible lors de la cérémonie de 1038, alors que le Soleil passait sur le noeud un 4-Ben, 5 jours plus tard. Il semble bien que la table qui nous est parvenue ait éte indexée sur le 12-Lamat lors du réglage calendrico-astronomique de 1038, et ait été d'actualité pratique entre ces deux dates 1038 - 1142. On en conclue que le réglage du jour rituel du passage du Soleil sur le noeud était effectué pour les 104 années à venir, avec une marge décroissante de 5 à 6 jours. Il suffit alors de suivre sur la table telle que nous la connaissons toutes les dates indiquées successivement, et d'attendre le moment de nouvelle Lune subséquent, une éclipse est alors probable ou certaine et peut-être observable.

Les différents points de références croisées que nous avons mis ici en oeuvre forment un réseau sérré, une sorte de triangulation qui semble très convaincante parce que la probabilité d'apparition naturelle d'un tel ensemble exact, fonctionnel et cohérent est presque nul:

-Nouvelle Lune proche du noeud un jour 12-Lamat aux alentours des XI-XIIème s.

-Série d'étapes de 11960 jours synchronisée sur la date initiale du 9.16.4.10.8.

-Tous les paramètres de la table réglés en situation de prévision. (un à six jours antécédants l'évènement escompté)

-Mention des Léonides à la seule date où l'on est en droit de les attendre.

Si notre hypothèse se montre bien fondée, **et que la table de Dresde va effectivement du 25 Avril 1083 au 23 Janvier 1116**, alors, par contre coup, nous obtenons:

-Une confirmation supplémentaire de la correlation 584284, seule solution qui accorde une nouvelle lune avec un 12-Lamat à une distance exacte d'un multiple de 11960 jours du 9.16.4.10.8, 12-Lamat.

-Une nouvelle indication pointant sur la Cérémonie du Feu Nouveau de 1038 comme tournant important de l'histoire du Mexique ancien et de ses traditions atronomiques.

-Une très probable nouvelle mention d'une pluie de léonides observée au Mexique en 1100.

Enfin, à ma très grande surprise, l'ancrage premier au 9.16.4.10.8, 12-Lamat en 755, marquant l'initiale des calculs tant de la dérive des noeuds que des cycles synodiques, semble contre toute attente redonner crédit aux hypothèses généralement très critiquées et rejetées de H. Spinden sur la longeur conventionnelle et non corrigée du mois lunaire chez les mayas[16], ainsi que l'ancrage historique de la table à cette date par V. et S. Bricker[17]

Je tiens à remercier Galina Yershova, Magda Stavinschi, Carlos Jaschek, Ed Krupp, et Bradley Schaefer pour leurs suggestions et pour les consultations, suggestions et documents qu'ils m'ont fournis à propos des pluies de léonides.

NOTES

1. A. LE BEUF, 1997.

2. A. LUDENDORFF, 1930.

3. A. LEBEUF et S. IWANISZEWSKI, 1992.

4. Puisque deux Tzolkin sont presque exactement égaux à trois saisons d'éclipses (2x260 = 3x 173,3).

5. A. AVENI, 1988:178-182.

6. Nous en concluons que son illustrotion pour le cinquième siècle Anno Domini ne représente donc qu'un cas de figure dénué de toute vraisemblance historique, ce qui est surprenant de la part d'un astronome travaillant dans le contexte d'une recherche des éclipses réellement observables et observées en Mésoamérique.

7. LOUNSBURY, 1978:800.

8. J'ai montré (Le Beuf, Salamanca 1997) que ces deux dates donnaient la mesure presque parfoite du mois synodique moyen sur 5626 mois, à condition que l'on parte du dernier instant du premier 12-Lamat pour terminer au premier instant du deuxième 12-Lamat, c'est-à-dire que l'on retranche un jour à 639 Tzolkins, ce qui fait que la proposition: -Du 12-Lamat au 12-Lamat 639 Tzolkin plus tard, on compte 5626 mois lunaires synodiques, reste vraie.

9. En 730 ans, les positions respectives de la lune et des noeuds passe de -18 à+18 jours, ce sont les limites de l'éclipse possible telles qu'elles apparaissent à l'examen de la table du codex de Dresde.

10. entretiens personnels.

11. Ce probleme avait déja été posé et bien documenté par Carlos Trenary dans son article «Universal Meteor Metaphars and their occurence in Mesoamerican Astronomy» Archaeoostronomy, The Journal af the Center for Archaeoastronomy, Vol.X, 1987-1988, pp.98-116. Mais je dois a Madame G. Ershova d'avoir attiré mon attention sur cette question. Je tiens à remercier Madame Magda Stavinschi, Messieurs Carlos Jaschek, Ed. Krupp, B. Schaefer m'avoir fournis des informations historiques et techniques concernant ce phenomene des pluies de Leonides.

12. Lors de ma présentation à la conférence de La Laguna, j'avais sous estimé l'importance de la dérive du noeud de l'orbite des léonides et son impact sur les dates d'observotions possibles dans le passé. Je remercie Bradley Schaefer d'avoir attiré mon attention sur cette inexactitude et d'avoir eu l'amabilité de me procurer une approximation plus juste.

13. TEEPLE, 1930:86.

14. THOMPSON, 1988:42-43.

15. On démontre de cette manière que les dieux sont satisfaits, qu'ils ont apprécié l'offrande puisqu'ils nous ont épargnés de l'éclipse. Si par contre l'éclipse a lieu, est observée, c'est l'occasion rêvée de réclamer une offrande supplémentaire, d'augmenter la taxe, les dieux ayant encore soif.

16. *«But there is the unconsidered possibility that the lunar calendar of the Mayas resembles their other calendars in being of the uncorrected type so that the true positions of the Moon depart from the calendarial positions by the amounts of an accumulated error. In the present study the records of the Supplementary Series are explained as having an error of this type»* (Spinden 1928:42)

17. Je reste peu enclin à accepter leur système de «reconvertion» de cette table, mais les résultats présents, n'en apportent pas moins un agument en faveur de leur choix d'ancrage historique en 755. (Bricker 1983).

BIBLIOGRAPHIE

ANONYME, 1901. «Shower of Leonids seen at Hudson Bay». Popular Astronomy. 9:162.

A. AVENI. «Sky watchers of Ancient Mexico», Univ. of Texas Press, Austin ,1988.

H. M. BRICKER and V. R. BRICKER. «Classic Maya Prediction of Solar Eclipses» Current Anthropology, vol.24, Nr 1, 1983

J. G. BURKE, 1986. «Cosmic Debris: Meteorites in History», Univ. of California Press, Berkeley

L. FLETCHER, 1890. «On the Mexican Meteorites with Especial Regards to the Supposed Occurence of Wide-Spread Meteoritic Showers» The mineralogical Magazine, vol.IX, nr.42:91-178

S. HAGAR, 1931. «The November Meteors in Maya and Mexican Traditions» Popular Astronomy 39 (7) :399-401

I. HASEGAWA, 1993, «Historical records of meteor showers» in J.Stohl & I.P. Williams (eds) : Meteoroids and their parent bodies. Inst. Slovak Acad. Sci., Bratislava, 209-223

IMO Visual Handbooks, pages 236-243, «Leonids (LEO)»

M. R. KIDGER, 1993. «Some comments on the identification of medieval meteor showers by the Arabs» QI. J.R. astr. Soc. 34:331-334.

L. KRESAK. «Meteor storms»in J.Stohl & I.P. Williams (eds) : Meteoroids and their parent bodies. Inst. Slovak Acad. Sci., Bratislava, 147-156

G. W. KRONK. «Meteors and Native Americans» ,Oxford University Press. (Clarendon), London, 1954.

A. LE BEUF. «Une nouvelle approche de la table d'éclipses du codex de Dresde» SEAC IV, Universidad de Salamanca, 1997

A. LE BEUF et S. IWANISZEWSKI. «The New Fire Ceremony» Time and Astronomy at the meeting of two worlds, CESLA, Warsaw University, Warsaw 1992

U. J. J. LE VERRIER, 1867: «Sur les étoiles filantes du 13 Novembre et du 10 Aout». Comptes rendus, Paris 64:94-99

A. LUDENDORFF. «Ueber die entstehung der Tzolkin Periode im Kalender der Maya» Preuss. Akad. der Wissenscaften, Phys-Math. Klasse, Berlin, 1930

H. A. NEWTON, 1863. «On November Star Showers» art.XXXVI, Silliman's American Journal of Science 38:377-389, New York.

H. A. NEWTON, 1864. «Newton on November Star Showers», Art. VI Silliman's American Journal of Sciences 38:53-61, New York.

D. OLMSTED, 1834. «Observations on the meteors of November 13», 1833. Amer. J. of Science 25:132-174.

J. RAO, 1995. «The Leonids: The Lion King of Meteor Showers» WGN, the Journal of the IMO 23:4

D. J. SCHOVE, 1972. «The Leonids, who saw them first?» Sky and Telescope, vol.43, n.3, pp. 165-157, March, Sky Publishing Corp. Cambridge, MA.

H. SPINDEN. «Maya dates and what they reveal», 24th Congress of Americanists, Hamburg 1930, The Museum of Brooklyn Institute of Arts and Sciences, 1931

J. E. TEEPLE. «Maya Astronomy» Washington 1930.

J. E. THOMPSON. «Un Comentario al Códice de Dresde», FCE, Mexico, 1988

Z. TIAN-SHAN. 1977 «Ancient Chinese records of meteor showers» Chinese Astronomy 1:197-220.

C. TRENARY, 1987-1988. «Universal Meteor Metaphors and their occurence in Mesoamerican Astronomy» Archaeoastronomy vol.X, 1987-1988:99-116

D. K. YEOMANS, 1991. «Comets. A chronological history of observation, science, myth, folklore» Wiley, New York.

STARBORN:
Analysis of Astronomical Symbolism in a Native American Legend

Von Del Chamberlain
Utah Valley State College, Salt Lake City, Utah, USA

ABSTRACT

Throughout the world we find stories involving the birth of heroes with one parent being mortal and the other celestial. The resulting births lead to saviors, protectors, and other heroes, and leave enduring ceremonies, rituals and heroic tales. Examples come from ancient Greece and other places in the Mediterranean and from the New World as well.

This paper focuses on the astronomical elements of a legend from North America that has been found from the Far North and along the Pacific coast; through the Rocky Mountains of Canada and the United States and into the Great Basin; from the many nations of the Great Plains; the Woodlands and Great Lakes; the North Atlantic Coast; and the Southeast.

Following a review of the available material, the paper selects and focuses on the cases that are strongest in astronomical symbolism, showing interpretations that involve the North Star, the Sun, Moon and planets, and even a double star. A strong element of these stories seems to be the apparent observational relationships between the Sun, Moon and planets, possibly inspired by conjunctions of other naked-eye planets with Venus and the Moon and by the movement of the two inferior planets in the dawn and evening twilight.

One of the inspirations for this work was the discovery the author made some years ago of an unpublished poem based on a Dakota version of the story kept at the Smithsonian Anthropological Archives. Parts of the poem are included.

INTRODUCTION

About twenty years ago, while doing research at the National Anthropological Archives in Washington, D.C., I came across a poetic version (Warner n.d.) of a Native American story that I had become familiar with years earlier. Realizing that this poem likely had never been published, my thought at that time was that it might be of interest to those involved in archaeoastronorny. I had a copy made and put it in my files. As years went by I learned that this intriguing tale with substantial astronomical symbolism had become distributed over most of North America, and that early in this century it had been published in many versions representing at least 44 different North American groups. I also found that it contained even more astronomical symbolism than I had imagined.

The basic story concerns a woman who married a star, planet, Sun or Moon, gave birth to a male child, and returned to earth. Often the woman was killed during the return, but the child survived. The story has appeared with many titles: "Star Husband 2", "The Girl Who Married-a Star", "The Sisters Who Married Stars", "The Girl Who Married the Moon", "Moon and Sun", "The Foolish Women", and others. In the versions we are most interested in here, the story continues with a sequel, the tale of the woman's child, bearing titles such as: "Star Boy", "Sun Child", "Moon Boy", "Old Woman's Grandchild", and "Scarface". This child of heaven performed heroic acts to save people from starvation caused by creatures and forces of nature.

At least two novels (Highwater 1977, Welch 1986) and an opera (Nevin 1909) have been based on this story. I highly recommend both novels, but especially the one by James Welch, titled *Fools Crow*. The opera, titled "Poia," was composed by Arthur Finley Nevin, who lived among the Blackfoot people in Montana in 1903 and 1904, with libretto by Randolph Hartley. It was performed at Carnegie Music Hall in Pittsburgh in 1907 and in Berlin in 1909.

In passing, it is worth noting that this story is but one of the many found throughout the world involving a mortal mother and celestial father giving birth to a hero or savior. Other examples include many Greek stories and the American Southwest story of twin war gods, as well as the Christian story of Jesus.

The Star Husband story, along with the Star Boy sequel, in its many guises, contains an impressive list of symbolism: some Pacific Coast groups used it in explaining the origin of Sun and Moon; both Pacific Coast and Plains peoples have included in it the origin of dark features on the Moon; California, Pacific Coast, Plains and Woodland groups included in the story perceived differences between different brightness and color of stars; Plains groups used it for origin of at least one planet, as well as for the apparent motions of planets in relation to the Sun and alluded to meteorites; for the Blackfoot specifically it involved origin of the pole star, reference to the Milky Way as a pathway between earth and sky and, most important of all, the origin of the Sun Dance ceremony; Arapaho also considered it to have given them the Sun Dance and related rituals; Hidatsa, as well as Blackfoot people, found in the story the origin of painting star symbols, including the Morning Star, on their lodges; for the Crow and Quileute the story included the origin of constellations; the Wasco, a Plateau group, included in the story a pair of "shadows" on either side of the Sun, possibly alluding to sundogs; finally, one Pawnee version and the Dakota based poem I have referred to end with reference to double stars.

This story introduces many cleaver ideas. The girls usually awoke in the sky after going to sleep dreaming of stars, but some versions lured the women up a tree, following a porcupine whose quills they coveted. Usually the women dug forbidden plants in the fields of the sky to find the hole allowing them to see their former country, resulting in homesickness that necessitated their return to earth, but in some cases the hole was discovered when they moved large stones, or even buffalo chips deposited by the great herd in the heavens. Some of the stories involve warfare between people and stars. In these cases the earthlings went up an arrow ladder, but as they returned the ladder broke leaving people in the sky to become constellations. The Eskimos of Kodiak Island described star men as one-sided with one bright eye in the center of the forehead who's work was to stretch out, face down, on the sky each night and observe what went on below.

In his 1953 extensive analysis of 86 published accounts of the Star Husband tale, Stith Thompson (1953) concluded that even though he could not be sure about when and where the tale originated, the Central Plains seemed a most reasonable place of origin. From my own study, the story as found among the Blackfoot has such strong ties to important ceremony, as well as such clear articulation of relationships between the parts of the story and its symbolic connections that I feel it might well have originated with this group, then filtered out to others where it acquired different symbolisms and usually was less focused on significant ritual and more on traditional ethics and moralities. All renderings include moralistic lessons, but for some this is their essence. For example, a Pawnee elder recently told the story to me, ending with the statement that stars are sacred and should not be casually talked about. Then she laughed as she added, "You should be careful what you wish for; you just might get it."

THE BLACKFOOT VERSION

The Blackfoot version of the story is the most widely known, having been published in a popular work as well as an opera, then republished over and over. Many readers will recognize it. Here it is in outline, as collected in 1905 by Walter McClintock (1992:491-505).

Two girls were sleeping out. One of them, named Feather Woman wished for the Morning Star as husband. Soon thereafter she becomes pregnant and was taunted and ridiculed. One day she met a handsome man who declared himself to he the star she had wished for, Morning Star. He took her to live with him in the lodge of his parents, Sun and Moon where her child, named Star Boy, was born. Moon gave her a special digging stick and told her not to dig a certain large turnip. Overcome with curiosity, she attempted to dig it and succeeded with help of a pair of white cranes. Seeing her old country through the hole she was homesick. The story made the point that this was the hole she came up through. Now that she could not be content in the sky world, she and her son were returned to earth with the sacred medicine bonnet, digging stick and certain rituals. On a mid-summer evening her people saw her descend as a light from the sky. The woman was never again happy, always yearning for her husband, Morning Star. She died and eventually her parents died also, leaving Star Boy a poor orphan who was teased and abused by other boys.

Then the sequel began

Star Boy developed a scar on his face which became more pronounced as he grew older. He fell in love with the daughter of a chief who told him that the condition of marriage would be removal of the scar. An old medicine woman informed him of the origin of the scar and told him the only way he could get it removed was to go to his grandfather, Sun. Through hardship, Star Boy journeyed to the great water, the Pacific Ocean, where one evening he saw a gleaming path over the water which led him into the sky, to the lodge of Sun and Moon, where Morning Star became his friend. He killed large birds that threatened the life of Morning Star. In reward, Sun removed the scar and appointed Star Boy to be messenger to the Blackfoot to give them the Sun Dance with promise that it would restore people to health. Sun taught Star Boy the secrets of the Sun Dance and gave him the courting flute to win the heart of his love. Poia, another name for Star Boy, returned to earth by the Wolf Trail, the Milky Way, and introduced the Sun Dance to the Blackfoot people. Later, the Sun God took Star Boy back to the sky and made him bright and beautiful like his father, Morning Star. The story made the point that sometimes Star Boy and Morning Star can be seen together, with Star Boy, now sometimes referred to as "Mistake Morning Star," because he appears first and is sometimes mistaken for Morning Star. The storyteller told McClintock:

> *I remember when I was a young man, seeing those two bright stars rising, one after the other, before the Sun. Then, if we were going on a war, or hunting expedition, my father would awake me, saying, 'My son, I see Morning Star and Young Morning Star in the sky above the prairie. . .' For many years these stars have travelled apart. I have also seen them together in the evening sky. They went down after the sun. This summer (1905), Morning Star and Poia are again travelling together. I see them in the eastern sky, rising together over the prairie before dawn. Poia comes up first. His father, Morning Star, rises soon afterwards, and then his grandfather, the Sun.... The 'Star that stands still' (North Star) is different from other stars, because it never moves. All the other stars walk round it. It is the hole in the sky, the same hole through which So-at-sa-ki was first drawn up to the sky and then let down again to earth. It is the hole through which she gazed upon the earth, after digging up the forbidden turnip. Its light is the radiance from the home of the Sun God shining through.*

McClintock noted observing Jupiter and Venus very soon after hearing the account, just as described in the story. He said they were in close conjunction that year, July 1905. He also note that the Blackfoot refer to Mars as "Big Fire Star," and Venus as "The Day Star," because it can sometimes be seen during the daytime.

I have carefully checked on the Jupiter-Venus conjunction of July 1905. The closest pairing appeared to be 5 July, with the planets to lower left of the Pleiades, Jupiter above Venus. During the following days Jupiter moved up and away from Venus in the morning sky.

I have studied five (Bullchild 1985, Grinnel 1962:93-103, Hungry Wolf 1980:41-42, McClintock 1992:491-505, Wissler and Duvall 1995:58-66) primary Blackfoot sources of this story, all very similar. The importance of the story for Blackfoot culture is very clear. According to their tradition, the combination of the woman who went to the sky and returned, then of her child returning to the sky, is fundamental to the origins of both the Ancient Pipe Bundle and the Sun Dance. When the Sun Dance was performed, both Feather Woman and Star Boy were ritually represented in the ceremony.

The sky symbolism is very strong and interesting. Sun, Moon and Morning Star are the main celestial characters, but the pole star and the Milky Way are also involved. McClintock's rendering indicates that Star Boy is Jupiter, but other accounts suggest that he might be Mercury, or perhaps a bright star. One story, not a primary source, ends, "Sometimes

Star Boy can he seen walking in the dawn with his father; other times he is seen walking with his mother in evening twilight." One Blackfoot authority (Bullchild 1985:345, 359, 365) says that "Mistaken Morning Star" and Star Boy are two different entities and that the Morning Star rising before the Sun is a necessary condition for the Sun Dance, yet we also learn that the Sun Dance was to be performed each year. If Venus, or any other planet, is Morning Star, this can not be so. There are many such questions that are frustrating, but such is the norm when dealing with mythology. Space will not permit going into these issues here.

STARBORN: THE POETIC VERSION

At the beginning I mentioned that there is a poetic version of the story. It was composed by H. E. Warner (n.d.) and comes from a Dakota version of the tale, titled "The Fallen Star." The poem is tided "The Star-Born: A Dakota Myth" Since it is very long, we can only abstract from it here, starting at the beginning, then skipping through it and on to the end.

Upon a grassy slope without the camp
Where shadows falling fold on fold grew deep
And broadened slowly, lay two maids at eve
And gazing on the star-groups floating far...one spake
"Oh, if I might but marry that bright star,
Then as she spoke she felt herself upborne...
...the bright star in which the maiden rose
Grew broad and splendid, flooding all the sky . . .
And one in shining raiment met her there
And led her home and she became his wife.

Now we skip to where the girl pulled the turnip bulb out of the floor of the sky:

When Lo! a hole was opened through where she
Looked down and saw and knew the azure world
But even as she gazed the sides fell in
And slipped below; then on the crumbling edge
She ran and shrieked, caught at the tumbling grass,
Then downward whirling like an arrow fell,
And swift and swifter till all sense was lost.

That, night a hunter saw a star,
For so it seemed, shoot swiftly to the earth
And going hither found, O piteous sight,
The mother crushed and broken, and a babe
Close by her side stretched out but breathing still ...
Thus Star-Born came, the offspring of the skies,
A tender babe, he grew to man's estate
Strong, faithful, brave not scorning earthly tasks,
Nor knowing yet how he should save his race.

We skip again, past his heroic and brave deeds, to the final part.

> *Then would the people build a house for him*
> *And give him wives, but Star-Born stood and spake*
> *'My friends, I need them not, I journey on.*
> *But if one maid among you, leaving all*
> *Her home, her friends, her country, all she loves*
> *Will go alone with me not knowing where,*
> *To share perchance my dangers and my toils,*
> *Give her to me, for she shall be my wife....*

To bring the poem to a close, imagine Star-Born and his wife standing high on a hill:

> *Then spake he, gazing upward to his star:*
> *'O Father! high exalted over all*
> *From whom a spark of the eternal fire*
> *I sprang to do thy bidding in the world,*
> *Lo! I have done the work thou gavest me,*
> *Have brought the people water, food and fire,*
> *Have tempered the cold winds and made the earth*
> *The fit abode of man. Now, with my friend,*
> *Made one with me, let me return again*
> *Up to the silent, ever watching sky*
> *That bends in love above the race of men.'*
> *So spake he and together they arose*
> *Above the earth beyond all cloud and storm,*
> *To heights serene and still, where yet we see*
> *Against the heavenly blue a double Star.*

Elsewhere I hope to publish a paper with the entire poem along with more complete bibliography and greater detail of the astronomical symbolism found within the many versions of this intriguing tale of one born of Earth and Sky to make the world a better place in which to live.

NOTES AND REFERENCES

P. BULLCHILD, *The Sun Came Down: The History of the World as My Blackfeet Elders Told It* (Harper & Row, 1985).

G. B. GRINNELL, *Blackfoot Lodge Tales*, (University of Nebraska Press, 1962), 93-103.

J. HIGHWATER, *Anpao: An American Indian Odyssey*, (Harper Collins, 1977).

B. HUNGRY WOLF, *The Ways of My Grandmothers* (William Morrow and Company, Inc., 1980).

W. McCLINTOCK, *The Old North Trail*, (University of Nebraska Press, 1992) 491-505, 523-524. Reprinted from original 1910 edition published by Macmillian and Co., London.

A. F. NEVIN, *Poia.* An opera with libretto by Randolph Hartley, (Berlin State Opera, *1909).*

S. THOMPSON, "The Star Husband Tale," *Studia Septentrionalia*, (1953) 4: 93-163. Reprinted 1965 in *The Study of Folklore*, by Alan Dundes, Prentice-Hall, Inc. (1965), 414-475.

H. E. WARNER, "Star-born: A Dakota Myth." (Smithsonian Bureau of American Ethnology, n.d.) Dakota, Eastern, MS 1050. Referenced to "The Fallen Star," a myth written in Dakota by Michel Renville, printed in Stephen R. Riggs, *Dakota Grammar, Texts, and Ethnography*, edited by James O. Dorsey, Washington, D.C. 1893.

Note attached to the manuscript indicated the following:

> Poetic version of "The Fallen Star," a myth written in Dakota by Michel Renville, printed in Stephen R. Riggs, "Dakota Grammar, Texts, and Ethnography," edited by James Owen Dorsey, CNAE IX, Washington, D.C., 1893, pp. 83-94. Warner was a son-in-law of Stephen R. Riggs. [Author identified from note in Dorsey's handwriting in MS. no. 1524, catalog of BAE MSS. See Shelf 83-L.]

J. WELCH, *Fools Crow*, (Penguin Books, 1986).

C. WISSLER and D. C. DUVALL, *Mythology of the Blackfoot Indians*, pp. 58-66, (University of Nebraska Press, 1995). Originally published in 1908 as volume 11, Part I of *Anthropological Papers of the American Museum of Natural History.*

HISTORICAL LEXICOGRAPHY AND THE ASTRONOMICAL LEXICON

Terry Mahoney
Instituto de Astrofísica de Canarias,
La Laguna, Tenerife, Spain

INTRODUCTION

I discuss the application of lexicographical techniques to the history of astronomy and introduce a set of working tools whose application to astronomy may be said to constitute *astrolexicography*[1,2]. *Lexicography* is defined as the art of making dictionaries and is concerned with the practical problems of sense recognition and definition, spellings and their variants, the grammatical functions of entry words and phrases, pronunciation, etymology and, in larger works, the gathering of illustrative quotations.

Dictionaries are many and varied in their typology. We may broadly differentiate among *dictionaries* (monolingual and multilingual), *thesauri*, *encyclopaedic dictionaries* and *encyclopaedias*. Monolingual dictionaries, offer succinct definitions of entry words and phrases, or their equivalents in the same language (often called "thesauri" or "dictionaries of synonyms"). Multilingual dictionaries provide equivalents in other, *target*, languages. *Thesaurus* has a distinct meaning within astrolexicography and refers to the compilation of thematically organized word lists with a view to standardizing astronomical terminology for the purposes of efficient abstracting and cataloguing. *The Astronomy Thesaurus*[3] and the *NASA Thesaurus Astronomy Vocabulary*[4] are noteworthy examples of such works. The closest approach to a true monolingual *dictionary* of astronomy, in the sense defined here, is the excellent, but now rather dated, work of Hopkins[5]. All other works that purport to be dictionaries of astronomy, to my knowledge, are really encyclopaedic dictionaries, which provide information far in excess of the needs of strict definition. A multilingual dictionary of astronomy worthy of special mention (but, once again, very dated) is that of Kleczek[6], which offers an extensive range of astronomical terminology, arranged thematically, in English, Russian, German, French, Italian and Czech), together with an alphabetically arranged index in each language. I shall not discuss encyclopaedias since the problems of their compilation overlap relatively little with lexicography.

THE PRINCIPLES OF ASTROLEXICOGRAPHY

Astrolexicography may be usefully discussed in terms of three sets of binary opposites: description vs. prescription, the written vs. the spoken word and diachrony vs. synchrony. Dictionaries may be either *descriptive*, listing senses from actual usage rather those that recommended by "authority", or *prescriptive*, giving the reader normative acceptations and labelling certain usages as "incorrect" or "unacceptable", or eschewing them altogether. The preoccupation of XX century linguistics with *spoken* language, in sharp contradistinction to the literary traditions of XIX century philology, has resulted in a revolution in lexicographical practice, with ever-increasing coverage of colloquial diction and taboo words and expressions, the aim being to provide a balanced overview of the lexicon . The concepts of *synchrony* and *diachrony* were introduced by Saussure[7] and are of fundamental importance. We may imagine the entire lexicon at a given moment in time to occupy a horizontal plane, like a stratum in the soil. This is a sychronic plane. Similarly we may imagine other synchronic planes beneath and above this stratum, like the strata of an archaeological site. The "topsoil" would represent the present-day synchronic plane, and the lower planes would represent a series of sychronic planes, the deeper ones representing the older planes. The size of the lexicon at any given moment is represented by the extension of the relevant "stratum" (*i.e.*, synchronic plane); "depth", the analogue to the time dimension, represents diachrony. Hence, the evolution of the lexicon may be represented as a time sequence of synchronic strata. The aim of synchronic astrolexicography is to describe the lexicon at a given period in time; diachronic, or historical, astrolexicography is concerned with recording the changes in the astronomical lexicon over time, in other words, with describing the evolution of the lexicon.

We now have a three-dimensional frame of reference whose axes are the above-mentioned binary opposites: description-prescription, speech-writing and synchrony-diachrony. There is a great deal of literature on the subject of dictionary typology, but for the purposes of astrolexicography at this early stage of its development this simple framework will suffice to provide a complete typology. More important than simple dictionary classification, however, is the methodological basis that this elementary scheme provides in approaching the process of dictionary compilation in astronomy.

A few illustrative examples of the various needs of different users of astronomical terminology would be in order at this point. The astronomical researcher or student of astronomy might wish to consult a dictionary for a succinct definition of, say, *ephemeris time* or *Type Ia supernova*; for this type of consultation a *synchronic* dictionary (which will almost certainly also be *prescriptive*) will suffice. The historian of astronomy might wish to investigate the introduction of Latin constellation names into the English language. A good *descriptive diachronic* dictionary would provide him with first recorded use in an English text, a series of subsequent quotations to the present day (or last known use if the name is now obsolete) and at least one English equivalent (there are more likely to be several). A newcomer to the history of astronomy wanting to know the meaning of, say, *prosthaphæresis* would also need to consult a diachronic dictionary, since the likelihood of finding such a term in a commercially produced synchronic dictionary of astronomy are remote indeed. The astronomical librarian's requirements are again quite different, his primary concern being the classification of books and journals, for which purpose he will quite definitely need a *prescriptive* and *synchronic* list of terms. If he is also engaged in answering readers' queries, however, he may also wish to resort to a good diachronic dictionary. Given that ethno- and archaeoastronomy are the theme of this meeting, I shall discuss the problems peculiar to oral traditions further on.

THE PRACTICE OF ASTROLEXICOGRAPHY

The greatest work of historical lexicography in the English language is, beyond all doubt, *The Oxford English Dictionary*[8]. The second edition, together with three *Additions* volumes published so far[9,10,11], form the most complete description of the English lexicon, from its earliest beginnings to the present day. An exhaustive account of the creation and working principles of the *OED* is just about to be published[12]. A brief overview of *OED* methodology would be useful at this juncture in order to provide the groundwork for the somewhat modified working principles of astrolexicography to be developed here.

The life's blood of the *OED* is its immense corpus of quotations from a wide range of written source ranging from the IX century to the present day. This corpus is the result of an organized reading programme that has been in operation for well over a century. Being a desciptive dictionary, the *OED* bases its entries entirely on this corpus, the fundamental idea being to raise definitions on the basis of the evidence accumulated in the corpus. A typical entry has a headword, suitably tagged where it is obsolete or rare, an International Phonetic Alphabet pronunciation, grammatical function, etymology, numbered senses and illustrative quotations. These last begin with the earliest recorded use and, where possible, are suitably spaced in time and give a clear example of the defined usage. Quotations are gathered on white slips, which contain the following information: 1) headword(s), 2) grammatical function, 3) date of source, 4) author(s), 5) title, 6) doubt date where applicable (see below), 7) volume number where applicable, 8) part number where applicable, 9) chapter where applicable and 10) page number.

While it is true that, when completed in 2010, *OED3* will be the most complete compendium of astronomical terminology in existence, it should be remembered that it will be primarily a *general* work, and that even its coverage of astronomy will necessarily be limited[13]. It would clearly be useful to all users of astronomical terminology and nomenclature to be have access to a similar reference work dedicated solely to astronomy. To achieve this, the first requirement is a corpus of quotations.

THE BUILDING AND POSSIBLE USES OF A QUOTATION CORPUS FOR ASTRONOMY

The very first task confronting any serious attempt at astrolexicography is the building of a quotations corpus since this provides the foundation for all subsequent work. At this point a clear distinction must be made between *terminology* and *nomenclature*. The distinction I choose to make here is that nomenclature deals with the naming of individual objects within classes of objects with similar attributes. The labels applied can be proper names, catalogue entries or alphanumerical sequences. These labels can, and indeed must, be controlled by a central nomenclature clearing house (usually the IAU in astronomy). Terminology, however, is fully a part of everyday language applied to various specialisms. Modern linguistics is quite firm in its well validated contention that language is extremely difficult to "control": it can, however, be studied. A corpus of quotations enables us to study the use of terminology through time on the basis of hard evidence. Such a database, apart from highlighting apparent inconsistencies of usage, provides the clearest and best evidence for the evolution of terminology over time, as well as providing a sound empirical base for all discussion relating to terminology, a base which is so far lacking in astronomy.

The best way to build a corpus is through a systematic reading programme. My work for the *OED* led me to begin my own astronomical corpus, but mainly on the basis of an alphabetical search for entry word and phrases. This entirely unsatisfactory method is imposed by the needs of the *OED* revision programme, which, for obvious reasons, follows a strict alphabetical sequence. I have also made a start on a more systematic reading programme with the correpsondence of John Flamsteed, which is now being published[14,15]. The corpus to date stands at about 5000 entries, mainly in the alphabetical interval M – R[16].

A suitable quotation is one that amply illustrates the usage of the headword; however, in practice it is not always possible to find the ideal quotation. Quite often in astronomy a term will appear in the form of a definition and it is not always easily possible to find examples of its use "in action". The most unsatisfactory quotations are those from dictionaries; while these are useful evidence that a term may have been in common use at the time of publication of the dictionary, even this cannot be guaranteed for early dictionaries, whose compilers often sought after the most arcane words or in some cases even invented them altogether (for an instructive and entertaining account of the history of English lexicography, see Landau[17]). Obviously a dictionary quotation cannot be meaningfully considered to be a first usage (although in some cases an early dictionary quotation may be fairly difficult to antedate).

For a corpus adequately to reflect the evolution of terminology it must clearly have a reasonable temporal density of quotations. However, the optimum density really depends on the use to which the corpus is to be put. One quotation per decade would be quite sufficient for a historical dictionary, but if we were, say, examining the change in the lexicon over the lifetime of Flamsteed, perhaps several quotations per year would be necessary.

Accurate dating is of the greatest importance in recording quotations. Where a later edition of a work is used, the date given must the that of the edition used and not of the first edition. Where there is any doubt whatever concerning whether any changes to the text of a non-facsimile reprinting have been made, the quotation should be doubt-dated (after the title) with the date of the reprint (this would not be necessary for true facsimile reprints).

A serious problem which any corpus must face is the increasing patchiness of the written record as one goes further back in time. What we might call *primary* quotations (earliest appearance in a manuscript or printed work) become increasingly more difficult to find once we go further back than the Middle Ages. The problem of primary quotations is extremely acute when we deal with sources in Antiquity, where many of the earliest extant records are copies of long-lost originals.

Yet another problem arises with early sources in that very often we may not be sure of the register of speech being used. Medieval copyists often copied only what they considered to be works "worthy" of copying and the diction, for example in the case of Old English works that have survived, may often be in a deliberately "literary" register; hence, the corpus may become less representative of normal language as we delve further back in time.

WORD STRATIGRAPHY: TOWARDS AN ARCHAEOLOGY OF THE ASTRONOMICAL LEXICON

The concept of synchronic planes in a diachronic sequence can clearly be seen as analogous to the stratification of artefacts in a buried archaeological site. The present-day synchronic plane would represent the site topsoil and earlier synchronic planes the lower strata. The words and phrases that consititute a given synchronic plane may then be seen as similar to the artefacts buried in the different stata of the site. Just as artefacts can be seen in mutual articulation with respect to one another, so the lexical units in a synchronic plane, quite literally, "articulate" and interrelate in the sentences that make up the text "matrix". As we descend the diachronic axis, we find that some lexical units eventually disappear and others begin to make their appearance: we are witnessing the births and deaths of words, in the same way that artefact types might occupy a given range of depths, thereby indicating the periods in which they were used in the past. Spellings change over time in the same way that the attributes of artefacts evolve temporally (for example, pottery styles).

"Repatterning in assemblages" of artefacts[18] can occur through later disturbances to the site (rebuilding or the filling in of previous digging activity by rubble, for example) or by the inclusion of artefacts from other cultures. The lexicographical equivalent of false stratification would be editorial manipulation of the original text with a view either to making the text more readable to the modern reader or to "improving" the style. As an example of this,recently I came across an edition of Chaucer's works in which *annulus* (the ring of an astrolabe) appeared as a section heading in his Treatise on the *Astrolabe*; comparison with a more scholarly edition, however, revealed that "annulus" was simply an editorial addition. Just as the presence of "foreign" artefacts can indicate inter-cultural trading, so the presence of foreign words in a text can indicate a process of inter-lingual word flow at a given period. For example, the correspondence of Flamsteed is replete with intercalated Latin phrases which he uses quite unselfconsciously, and for which he often provides English equivalents in other places. Flamsteed's letters give a clear impression of the English astronomical lexicon being in a state of flux, with many Greek and Latin borrowings being either transplanted bodily, translated or anglicized in a perfectly uncommented and natural way[19].

The English lexicon reveals abundant signs of what Clarke refers to as cultural *diffusion* (linguistically equivalent to word-borrowing, translation and anglicization), *intrusion/substitution* (the linguistic equivalent of the replacement of many everyday Old English words by their Norman French equivalents) and *assimilation* (the assimilation of a huge influx of Norman French vocabulary into the much modified and morphologically simplified form of English known as Middle English. There is, however, one very great difference between historical lexicography and archaeological excavation: once an archaeological site is excavated, information on the patterning of artefacts is irretrievably lost however carefully the documentation is executed; word-digging, in the form of corpus building, however, is a purely non-destructive process. The lexical "site" (the text) is always there for future generations to "dig" into without fear of "disturbing" the site!

THE LEXICOGRAPHICAL PROBLEMS OF ARCHAEO- AND ETHNOASTRONOMY

So far I have concentrated solely on the written word. What approach should be adopted to the problem of the dating of oral traditions, which are of such great importance to ethno- and archaeoastronomy? It hardly needs to be stressed that the greatest caution is necessary in the dating of such material. It is not the tradition itself but its recording (sound or written) that should figure as the date of the quotation concerned. Once an alphabet has been devised for the language concerned, then the normal process of recording written quotations can be followed. All datings based on internal and external evidence relating to the tradition should be considered as doubt-datings.

The principle concerned in the dating of oral traditions is that of *diachrony in synchrony*; *i.e.*, the appearance of old forms of speech in a modern text (the posterior recording of the tradition). For example, the prayers used in Navajo curing ceremonies must be word-perfect, in keeping with the meticulous prescribed ritual procedures that are characteristic of these ceremonies[20]. The earliest dating of these prayers would be that of their first recording on paper or tape. However, the internal and external evidence relating to the prayers and the ceremonies in which they are uttered suggest that they could be centuries old. A useful linguistic test would be to examine the register of the prayers by comparing their use of vocabulary with present-day Navajo speech. If the prayers are genuinely old, as the evidence quite definitely suggests, then the techniques of linguistic, historical and anthropological research can be employed to provide a reasonably reliable doubt-dating, perhaps to the nearest century. A cautionary note must be sounded on the use of bilingual dictionaries. When using a dictionary of the language of a hitherto pre-literate society, we must remember at all times that the dictionary concerned is an example of diachrony in synchrony.

REFERENCES AND NOTES

1. T. J. MAHONEY, "La lexicografía astronómica", *IAC Noticias*, 1-1996 (1996), 54.

2. T. J. MAHONEY, "Historical astrolexicography and old publications", edited by U. Grothkopf *et al.*, ASP Conf. Ser., Vol. 153, *Library and Information Services in Astronomy III (LISA III)*, (San Francisco, 1998), 218.

3. R. M. SHOBBROOK and R. R. SHOBBROOK, *The Astronomy Thesaurus*, Epping (1993).

4. *NASA Thesaurus Astronomy Vocabulary*, Springfield (1988). NASA SP-7069.

5. J. HOPKINS, *Glossary of Astronomy and Astrophysics* (2nd. edn.), (Chicago, 1980).

6. J. KLECZECK, *Astronomical Dictionary in Six Languages*, (New York, 1961).

7. F. DE SAUSSURE, *Course in General Linguistics*, (New York, 1959), chapter 3.

8. A. SIMPSON and E. S. C. WEINER (eds.), *The Oxford English Dictionary* (2nd. edn.) (Oxford, 1989).

9. J. SIMPSON and E. WIENER (eds.), *Oxford English Dictionary Additions Series*, Volume 1 (Oxford, 1993).

10. J. SIMPSON and E. WIENER (eds.), *Oxford English Dictionary Additions Series*, Volume 2 (Oxford, 1993).

11. M. PROFFITT (ed.), *Oxford English Dictionary Additions Series*, Volume 3 (Oxford, 1997).

12. L. MUGGLESTONE, *Lexicography and the OED*, (Oxford, 2000).

13. MAHONEY (1998), *Ibid.*

14. E. G. FORBES, L. MURDIN and F. WILLMOTH (eds.), *The Correspondence of John Flamsteed, First Astronomer Royal*, Volume 1, (Bristol, 1995).

15. E. G. FORBES, L. MURDIN and F. WILLMOTH (eds.), *The Correspondence of John Flamsteed, First Astronomer Royal*, Volume 2, (Bristol, 1997).

16. Clearly, the reading programme would benefit from the help of several readers, and anyone interested in taking part is most welcome to contact me at tjm@iac.es.

17. L. LANDAU, *Dictionaries: the Art and Craft of Lexicography* (2nd. edn.), (Cambridge, 1989).

18. D. L. CLARKE, *Analytical Arcaheology*, (London, 1968).

19. The publication of Flamsteed's correspondence during the commencement of the the *OED* revision programme is most fortunate, since it is providing many antedatings for entries in the dictionary.

20. A. M. Jr, JOSEPHY, *The Indian Heritage of America*, (Harmondsworth, 1975), 178.

THE BABYLONIAN CIVIL CALENDAR 731-626 B.C. EVIDENCE FOR PRE-"METONIC" PERIODIC INTERCALATION PATTERNS

Manuel Gerber
Institute of Ancient Near Eastern Archaeology and Languages,
University of Berne, Switzerland

ABSTRACT

It is commonly assumed that Babylonian intercalations did not follow regular patterns before the 5th century B.C. On the basis of the reliably known sequence of Babylonian New Year's dates between 626-539 B.C. and a partial reconstruction of the calendar after 731 B.C., a complex system of 12-year patterns spaced at 19-year intervals is here demonstrated to be present throughout the attested sequence and the reconstructed parts. These patterns are embedded in a cyclic superstructure with a period of 190 years. A periodic system of intercalation based on the recognition of the equality of 235 lunar months and 19 solar years thus appears to have been in use in Babylonia two and a half centuries before the introduction of the "Metonic" cycle. It ended with the Persian conquest in 539 B.C.

1. INTRODUCTION

Before the introduction of the 19-year, "Metonic" cycle in the early 5th century B.C.[1] intercalary years are generally believed to have been determined empirically by the Babylonians[2]. Despite the fact that in the case of applied observational criteria for leap years one should expect the resulting pattern to be periodic, Neugebauer's verdict that "[these earlier] intercalations of the lunar calendar show no regularity whatsoever"[3] has in its essence remained uncontested. Here, evidence for complex periodic intercalation patterns as early as the 8th century B.C. is presented. ("B.C." is omitted hereafter.)

2. PARTIAL RECONSTRUCTION OF THE CIVIL CALENDAR BEFORE 626

2.1 Previous work

The Julian equivalents of the beginnings of the Babylonian year (fig. 1) are known reliably ($\pm$1day)[4] from 626 onwards[5]. Only 14 earlier New Year's dates can be derived from eclipse data[6] between 748-626[7], three of which are not entirely certain (748, 747 and 746). Additionally, the temporal positions of 9 intercalations are known from date formulae in Babylonian economic texts[8]. In a recent study by the author[9], the amount of available information was increased by calculating the number of intercalations between attested dates: It was shown that a) a constant ratio of ~7 intercalations per 19 years was maintained between 731-601 and from shortly after the turn of the century to the Persian Conquest in 539, and that b) an excess intercalation between 746-731 and around 600 respectively caused an upwards shift of about two weeks in the average beginning of the Babylonian year in relation to the solar year. New Year's dates between 600-539 are distributed normally on the Julian scale. Projecting the 95%-C.I. (dashed lines in fig.1) onto the incomplete dataset of the years 731-601, there is a single New Moon within the range thus defined in about 50% of the cases. Together with the 11 reliable dates inferred from cuneiform eclipse records, roughly 65% of the New Year's dates between 731-626 can therefore be determined with a confidence >95%.

2.2 An example sequence

Table 1 shows the reconstructed sequence of New Year's dates of the years 699-689: The New Year syzygy of 695 is determined by eclipse data[1]. In the years 698, 696, 693 and 690, there was a single New Moon within the accepted temporal range. An intercalary month is mentioned in a contemporary economic text for 697; of the two possible dates only the earlier one can account for the 18-day increase to 27 March in the following year caused by the intercalation. The remaining New Year's dates cannot be determined unequivocally. However, the number of intercalations between known dates restricts the amount of possible intercalation patterns: in the years 695-691 the pattern 10010 is possible, 00101 and 11000 are not.

3. PERIODIC INTERCALATION PATTERNS

The reconstructed sequence of known and inferred intercalations (1) and normal years (0) between 731-539 was tested for autocorrelation at lags between 1 and 50 years (fig.2). The resulting picture is far from clear; the correlations at lags 1-5 are irrelevant since they only reflect the combined effects of the obvious scarcity of two intercalations in a row, the scarcity of more than two normal years in a row, and the fact that a sequence 101 is more often than not preceded or followed by 100 or 001 respectively. At lags >5 the sequence correlates best, if not significantly, with itself at a lag of 19 years, implying that some but not all patterns repeat themselves at 19-year intervals with some but not complete regularity.

A look at the attested pattern between 600-539 in fig.3 confirms this: the beginnings of three exceptionally long series of normal years (*000* and *0000*; bold print) in 587, 568 and 549 are spaced 19 years apart. The surroundings of the two outer series form an identical 12-year pattern (underlined) spaced 38 years apart. The corresponding pattern of the inner series (underlined) is similar but not identical. A three-year pattern (*010*; bold print) adjacent to each occurs a fourth time at the required interval (599-597) but is not preceeded by either 12-year pattern. The remaining 4-year patterns exhibit no apparent regularity. Searching for possible series of three normal years in a row compatible with the reconstructed parts of the calendar before 600 (shaded areas), one finds that in the 7th century such possibilities occur *i.a.* at four 19-year intervals starting at 684, 665, 646 and 627. Assuming a series *000* in each case, there are very few possible reconstructions of the 12-year pattern embedding them (underlined): a single one in 688-677 and 631-620, two in 669-658 and four in 650-639. The resulting pattern in 688-677 is the inverted counterpart of the two identical 12-year

Table 1. Distribution of known New Year's dates

		1			1			1			← Number of intercalations between known dates
2.3./31.3.	**21.3.**	9.3./7.4.	**27.3.**	**17.3.**	6.3./5.4.	**24.3.**	14.3./12.4.	3.3./2.4.	**22.3.**	10.3./9.4.	← Beginning of the Babylonian year: = New Year syzygy computed from contemporary eclipse data; ≤ = New Moons within range (95%-C.I.); **Bold** = Known or inferred from surroundings
699	698	697	696	695	694	693	692	691	690	689	← ' = Intercalary month attested in contemporary economic texts
	0	**1**	**0**								← = Inferred from surroundings

patterns after 600. These patterns are spaced 38 years apart, and, interestingly, one of the four possible reconstructions of the 12-year pattern in 650-639 is identical to the single one in 688-677. The same is true for the two remaining 12-year patterns spaced 38 years apart; they differ from the isolated sequence in 573-562 in the position of one intercalation, however. If the analogy were significant, one would expect the 12-year patterns in the adjacent intervals to exhibit the same behaviour - which is indeed the case: one of the four possible reconstructions of the pattern in 707-696 has the inverted sequence of the corresponding series in 612-601. Thus, there seems to be a complex but regular structure of 12-year patterns in 19-year intervals, which may be summarized as follows: A B C B C A_{Inv} B_{Inv} C_{Inv} B_{Inv} C_{Inv} with a single inconsistency in the position of one intercalation and an irregular 20-year interval separating C and A_{Inv}. While no motivation for the former is apparent, the latter is due to the excess year with an intercalary month predicted for the time around 600 (see §2.1). Ignoring such excess years (there is another one between 748-731), each 12-year sequence is repeated after 2 inversions spaced 95 years apart. There is thus a cyclic superstructure with a period of 190 years.

Extrapolating this system further back in time does not conflict with the earliest of the reconstructed parts of the calendar. The amount of missing data from the as yet unexamined 7-year sequences presently renders an assessment of the overall significance impossible.[2] However, in the light of the large number of possible 12-year patterns the found regularities can hardly be considered random: All of the 12-year sequences taken into consideration begin and end with a normal year. There are 61distinct patterns meeting this criterion which do not violate the limits imposed by the accepted range of 43 days (fig.1). The probability that one of these patterns occurs randomly is thus $p=0.0164$. The corresponding probability that the inverse of B_{Inv} randomly appears twice ($x=2$) in the total of five possible reconstructions with 000 for the years 688-677 and 650-639 ($n=5$), for example, is $P_n(x)<0.003$.

4. CONCLUSIONS

Contrary to the prevalent view, the complete series of reliably attested New Year's dates between 626-539 contains evidence for regular intercalation patterns. For the years 748-626 the Babylonian calendar can be partly reconstructed with a satisfactory degree of confidence (95%). A complex system of 12-year patterns spaced at intervals of x·19-years was here demonstrated to be present throughout the attested and the reconstructed parts of the sequence. These patterns are embedded in a cyclic superstructure with a period of 190 years. Hence, an elegant, if somewhat uneconomic, periodic system of intercalation -based, it seems, on the recognition of the equality of 235 lunar months and 19 solar years- appears to have been in use in Babylonia two and a half centuries before the introduction of the "Metonic" cycle. It ended with the Persian conquest in 539.

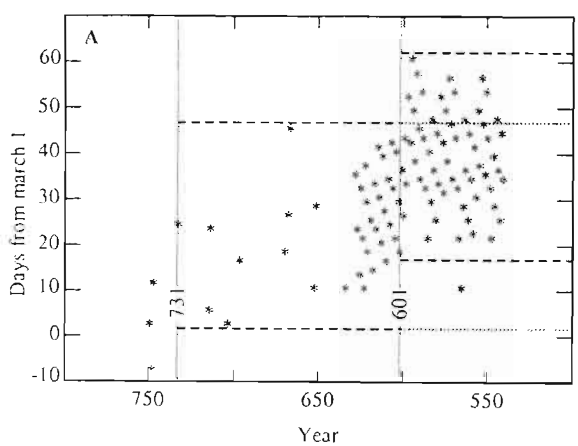


Figure 1. Distribution of known New Year's dates

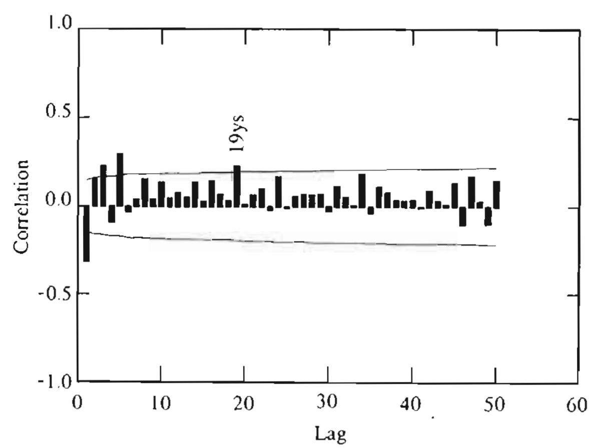


Figure 2.Autocorrelation Plot

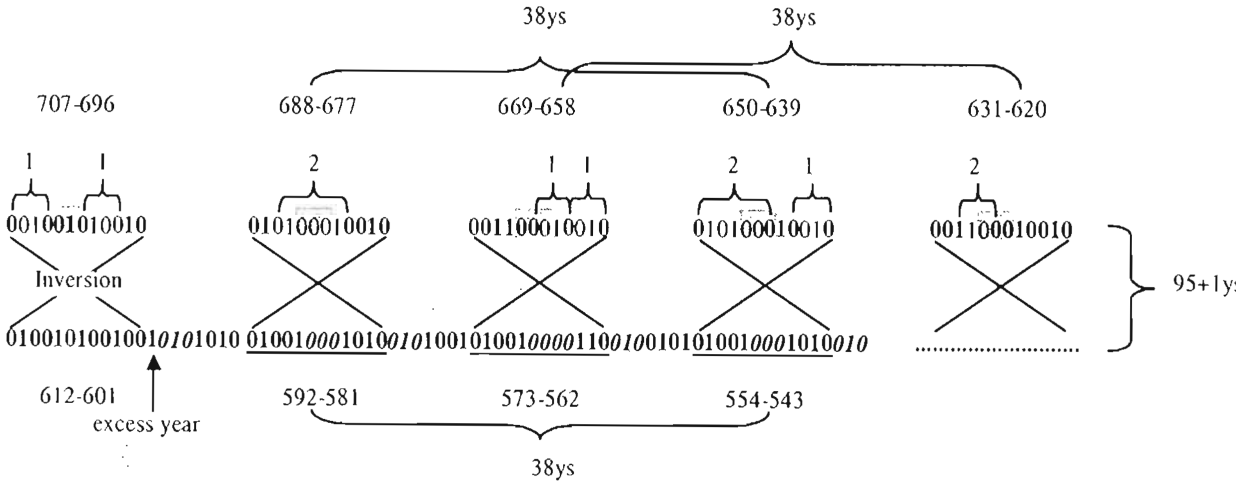


Figure 3. Intercalation patterns; the 190-year period. Bold= known, Light= periodic repetition

The corresponding 7-year sequences remain to be examined. The attested patterns are obviously not linked directly with their regular 12-year counterparts. They may be aperiodic or governed by a different period. Understanding their structure may eventually lead to a complete reconstruction of the Babylonian civil calendar of the late 8th and 7th centuries, thus allowing the proper determination of the overall significance of the proposed pattern as well as a systematic search for possible observational correlates.

NOTES AND REFERENCES

1 A. AABOE, J. P. BRITTON, J. A. HENDERSON, O. NEUGEBAUER and A. J. SACHS, *Saros cycle dates and related Babylonian astronomical texts* (Philadelphia, 1991), 16.

2 R. A. PARKER and W. H. DUBBERSTEIN, *Babylonian chronology 626 B. C. - A. D.* (Providence, 1956), 1-2.

3 O. NEUGEBAUER, *The exact sciences in antiquity. Second edition.* (New York, 1969), 102.

4 note, however, D. PINGREE, "Legacies in astronomy and celestial omens", in *The legacy of Mesopotamia*, ed. by S. Dalley (Oxford, 1998), 12616.

5 R.A. PARKER and W. H. DUBBERSTEIN *op. cit.* (ref. 2), 27-47, with a correction in O. Neugebauer and A. Sachs, "Some atypical astronomical cuneiform texts I", *Journal of Cuneiform Studies 21* (1967), 189.

6 A. J. SACHS and J. SCHAUMBERBER, *Late Babylonian astronomical and related texts* (Providence, 1955), Texts No. 1413-1417.

7 P. J. HUBER, *Astronomical dating of Babylon I and Ur III* (Malibu, 1982).

8 J. A. BRINKMAN and D. A. KENNEDY, "Documentary evidence for the economic base of early Neo-Babylonian society: A survey of dated Babylonian economic texts 721-626 B.C.", *Journal of Cuneiform Studies* 35 (1983), 222.

9 M. GERBER, "A common source to the Late Babylonian Chronicles of the 8th and 7th centuries", *Journal of the American Oriental Society*, submitted.

10 A. J. SACHS and J. SCHAUMBERGER, *op.cit.* (ref. 6), Text No. 1414.

11 I gratefully acknowledge V. Gurzadyan's suggestion to calculate the Kolmogorov Complexity as a measure of the significance of the proposed periodicities.

LUNAR SEASONAL CALENDARS FROM THE ANCIENT NEAR EAST

Duane W. Eichholz
North Shore Community College
Beverly, Massachusetts, USA

ABSTRACT

Three Near Eastern circle discs regulate a schedule of biological and environmental indicators with a count of step-intervals that total 386. This count coordinates the natural year with phases of the moon in a synodic luni-solar year of thirteen months. The discs establish a system of lunar motion that will notice two successive New Moons or the interval between a passage of the Moon at the same node of its orbit. When this period is tied to the helical rising of *Serpet* (Sothis or Sirius) that signaled the season when the Nile flooded, an interval is determined that could be intercalated to force synchrony with the solar year. The Roman Codex Calendar of 354 A. D. translates this rhythm to urban life as festival, commercial and legal days.

Three circle discs illustrated in Biblical Archaeological Review are identified as the "coiled serpent" game called *mehen*, said to have "originated in Egypt during the Predynastic period and spread through the Levant."[1] An alternate translation for the term *mehen* in an Egyptian Pyramid Text reads "an actual coiled serpent hostile to the king." It "refers to an act of homage to the king by the earth and sky in their eastern and western aspects."[2] As the king takes his place in the beyond, the relation of the King to the "goodly thrones on earth" and his "pure throne which is in the sky," will direct the bark of Ra, in a pattern "round about the horizon."[3]

Elements marked on these so-called "game" discs demonstrate a possible twelve or thirteen month, luni-solar calendar used to regulate a twelve synodic month year of 354 days. The insertion of an occasional thirteenth month restored its desired relation to the season, or "forced synchrony with the heliacal rising of Sirius" during the last month of the year.[4]

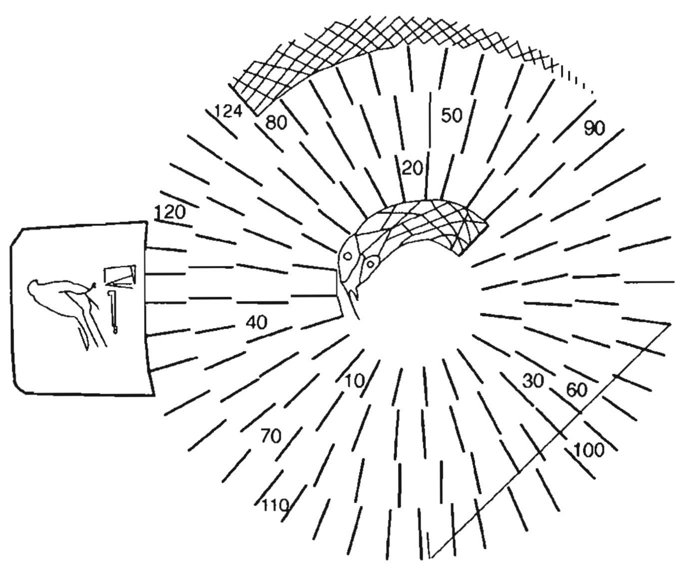


Figure 1. Greywacke disc. Serpent with Sooty Falcon or Hawk Eagle. Metropolitan Museum of Art. Harris Brisbane Dick Fund. 1958 (58. 125.1).

Bird-figure elements are located on the circumference of each disc. The centers present a serpent head with protruding tongue, eyes and columnar "horns." The neck and tail of each snake are marked in a naturalistic diamond pattern of scales to limit a series of regular steps-intervals marked within this pattern. The graywacke disc has 124 steps that are modified with a line across 10 or 11 steps marked in the last sector of steps (Figure 1). The relieve of the white limestone disc has 127 marks (Figure 2). The red-saffron, ivory disc has 135 steps (Figure 3). The total count of the steps on the three discs is 386.

The bird-images make up a three season, biological clock. Inside a squared shape on the exterior of the greywacke disc, a bird in profile is mounted on a structure called a "fustrum." This form was used to calculate the volume of any pyramidal structure.[5] Beside this form a "hand and arm outreached," is translated as "to plant."[6] The bird is the grey Sooty Falcon (Falco concolor) that breeds during June to October, in Libya, through Egypt, northern Ethiopia, and into the Sinai Peninsula and the Negev Desert. The African Hawk Eagle (Hieraaetus silogaster) also breeds on the savanna of Africa in this season.[7]

The white limestone disc displays the head, eye and beak of goose (Ancerinae) of the savanna that breeds in the season of *Peret* or "emergence" (of seed). The naturalist will remember the relief of the Geese of Meidum. It is associated with the "Jewish *Nisan*, our March-April."[8] The Egyptologist, Renouf (1824-1897), identified alpha Arietis as the Goose among the native star groups of Egypt.[9]

The red-saffron, ivory disc shows a bird with a long beak, a tuft of mating feathers, and eye. This crane of the marsh, Demoiselle (Anthropoides virgo) breeds in season of *Shemu* or "heat." It represents the sacred ibis (Treskiornis aethiopica) identified with the ancient moon god and Thoth, "the venerable ibis....the time determiner....the tongue of Ra....guide of heaven, earth, and netherland."[10]. On the serpent body opposite the bird-head a rounding depicts a swollen birth orifice that is later represented variously as a "sheaf of wheat," or the "Knot of Isis," in the hand, dress or hair of the seasonal, equinoctial constellation of Virgo.[11]

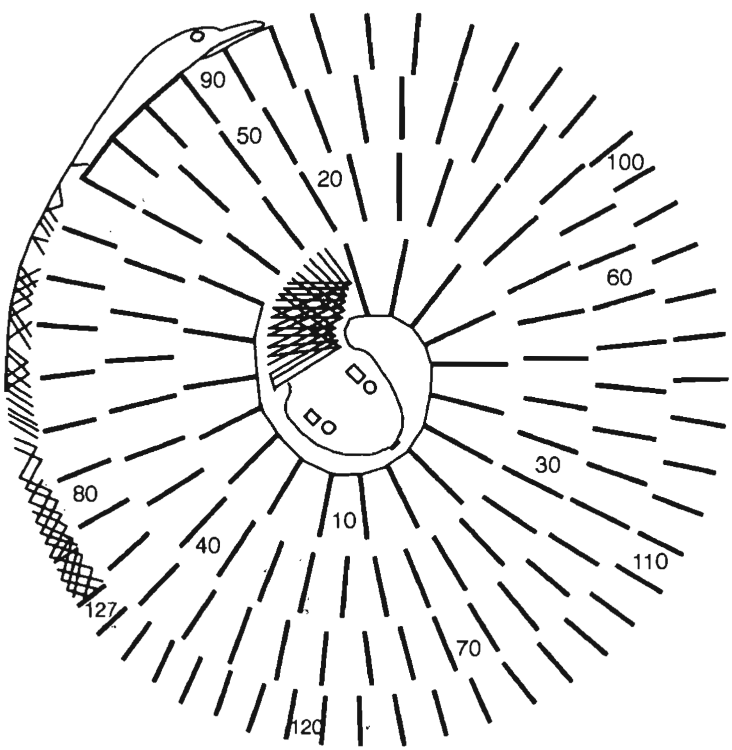


Figure 2. Limestone disc. Serpent with Goose. Emily Teeter/Oriental Institute.

The coiled form at the center of the slate disc presents the cupped face of a land snake identified as the African rock python. It has a protruding forked tongue and pointed ears to represent adjoining double triangles. The snake on the stone and ivory discs is the snub-nosed, Congo river cobra. On these discs one tongue is an ocher square and the other is a rectangle shape filled with red relieve. Eyes on the grey disc are engraved in a light shadow. On the white disc eyes are gouged into the surface and the ivory disc eyes are inlaid with glass. Parallel, grooved elements project above the stone and ivory head like columns.

A dictionary of forms can be read from papyri, wall painting, and the sculpture of Egypt. In the Book of What is in the Duat, on the walls of the tombs of Tuthmosis III (1479-1425 BC) and Amenhotep II (1479-1401 BC) there is a variation of snake with an undulating body made up in the light and dark spots of the natural pattern on the body of the Rock python. This snake is the adversary of Ra called, Apopis, "the coiled serpent hostile to the king." It inhabits the Third Region of Night. A jackal with cut off ears, associated with Horus and the falcon, guarded the east and west. A black jackal with pointed ears called Anubis roamed the west to prepare and accompany the soul of Osiris through the underworld as a lunar symbol. These forms are brought together as, "My face is that of a Jackal, my middle is that of the Celestial Serpent...."[12]

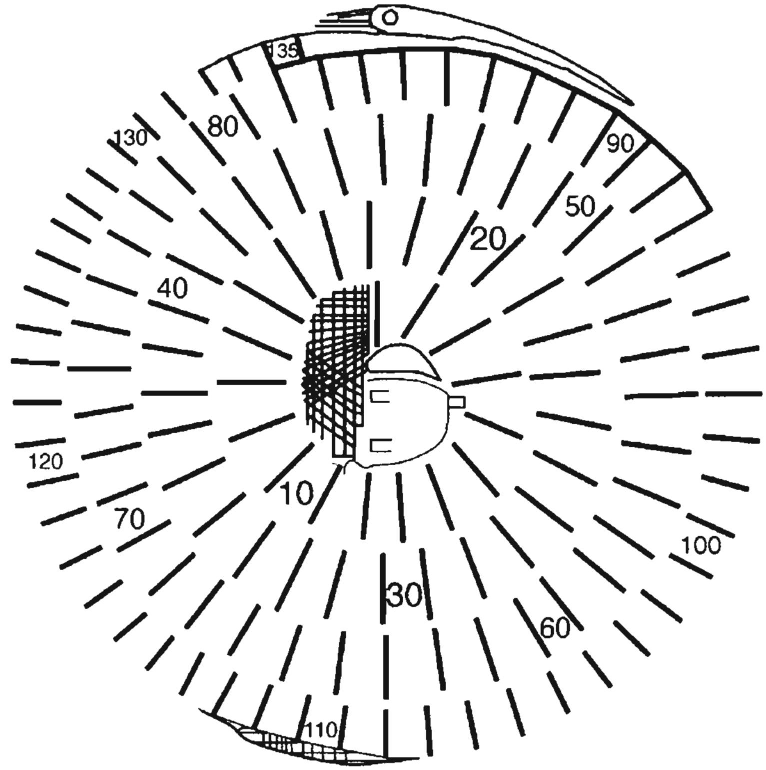


Figure 3. Ivory disc. Serpent with Demoiselle Crane or Sacred Ibus. Musee D u Louvre.

The columnar poles or "horns" at the center of the limestone and ivory disc are seen to mark "The Milky Way that crosses the ecliptic at the two tropical signs. Natural Philosophers named them the 'portals of the sun' because the solstices lie athwart the sun's path on either side."[13] Bernard Goldman identified this "cosmic door motif" associated with "the Pillar and The Milky Way" as "the palace shrine of divinity," that "combines and continues in the diverse styles of Egypt, Mesopotamia, Syria, and Anatolia."[14] The double column is said to be first represented by "an early Akkadian cuneiform ideograph of the month of *Kas*, or the Twins (Gemini)."[15] The second portal in the southern latitudes of the sky is variously located in the area of Capricorn, Scorpio, Sagittarius or *Ophiuchus*, The Serpent Killer. The serpent on the grey-green disc diverges from the column representation with the raised ears of the jackal cited above to represent these poles as triangle elements that separate the Third level of the Night guarded by Apopis.

To find the rule of these enigmatic discs we see that the form is exclusive, that is, there is no entry from the exterior, and, all discs are a circle that is always in place if there is no rule to orient the disc. Real geography was made when the pyramids were aligned to a stationary point at the top of the sky joined to the mouth of the Nile River at Giza and extended along the line of the directional flow of the river to the southern star, Canopus. This line was the geographic north- south "pole" of Egypt as the backbone of Osiris or the djed. A jackal with squared ears in prowls the east at sunrise and a jackal or a hawk/falcon marks the west at sunset. The djed as "earth and sky" and the jackal/hawk/falcon at "east and west" establish the required coordinates of Egypt.

The "months began at sunrise on the first day on which the old crescent was no longer visible in the East at dawn."[4] It was later coordinated in a calendar with the rise of Sirius at sunrise and the inundation of the Nile River. This beginning was made visible at a bound on the earth by the uppermost shadow of the sun at the summer solstice. A ritual New Year was celebrated at the lower solstice shadow. These coordinates become the "east-west" entry to the whole system.

The figure of the "serpent's tongue" on the "coiled serpent" rules entry through the gate created by the "horns" of the serpent and directs us to this start-point. "My tongue is the pilot in charge of the Bark of Righteousness."[16] The body "coils" in a spiral of steps-intervals between a naturalistic, diamond pattern on the neck and tail. These marks are accounted for when the declination of the moon reaches about 29 degrees. The stage on the horizon may vary but the time of the cycle is not changed.

Graphic indicators of step and interval articulate a pattern for the abstraction of day to mark equal and parallel limits to simulate the durable interval of one night-day. Without an easy number system that was accessible to the farmer, they make a number set (1+1+1 etc.) derived from a pattern that can be seen by the eye rather than the mind. This set is placed on a spiral line to direct an intuitive order of coherence and economy to the count.

The character of these objects also considers the color and material as a visual metaphor of season. Dark material was used for figures that appeared before the creation of Human Beings and Osiris in his journey through the night or the darkness of the season of Inundation. When the surface of the slate is broken, the light grey color of the engraving gives the appearance of an object in "solar shadow." Imported, white stone was used for the model of the universe during the season of "Planting and Gestation," dedicated to Isis "who was pre-eminently the goddess of the family in Egypt."[17] The organic, ivory disc gives the authority of nature to the Harvest.

In a thirteen month lunar year, the total number of steps on the discs give a steps/intervals count to regulate a pattern of days. They are a tool that creates mundane public time represented along the length of the ecliptic. This event will begin an order that coordinates the conjunction of the moon with the sun and *Serpet* (Sirius) on the ecliptic to count the months in the year as a lunisolar and sidereal year. A possible example of this step-interval count follows.[18]

Sirius: Local Rise Time, 04:09 AM at -19 degrees 44 minutes, (Julian Day, 1236926.590).

Moon: Local Rise Time, 04:09 AM at +27 degrees 55 minutes, (Julian Day, 1236926.590).

Sun: Local Rise Time, 04:52 AM at +23 degrees 23 minutes, (Julian Day, 1236926.619).

Begin disc: Jul 10, 1327 BC. Waning crescent moon, 29 days old. (JD 1236926.590).

124 days: Nov 10, 1327 BC. Waxing crescent moon, 5 days old. (JD 1237050.308).

127 days: Mar 17, 1326 BC. Waxing gibbous moon, 13 days old. (JD 1237176.633).

135 days. Jul 30, 1326 BC. Waxing crescent moon, 1 day old. (JD 1237312.232).

386 = discs total. This calculated period (Julian) of 13 visible lunations is 385.642 days.

The astronomical period (Julian) of 13 lunations of 29.530589 days is 383.897657 days.

[A lunation is the (mean) interval between two similar phases.]

To order these discs with the Egyptian year, the grey slate tongue, the ocher tongue on the white disc, and the red tongue point to seasons to be in conjunction with the sun. In the season of the grey slate the Sun passes through Virgo to the Tropic of Capricorn. The white slate season passes through Sagittarius at the bottom of the Tropic of Cancer . The ivorv disc passes through Aries to the season of "heat" at the high Tropic harvest.

"A thirteenth month was intercalated if the helical rising of Sirius occurred in the last 11 days of the twelfth month. In this way the year was forced into synchrony with the Sothic year. This month was called Thoth after a moon god."[20]. The line across 10 or 11 steps marked in the outer sector on the grey disc indicates this steps-intervals period.

The Roman Calendar of Numa, of the early first century BC used a "12 month lunar year of 355 days, with provision for an intercalary month of 22 or 23 days every two years. Intercalary months were inserted so that in the twentieth year the days should fall in with the same position from which they started and the period of twenty years be rounded out."[19] Using this cycle, "Only after 310 Julian years do the cyclically computed mean new moons fall one day earlier than they should. This cyclical computation formed the basis of the calendar of the Selucid empire in antiquity but is the foundation of the Jewish and Christian religious calendar, especially so far as Easter is concerned."[21]

The Roman Codex Calendar of 384 illustrate two seasonal themes shown on these discs. The November illustration shows a bald man who serves a coiled serpent on a tray of scraps to the goose of Isis. His right arm holds a cistern. On his right a specimen head of Anubis looks to the west. Mature pods of poppy (Papever somniferum) with its characteristic leaves float through the scene as a symbol that anticipates the rejuvenation of spring. In Rome the festival of Isis was celebrated in February to show a pregnant woman with the "Knot of Isis," holding a goose by a standing crane, a fish as Pisces and the Urn of Aquarius.[22]

When the plan of the discs is formulated, it is a unified calendar coupled with real astronomy to represent a set of environmental and cultural elements. The length of the season, the fluid floor or geometry of the Nile, and the geography of irrigation and soil management was subject to random variations. These factors could not be known exactly but they were brought together by these calendar discs in a system "of the earth and sky in relation to the east and west seen in the pattern of the Sun and Moon."

NOTES AND REFERENCES

1. A. LEVY, "Bad Timing," Biblical Archaeological Review, Vol. 24, No 4, July/August, (1998), 18-23.
2. R. O. FAULKER, The Ancient Egyptian Pyramid Texts, (New York, 1998), 107, n.1-2.
3. Ibid, Utt. 407, 133.
4. E. A. RICHARDS, Mapping Time The Calendar and its History, (New York, 1998) 152-153.
5. R. GILLINGS, Mathematics in the Time of the Pharaohs, (Cambridge, 1972), 187-89.
6. E. A. BUDGE and E. A. WALLIS, An Egyptian Hieroglyphic Dictionary, (New York, 1978), Vol. 1501a.
7. TARBOTON and WARWICK, African birds of Prey, (Ithica, New York, 1990).
8. A. R. HINCKLEY, Star Names: Their Lore and Meaning, (New York, 1963), 77.
9. Ibid, 20.
10. P. BOYLAND, Thoth the Hermes of Egypt, (New York, 1922), 197-198.
11. R. E. WITT, Isis in the Ancient World, (Baltimore, 1971), Fig. 4-7.
12. Op. cit., Faulkner, R. O., Utt. 582, par. 1564, 236.
13. W. H. STAHL, tr., Macrobious: Commentary on the Dream of Scipio, (New York, 1952), 133.
14. B. GOLDMAN, The Sacred Portal: A Primary Symbol in Ancient Judaic Art, (Lanham MD, 1986), 88-92.
15. R. H. ALLEN, op. cit., 229.
16. Op.cit., R. O. FAULKNER, Utt. 539 par. 1306, 206
17. Op. cit, R. E. WITT, 19.
18. Carina Software, Voyager II Dynamic Sky Simulator, Version 2, (San Ramon, CA, 1994).
19. N. LEWIS, and Meyer Reinhold, Ed., Roman Civilization: The Republic, (New York, 1966), 62-66.

20. Op. cit., E. A. RICHARDS, 152-153.

21. Neugebauer, O., The Exact Sciences in Antiquity, (New York, 1969), 7.

22. M. R. SALZMAN, On Roman Time The Codex-Calendar of 354,and the Rhythmns of Urban Life in Late Antiquity, (Berkeley, 1990), Fig. 28 and 32.

DOMESTICATING THE LANDSCAPE - THE PROBLEM OF THE 17 - DEGREE FAMILY ORIENTATION IN MESOAMERICA

Elżbieta Siarkiewicz
Department of Iberian Studies, Warsaw University, Poland

The archaeological investigations of the last decades have confirmed the existence of the so called "17-degree family orientation" of civic and ceremonial buildings in Mesoamerica (Aveni 1991:269). This family orientation ranges from about 15 to 18 degrees south of east (Aveni and Gibbs 1976) and clearly shows that it is largely astronomical, referring to phenomena visible out the horizon (Aveni 1991:266-7; Aveni and Hartung 1986:7-14: Šprajc 1997:7-9).

This is important specially when dealing with the sun count as this celestial body marks on the eastern and western horizons fixed dates of the tropical year. The importance of these dates has been explained by their link with the wet and dry season and with the agricultural ritual (Iwaniszewski 1991; Šprajc 1997). As the dates are the same in regions that differ in ecological conditions, there are suggestions that they were vinculated with a ritual or canonical agricultural cycle, and marked ritually important moments of maize cultivation stages (Broda 1993; Šprajc 1997:51-59).

Here I would like to point out some additional aspects related to the dates marked on the horizon by the "17-degree family alineation" and explain some other functions the observational calendars might have had. We shall first consider the 260-day computing cycle, with its regular subdivisions, and later, the Sun-Moon computing cycle.

According to Sprajc (1997) there are two main schemes of observational calendars, part of the dates today are still celebrated by local groups. The dates are (fig 1):

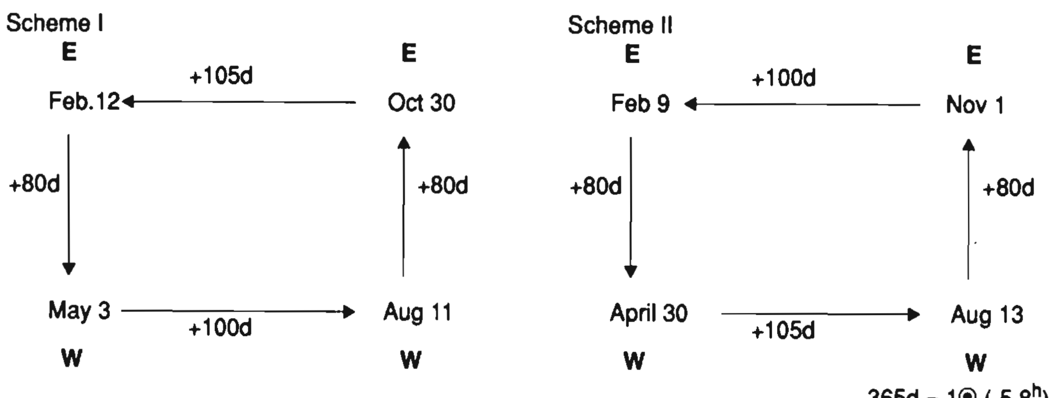


Figure 1

Šprajc observed in both of the schemes a division of the year of 365 days into two segments: that of 260 days (Feb 12 - Oct 30 and Aug 13 - April 30) and that of 105 days. The 260-day period in this case is composed of three time intervals (80d, 100d and 80d) divisible by twenty, while the total (260d) is divisible also by thirteen. I would like to remark that counting clockwise we may compute four tropical years (TY) (fig. 2):

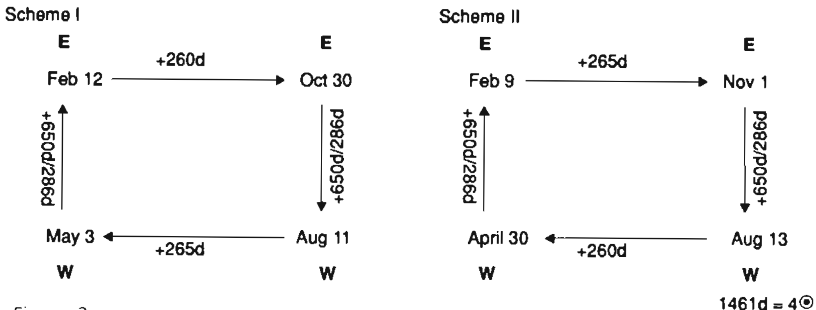


Figure 2

In this second case the 1461d cycle consists of three elements (260d, 650d and 286d) divisible by thirteen and that of 265 days. Why having 365 dates in the solar year just these dates were chosen and repeated for at least one and a half millennium?

To solve this problem, at least in part, we ought to return to the tzolkin (t) - the 260 day count system based on twenty day signs and on thirteen coefficients - and see how it functions paired with the tropical year and with the eight dates marked each year on the horizon. It is worth reminding that 59t = 15340d = 42 tropical years (TY), which means that after 59 so called "sacred rounds" the Sun and the tzolkin will be in the same starting point (Siarkiewicz 1995). The same happens after 29,5t = 7670d = 21TY, but the name of the day advances by 130 positions in the 260-day count The 21TY may be subdivided into 11TY (15,45t=4017d) +10TY(14,05t= 3653d). All the mentioned numbers of days are divisible by thirteen so they share the same coefficient.

On the basis of the whole 260 day cycle, the dates marked by the alineations constitute an observational calendar which allows us to compute:

Scheme I

Feb 12+260d (1t) = Oct 30+6760d(26t) = May 3+1560d(6t) = Aug 10+ 6760d(26t) = Feb 12 (59t)

Scheme II

Aug 13+260d (1t) =April 30+6760d (26t) = Nov 1+1560d (6t) = Feb 8+6760d (26t) = Aug 13 (59t)

By these means, we see that the alineation dates might have been used as an instrument to control the cycles of the tzolkin visually. At the same time the same dates predict the solar stations which are linked by the tzolkin in the following way:

Vernal Equinox (March 21)+13t = Summer Solstice (June 22)+13t = Autumnal Equinox (Sept 23)+33t = March 21 (59t)

If we now introduce the solar stations into schemes I and II we see that using a chosen name of the day (p.eg 1-Ahau), that name of the day will designate the following dates of the tropical year:

Scheme I

Feb 12 +1t = Oct 30+16t = March 21+10t = May 3+3t = June 22+3t = Aug 10+10t = Sept 23 +10t = Feb 12

Scheme II

Aug 13 + 1t = April 30 + 26t = Nov 1+ 3t = Dec 21 + 3t = Feb 8 + 26t = Aug 13

The above mentioned relations are repeated after 11TY = 4017d, 10TY = 3653d, 21TY = 7670d and 42TY = 15340d = 59t. The first scheme allows us to compute on the same name of the day the equinoxes and the summer solstice, the second scheme, the winter solstice, but in this case the name of the day will be different (1-Ik), and depends on the one used in the first scheme. This dependency results from the fact that all the dates of the second scheme are arranged symmetrically 182 days after the dates of the first scheme.

Feb 12 + 182d = Aug 13; Oct 30 + 182d = April 30; May 3 + 182d = Nov 1; Aug 11 + 182d = Feb 9

This is one of the reasons of using the two schemes of dates simultaneously.

Many investigators noticed that there is a 52-day interval between the summer solstice and the 13th of August, and 52/53 days between winter solstice and the 30th of October and the 12th of February (Malmstrom 1978:114, 1997:87ss; 1996:96; Galindo1990; Broda 1993). But to say the truth there are more units of days divisible by thirteen that link the alineation dates and the solar stations. We shall only mention some of them as the problem is worth a more thorough study.

+65 days:

Feb 12 + 65dx2 = June 22 +65dx2 = Oct 30 + 65dx10 = Aug 11 +65dx94 = May 3+65dx10 = Feb 12

Aug 13 + 65dx2 = Dec 21+65dx2 = April 30 + 65dx5 = March 21 +65dx5 = Feb 9+65dx94 = Nov 1+65dx5 = Sept 22 + 65dx5 = Aug 13 (7670d)

The elements for the +65-day computation appear in many series of the Dresden Codex (e.g., pp 42c-45c; 33c-29c; 29c-30c; 31b-35b; 29a-30a)

+78 days:

Aug 13 +78d = Oct 30

Feb 12 +78dx4=Dec 21+78dx10=Feb 9+78dx31=Sept 23+78dx45=May 3 (7020d)

May 3+78dx10=June 22 +78dx4 =April 30+78dx3 =12.20+78dx3=Aug 10 (1560d)

Aug 10+78dx45=March 21+78dx44=Aug 13 +78d=Oct 30+78dx89=Aug 13 (6942d)

These are only some examples of the possibilities that the +78-day cycle opens if we introduce the dates of the observational calendars. The numbers of days we need for these kinds of calculations appear in the Dresden Codex on p. 59 (Series 13 Muluc) or pp 44b-43b (Series 3 Lamat).

+91 days:

Feb 12+ 91dx2 = Aug 13 + 91dx8 = Aug 11+91dx2 = Feb 9+91dx25 = May 3

May 3+ 91dx2 = Nov 1 +91dx8 = Oct 30 +91dx2 = April 30 + 91dx114 = Sept 23

Sept 23+ 91dx7 = June 22+ 91dx2 = 12.20 +91 = 3.22+ 91dx4 = March 21

Feb 12 +91dx293 = 73x364 +91d = 73TY

Feb 12 +91dx586 = 146x364d +182d = 146 TY + 182d = Aug 13 (147 x 364d)

Feb 12 +91dx879 = 219x364d +273 = 219TY

Feb 12 + 91dx1176 = 294x364 =293TY

The numbers we need to reconstruct such a calendar appear in the Dresden Codex on pages 31a-32a (Series 13 Akbal) and 63-64 (Series 3 Chicchan). On page 45a (Series 13 Oc) there are the multiples of 364d (91dx4).

If we try to link the solstices, equinoxes and our eight dates by means of the shortest periods of time, divisible by thirteen, we obtain the following combinations:

Feb 12 +130d = June 22 +52d = Aug 13 +78d = Oct 30 +52d = Dec 21 +130d = April 30 (442d)

April 30 +52d = June 21 + 273d = March 21 +143d = Aug 11 + 182d = Feb 9 + 2275d= May 3 (3367d)

May 3 +143d = Sept 23 +39d = Nov 1 + 325d = Sept 22 + 143d = Feb 12 (4017d)

Feb 12 +130d = June 21 + 52d = Aug 12 +78d = Oct 29 + 52d =Dec 20 + 130d =April 29

April 29 +104d = Aug 11 + 182d =Feb 9 + 2275 = May 3 (7020d = 27t)

May 3+143d = Sept 23 + 39d = Nov 1 +325d = Sept 22 +143d = Feb 12 (7670d = 21TY)

Repeating the calculation we see that the dates designated by the fractions of the tzolkin start to lose their precision and the corrective function of 364d (as a negative number) appears when we may deduct 364 days from the 650-day interval between April 30 and Feb 9. This type of correction may be done when the error amounts to one day, between the four pairs of dates separated by 650 days, that is May 3→Feb 12; Oct 30→Aug 11; April 30 →Feb 9 and Nov 1→ Aug 13.

All the mentioned examples illustrate the utility of the tzolkin and that of its subdivisions in computing the tropical year and the solar stations. They also explain the presence of the so-called multiplication tables in the Dresden Codex and why some multiples of the tzolkin appear to be very important as, for example 780d (3t) or 7020d (27t). The eight dates marked by the alineations are optimal as they are symmetrically disposed in reference to the solstices and equinoxes and constitute a sort of graphic chart on the horizon, useful in the computation.

THE LUNI-SOLAR COUNT

Many of the numbers, co-ordinators of the solar count we have mentioned, are at the same time numbers of days that we need to compute full Lunations. Here we approach the luni-solar function of the alineations. The Eclipse table of the Dresden Codex (pp.53a-58b) gives evidence that the Maya knew and applied in their computations the so-called Methonic Cycle (235 Lunations (L) = 19 TY = 6939/40d). This comes out when we incorporate the dates of the alineations into the Eclipse table:

I) Oct 30 + 2244d ▶ Dec 22 + 2244d ————▶ Feb 12 + 2451d ▶ Oct 29/30 + 2244d ————▶ Dec 21 + 2244d ————▶ Feb 11

II)	April 30 + 2244d ▶	June 22 + 1920d ▶	Sep 23 + 324d ▶	Aug 13 + 2451d ▶	April 29/30 + 325d ▶	March 20 + 1919d ▶	June21 + 1919d ▶	Sept 22 + 325d ▶	Aug 12
	0☾	76☾	141☾	152☾	235☾	246☾	311☾ (-1d)	376☾ (-1,5d)	387☾ (-1,3d)
	0	6.4.4	11.10.4	12.8.8	19.4.19	1.0.3.4	1.5.9.3	1.10.15.2	1.11.13.7
		(2244d)	(4164d)	(4488d)	(6939d)	(7264d)	(9183d)	(11102d)	(11427d)
Dresden Codex		p.54a	p.57a	p.57a	p.52b	p.53b	p.55b	p.57b	p.57b

It is not the place here to develop all the implications that result from this fact. At this moment it is important to state, that every 19 TY each date of the alineations will repeat a luni-solar date with precision, a minimal error arising to one day of discrepancy after eleven cycles (209TY). The 19·TY may be subdivided into two less precise periods (one of them we have already discussed):

4017d + 2922/23d = 11 TY (136 L) + 8 TY (99 L) = 19 TY (235 L) = 6939/40d

Let us return to schemes I and II (fig3 and fig.4):

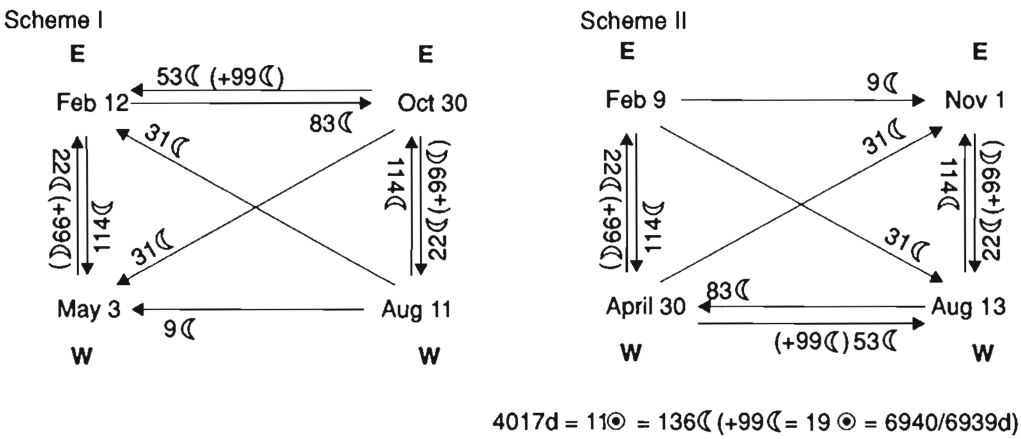


Figure 3

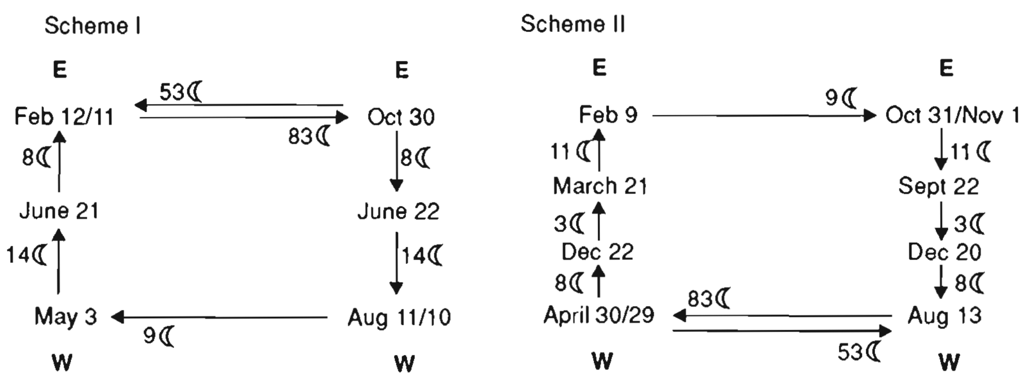


Figure 4

We know that the pairs of dates: May 3-Feb 12; Oct 30-Aug 11; Feb 9-April 30 and Aug 13-Nov 1 are separated by 650 days, that is 22 Lunations. Half of this period in scheme II (325d = 11 L) designates the dates of the equinoxes. The second half (11 L) may be subdivided into 3 L - winter solstice- and 8 L - Aug 13. Something similar happens when counting from April 30: + 236d (8 L) - 12.22 + 89d (3 L) - March 21 + 325d (11 L) - Feb 9.

In scheme I the summer solstice falls 8 Lunations (236d) before Feb 12 and 8 Lunations after Oct 30. The dates of the Lunations fall +/- 1day from the solar stations, only those of the vernal equinox and of the summer solstice (counted after May 3) are precise.

Another structural luni-solar period of time, that of 9 Lunations (265/6 days) appears between the dates Feb 9-

Nov 1 and Aug 11- May 3. The stable relation of Lunations between Feb 12 - Oct 30 and Aug 13 - April 30 is given by the Eclipse table, where we see that 2451d (53 L) appear between the mentioned dates. If we now add all the days in each scheme, we shall obtain 4017d = 136 Lunations. The date will be slightly unprecise (the Sun in minus hours, the Moon in plus hours), which is corrected after 99 moons. This technique of computation is superior to that of Methon as it allows to add additionally one cycle of 4017d, while when applying the Methonic cycle the Moon starts to lose about one day in its course with the Sun. It is interesting to notice that if we make such a correction after 11 x 235 L we obtain 2721 L = 220TY = 80353d = 309t + 13d, which for the users of the tzolkin means that the date will repeat the coefficient of the starting date.

Let us see the way the two schemes of luni-solar dates work together. If we treat the 12th of February as a starting point, the shortest distance in the number of Lunations is 15 L (442d) on April 30. The same 15 L (443d) link Aug 13 with Oct 30. We already know that there are 650 days (22 L) between April 30 and Feb 9, which means that from Feb 12 to Feb 9 we will compute 37 L = 3x364d = 1092d (the same relation links May 3 with April 30). 37 Lunations also link Nov 1 with Oct 30 and Aug 13 with Aug 11, only that in this case the number of days computed is 1093. Between the dates of the two sets there is one structural relation more. We have mentioned its importance speaking of the Sun count. It concerns the 182 days of difference between the second and first set of dates. This allows to compute 68 L (2008d = 5 TY + 182d, a half of the mentioned 136 L period) from the date of scheme I to the date of the other one.

For a user of the tzolkin it is worth knowing that part of this computation will be held on the same coefficient:

Feb 12 + 15 L = April 30 + 11L = March 21 + 11 L = Feb 9 + 77L (2275d) = May 3 + 22 L = Feb 12 = 136 L = 4017d = 15t + 13dx9

It seems that the main reasons that this type of orientation was applied in Mesoamerica since the pre-classic until the Spanish arrival were the facilities it offered. The sky-observers could visually control the devices they used in time computing, that is: the tzolkin and the smaller multiples of thirteen days, and the perpetual Luni-Solar calendar. They could also predict the solar stations, even if the orientation of the constructions did not do it.

Before installing a new settlement the builders first had to "domesticate" the landscape, by learning the new topography and the line of the horizon with all its potential markers. They knew the dates they were waiting for and the numbers of days left since they came to the place. So they waited for the nearest sunrise / sunset which would mark one of the eight dates, chosing the optimal point of observation. That would be where they were going to build the main temple. If they started from the East, they would observe the western horizon and after the numbers of days they knew by heart, they marked the place of the setting Sun on the horizon so that they could design the construction according to the "time-spatial" model they were copying.

This might have been the way of transmitting the tools of the old time computing tradition to a new settlement and for new generations. The domesticated horizon transformed into a chart matched the time computing system used in the whole cultural area, a projection of which we have on many pages of the Indian codices.

REFERENCES

A. F. AVENI. *Observadores del cielo en el México Antiguo* (trad. J.Ferreiro), Fondo de Cultura Económica, (Mexico D.F.1991).

A. F. AVENI and S. L. GIBBS. "On the orientation of Precolumbian Buildings in Central Mexico", *American Antiquity*, 41(1976), 510:517.

A. F. AVENI and H. HARTUNG. *Maya City Planning and the Calendar*, Transactions of the American Philosophical Society, American Philosophical Society, Philadelphia, vol. 76(1981).

Códice de Dresde Facsimile commented by J. E. S. THOMPSON, (trad. de J.Ferreiro Santana of the English version of 1972), FCE, (México 1988).

J. BRODA. "Astronomical Knowledge, Calendrics, and Sacred Geography in Ancient Mesoamerica", in *Astronomies and Cultures*, C.L.N. Ruggles and N.J.Saunders editors, University of Colorado Press, Niwot, (1993), 253-295.

D. H. KELLEY and A. KERR. "Maya astronomy and astronomical glyphs". *Mesoamerican Writing Systems*, ed.E.P.Benson, Dumbarton Oaks, Washington (1973), 179-215.

J. GALINDO TREJO. *Arqueoastronomía en la America Antigua*, Consejo Nacional de Ciencia y Tecnologia, Editorial Equipo Sirius, (Mexico D.F. 1994).

S. IWANISZEWSKI. "La arqueología y la astronomía en Teotihuacan". In *Arqueoastronomía y etnoastronomía en Mesoamérica*, editors: J.Broda, S.Iwaniszewski and L.Maupome, Instituto de Investigaciones Históricas, U.N.A.M., (Mexico D.F.1991), 269-290.

V. H. MALMSTROM. "A reconstruction of the chronology of Mesoamerican Calendrical Systems", *Journal for the History of Astronomy* 9 (1978), 105-116.

E. SIARKIEWICZ. *El tiempo en el tonalamatl*. University of Warsaw, (Warsaw,1995).

E. SIARKIEWICZ. "El problema de la subdivisión interna de 584 dias en el Códice Dresde", in *Itinerarios*, n. 2, Catedra de Estudios Ibéricos, University of Warsaw (in press).

H. J. SPINDEN, "Maya Dates and What They Reveal". *Science Bulletin*, Vol IV, No 1, The Museum of Brooklyn Institute of Arts and Sciences, (1930).

I. SPRAJC, *Orientaciones en la arquitectura prehispanica del México Central: Aspectos de la geografia sagrada en Mesoamerica*. Ph.D. dissertation, Facultad de Filosofia y Letras, U.N.A.M., (México, D.F. 1997).

CALENDRICAL INFORMATION ON MAPUCHE CERAMICS

Carlos A. González Vargas
Instituto de Estetica
Pontificia Universidad Católica de Chile, Chile

ABSTRACT

Studying and analyzing graphical codes associated with ceramic pieces from the Valdivia Province (X Region, Chile), made by the pre-Hispanic Mapuche people around the XV century, I have identified on jars and plates what is very likely a calendarical code painted using lineal patterns. These codes refer to the count of the solar and sacred year, of 365 and 260 years respectively, and the Venus synodical period of 584 days.

1. INTRODUCTION

Little work has been done about the Mapuche cosmovision. This is mainly due to their permanent struggle, since the arrival of the Europeans in Chile, to maintain their independence and cultural values. Even today, it is extremely hard to conduct ethnographical investigation among Mapuche communities because they are very reserved and usually do not explain their customs and celebrations. In a Mapuche community, the Machi has religious and medical (traditional medicine) responsibilities. Sometimes, one can participate to religious ceremonies but will be asked to leave at the most important moments. In the past, Grebe (1972, 1992) has written some interesting works about this topic but has not tried to analyze in details their understanding of time and calendars. On the archaeological side, there are also some difficulties to be authorized to realize excavations on Mapuche land, although the potential is obviously large. A few authors have described the presence of hundreds of tombs in some areas, for which it would be interesting to measure orientations (Dillehay, 1990).

2. ARCHAEOLOGICAL OBJECTS EXAMINED

Toward the end of the year 1974, a small archaeological collection (five ceramic objects) reached my hands. It came from a Mapuche area, more specifically, from Cudico, a place associated with the river basin of the Bueno river, province of Valdivia, 10th Region of the country (approximate geographical coordinates: 40° 15′ S, 73° 08′ W). At that time, I used to work with my university students in a museum, drawing different archaeological pieces, in order to improve our observation sense. After finishing my analysis of these five first pieces, I searched similar objects in the museums of Puerto Montt, Osorno, Lago Ranco, Rio Bueno, Valdivia, Villarica, Temuco, Angol, Concepcion, Hualpencillo and the National Museum of Natural History in Santiago. The main Mapuche geographical area covered extends from 36°S to 41°S. I also added some private collections from the city of Valdivia, Los Lagos, La Union and one piece documented by the archaeologist Jorge Kaltwasser (1968), who found it in the village of Valle Hermoso (32°S). Around 1984, I had photographed some 400 objects. All of them have the geometrical elements we were interested in but only about 35% showed geometrical structures similar to the triangles and «butterflies» characterizing the collection I was given. From that set, a large proportion of the objects were broken or with graphics partly erased and, all in all, only a few tens of pieces were entirely readable. I succeeded in detecting the existence of at least nine vessels (five jars and four plates) that were closely related to the calendaric system I will describe. Among this large collection, Chilean archaeologists have dated some ceramics (with design similar to the ones I examine here) to the end of the XV century, at the time of the first contact with Europeans.

3. ETHNOGRAPHICAL INFORMATION

Here I am reporting mainly four arguments that I have obtained from Mapuche people (whose name I can not cite for obvious confidentiality reasons) and that will help my understanding:

The structure and importance of the cardinal orientations of landscape (figure 1). The Mapuche people divide their environment in four quadrants according to the cardinal directions but also give an increasing importance to each of them: West is negative (- -) because this is where the sun dies, East is very positive (+ +) because this is where the sun is born and brings fertility. North is negative (-) because, in the trajectories of the sun in the sky, it represents the winter, the coldest and shortest days, and South is positive (+) because it is the highest sun at the meridian. That traces an increasing sequence in the horizon: from West to North, to South and ending East, which is the symbolic path the Machi follows to reach God and communicate with Him. From east back to west is showed the path to start a new cycle (at a new cosmic level before reaching God). Coming back to Earth, the Machi will follow the opposite path. The path has a «butterfly» shape if one looks at it with the dividing axis laid vertical.

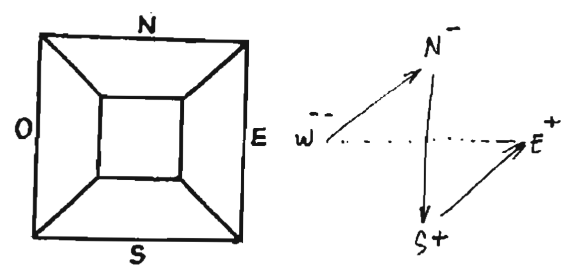


Figure 1

In July 1972, a Machi (a woman) explained me how she remembered the lunar count of the year (Gonzalez 1976). She drew on the ground a kultrun (figure 2) with the cardinal divisions (double lines) and double oblique lines and on each side of the cardinal axis. Then, she drew two additional axis at 45°. Then, she started to count the spaces between the lines, starting from one 45° axis. In each quadrant defined between the 45° axis, she counted seven spaces. A full loop around the circle therefore gives 7x4=28. Next she counted the numbers of branches: the two northern lines form one branch, the two oblique lines on the right of the North form a second branch, etc...., and she ended up with twelve branches. Next she added the position of the center of the circle, getting a total of thirteen. She multiplied 28x13 and added one to get 365 days, i.e. the solar year of a modern calendar. This is as bit enigmatic: such a count is a mnemotechnic method she was taught to remember that cycle. We obviously do not know if the method results from the combination of modern thinking -brought by the Spanish- and ancient traditions, or if it can be trusted as a purely ancient way of using graphical codes and numbers counted on the graphics to calculate celestial cycles.

Ethnologists already know two celebrations realized in the Mapuche communities: acknowledgements for the crops freshly collected (variable), and the start of the new year (23-24 of June). Other ceremonies are not well documented and are not necessarily part of a schedule known in advance.

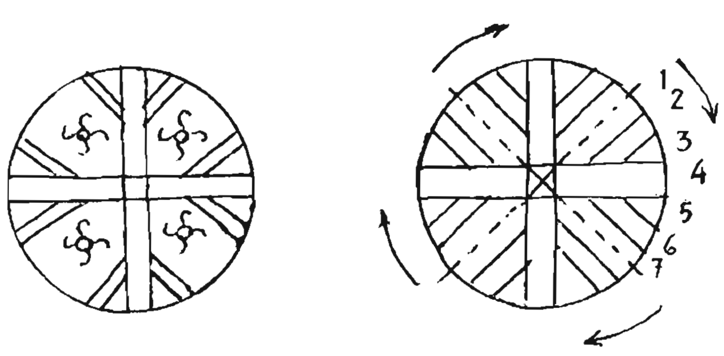


Figure 2

Once, I showed one of the jars to an old Mapuche woman, asking her about the age of the object. Her attitude was not hesitant at all: she took the jar from the handle, turned it upside down, looked at it and said: «yes, it is very old». It can appear as a brief and insignificant piece of information but I will show later that my reading of the graphical codes use the same views (i.e. from the bottom or from the top) as the one used by the Mapuche woman. Furthermore, I have, purposely, never forced any Mapuche informants to answer lots of questions but rather to comment simple questions through very informal conversation.

4. NUMERICAL COINCIDENCES ON JARS AND PLATES

In the first set of objects, we studied four jars (this was described in long details in Gonzalez, 1984). They have a flat bottom, with symmetrical axis. They have a relatively wide neck whose mouth opens like a cone. A handle goes down from the upper rim towards the vessel's body near its union with the neck. The small annulus area, which is defined at this height, is occasionally marked with points or small crosses (figure 3).

All jars have a white or ocher tone surface and they also show lineal designs of colors that go from a reddish drab to a nearly black color. All the graphical elements drawn in the pieces show a similar distribution: there are figures on the handles - from one to three - whose shape is composed of two triangles connected by one of their apex and filled up with the color of the lines (what we call «butterfly»). At the mouth edge and going down a little towards the inside of the neck, there are lines of approximately equal length in every vessel. The outer part of the neck is covered with a group of zigzag lines, parallel to each other and that go down near the neck-body union, limited by two other lines that encircle the neck. In all these four jars, the main body of the ceramic is divided in two hemispheres, upper and lower; each containing series of geometrical figures (figure 4).

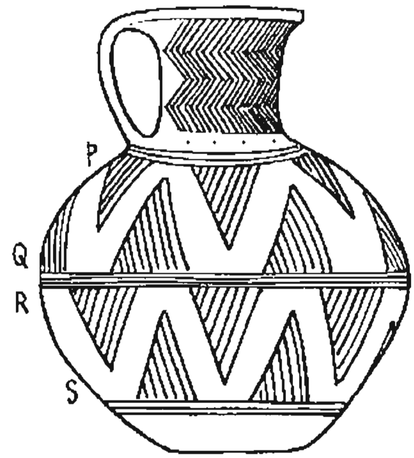


Figure 3

When the jars are observed from an upper and lower views, it can be seen in all of them a figure with the shape of a star (figure 5), which is formed by series of triangles distributed alternately downwards and upwards respectively. All the triangles are tidily filled in their inside with a variable amount of lines parallel to one of the triangle side and, occasionally, with other isosceles triangles decreasing in size, again parallel to each other and to the main triangle base.

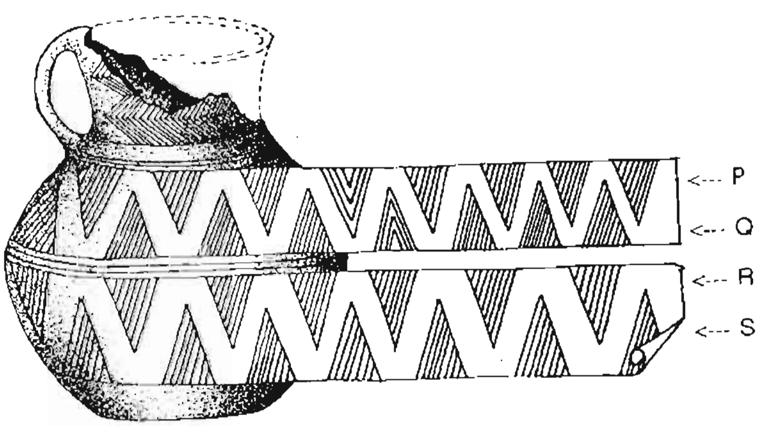
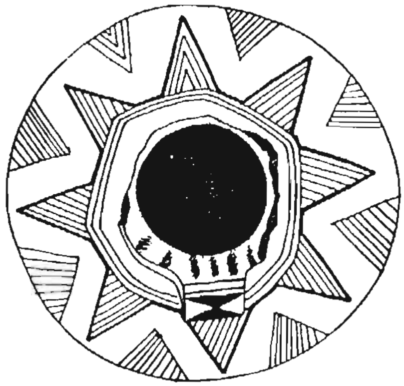


Figure 4

Because of a constant factor present on these vessels, i.e. the existence of stars visible from the upper and lower views and whose only difference is the amount of spikes, and because of the experience of the «lunar kultrun» above described, the first step we took was to count the number of spaces seen in each triangle. I realized that this star-shaped form allowed to see the important role played by the handle, since the sequence of spikes of each star showed a tetra-partition in the observed hemisphere (in each hemisphere there are one or two raws of triangles named P, Q, R and S respectively on figure 3). Adding the amount of spaces enclosed in each triangle,

Figure 5



and grouping them according to the tetra-partition suggested by the two axis, we get interesting numbers: sometimes they are identical (P and R on jar 1; R and S on jar 3; P and Q on jar 4) and sometimes the sum of each quadrant represent an increasing sequence following with a surprising similarity the ritual cardinal path (the butterfly) previously explained, for example 30, 31, 32 and 33 on figure 5 (this butterfly counting sequence is respected for P on jar 1, R on jar 2, P+Q on jar 3). These facts lead us to understand that the graphical design of the artist would be intentional in some cases and speculate that it could be intentional in all cases as we probably do not understand all the codes. Besides, among the sums obtained we already noticed the presence of numbers (73, 130, 236, 260) that we understood in a second phase of the investigation.

5. A CALENDARICAL PLATE

Our most amazing discovery was the information contained in a plate (figure 6) which we called our «Rosette Stone" . The basic information we notice is:

It has a symmetric geometry and there are tetra partitions defined by the four butterflies, the four small triangles, and the two sets of longer triangles.

The exterior ring of the plate is painted with thirteen white marks.

Four triangles are smaller and they have five interior spaces each. This adds up to 4x5=20. By multiplying that number by the thirteen dots (in a way similar to what the Machi woman did), we get 20x13=260, the length of a sacred year.

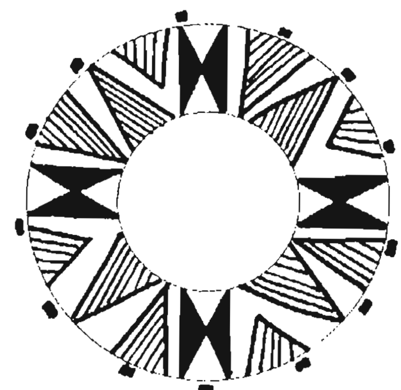


Figure 6

Starting from the small triangle following the one with eight spaces (the maximum), and counting clockwise, we see an increasing sum of spaces in the interior large triangles: six, seven, seven and eight, and in the exterior large triangles: five, six, seven and seven. This small triangle thus defines the starting point for a logical sequence (to us) of reading.

The total sum of spaces is 73.

236=(73x3)+17 ; 90=73+17 ; 250=(73x3)+31 ; 8. In other words, we use seven full loops and the eighth one is subdivided into the days missing to complement each of the four phases of Venus, ending with the eight-spaces triangle in the plate (figure 7 a and b).

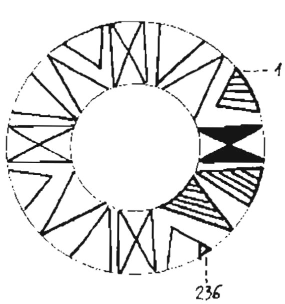


Figure 7

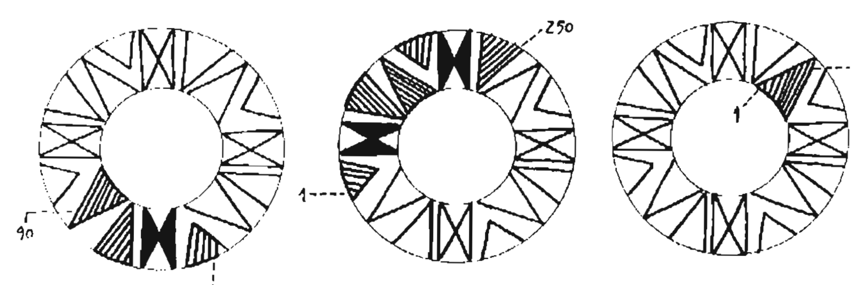


Figure 8

6. CONCLUSION

At the time of writing my initial synthesis, I could also report the existence of at least two bowls belonging to the Diaguita people (formerly inhabiting the 3rd and 4th Regions of Chile), in which I found the same numbers as the ones read in the Valdivia ceramic. The Diaguita objects, which were found during excavations conducted by archaeologists of the Museum of La Serena are conserved today and shown in the permanent exhibits at the National Museum of Natural History in Santiago of Chile. Three of the Valdivia objects are conserved at the Austral University's Museum, whose principal division is located in Valdivia, and the author conserves the rest (five pieces).

We are very puzzled by the fact that these kind of astronomical numbers resemble so much the ones known and used by the Meso-Americans, whose knowledge has never been found in South-America. In order to confirm my speculation of a Venus calendar hidden in the plate, I thought that an important event, among the ones recorded for the Sun and Venus, would be the re-apparition of Venus in the morning after its conjunction, as a sign of fertility for the Mapuche communities. As a matter of fact, in early 1986, after finalizing this research, I inquired at the National Observatory of Chile the date of the next inferior conjunction of Venus. I then called a Machi that I was introduced to in the past and predicted him that he would celebrate a ceremony at a particular date at the end of the year, without telling him the reason of the ceremony. His immediate answer was negative. Early November, I was stunned when he called me to invite me to a ceremony that he would actually conduct at the date I predicted. Unfortunately, I was not able to attend but I did learn that they had a celebration related to Venus... I did not know how the Machi finally decided on the date, probably through observations of the planet.

The existence of this modern knowledge of the night-time sky lead us to think that it was probably even more complete in the past, at the time of the creation of the objects we analyzed. In addition to this study, I gathered valuable information about the modern knowledge of constellations among the Chilean Mapuche, which I will present elsewhere. When conducting a numerological analysis focused on calendars, we are aware of the risk to fall in the classical trap of finding a solution at any price, just by manipulating numbers. Nevertheless, we have been cautious with that and did base our reading onto real ethnographical information and through the use of very basic and logical graphical codes. It was a surprise to find such an interesting result. We believe the Mapuche used these vessels mainly for ritual ceremonies, not so much for domestic use or even day-to-day time recording. The ceramics could also be considered as mnemotechnical tools to keep record of a knowledge, reserved to the Machi, and transmit it onto the following generations.

We would encourage people to perform similar analysis with ceramics of other parts of South America to try confirming the apparent universality of the astronomical calendars used.

I want to thank Dr. Belmonte and the VI Oxford conference committee for offering me a grant to participate and present my work, and to Dr. Bradley Schaefer for useful comments.

REFERENCES

T. DILLEHAY, 1990. Mapuche ceremonial landscape, social recruitment and resource rights, World Archaeology, Vol.22, N°2, pp.223-241.

C. GONZÁLEZ VARGAS, 1976, Un signo pintado en la ceramica Chilena, Aisthesis 9, Instituto de Estetica, Pontificia Universidad Catolica de Chile, pp65-82.

C. GONZÁLEZ VARGAS, 1984, Simbolismo en la alfareria Mapuche, Colección Aisthesis, Pontificia Universidad Catolica de Chile.

M. E. GREBE VICUNA, 1972, Cosmovision Mapuche, Cuadernos de la Realidad Nacional, 14, Pontificia Universidad Católica de Chile, Santiago

M. E. GREBE VICUNA, 1992, Concepcion del tiempo en las culturas Sur-andinas, Time and astronomy and the meeting of two worlds, Proceedings of the international symposium held at Varsaw University, pp.265-278.

J. KALTWASSER PASSIG, 1968, Excavaciones en Valle Hermoso, Boletin de Prehistoria de Chile, Departamento de Historia, Universidad de Chile, Santiago, Año 1 N° 1, pp. 99-106.

AGRICULTURAL CALENDARS AND CALENDAR FORECASTING PREDICTIONS: AN INTERPRETATION OF CANARY ABORIGINAL CALENDARS

José Manuel González Rodríguez
University of La Laguna
Canary Islands, SPAIN

ABSTRACT

In this work we formulate some preliminary hypotheses about the aboriginal calendar calculation of pre-Hispanic inhabitants of the Canary Islands. We have investigated their knowledge on counting, oral numbering systems and weather forecasting methods to assert some conclusions, which can be confirmed by the surviving traditions.

Section 1 offers a first discussion about the study of the scientific level of mathematical and astronomical resources among the ancient canaries. Section 2 is devoted to analyse their oral numbering systems. In section 3 we propose an interpretation of aboriginal mental counting techniques. Section 4 is devoted to the study of the *"tarjas"*: the tallies. In section 5 we study the ethnographic and historic evidences about the pre-Hispanic calendars, and their surviving traditions on calendar forecasting predictions. Then, we present a discussion of all the available information, together to our hypotheses.

1. STUDIES ABOUT THE "GUANCHES" MATHEMATICAL AND ASTRONOMICAL RESOURCES

We know the information about the scientific level of pre-Hispanic inhabitants of the Islands by five different ways:

First references wrote by European conquerors: the "chronicles": *Pedro Gómez Escudero, XV century, Antonio Sedeño, 1505, Fray Alonso de Espinosa, 1590, Juan Abreu Galindo, 1592, Leonardo Torriani, 1594, Tomás Marín de Cubas, 1694*. These are second hand compiled and strongly contaminated by cultural and religious prejudices.

The texts of the "chronicles" were misrepresented by numerous European scientists and travellers in XVIII and XIX centuries: *George Glass, 1764, J. B. Bory de Saint Vincent, 1804, Sabin Berthelot, 1842 and René Verneau, 1876*, among others, which offered a idyllic vision of the aboriginal culture, next to the myth of "good savage". Many of them magnified the real level of the scientific aboriginal knowledge, by seeing the "Guanche" culture as an hypothetical legacy of the "Atlantes" and other fantastic peoples.

By the end of the XIX century, the canarian searchers about the life of the aborigines were interested in the exaltation of the national spirit, and then: J. *Alvarez Rixo, 1794-1880. G. Chil y Naranjo, J. Bethencourt Alfonso, 1847-1913, V. Grau Bassas, 1847-1918 or D. J. Manrique* assumed a scientific point of view to confirm the exact reality of the pre-Hispanic legacy with theories near to the Darwinism, the Positivism or the Folklore science.

In the XX century we know two ways of aboriginal culture search. The first one was initiated by the diffusionist current, with: *José Pérez Vidal, Luis Diego Cuscoy, Elías Serra Rafols, Leopoldo de La Rosa Olivera, Sebastián Jiménez Sánchez, Buenaventura Bonnet and J. Alvarez Delgado* as principal representatives searchers. They did not find an exact correlation between the aboriginal heritage and the oral tradition in the Islands. Some of them assumed an *"españolista"* (Spanishness) vision to explain the ethnographic background of the Canaries.

The second way join researchers of different sciences, as *mathematicians: A. Alamo Machín and J. Barrios García, astronomers: J. A. Belmonte or C. Esteban, linguists: I. Reyes García, R. Muñoz or L. Galand*, or *archaeologists: A. Tejera Gaspar, J. J. Jiménez González or J. C. Cabrera Pérez* among others, which have found the real meaning of the scientific level of our ancestors and the reality of their ethnographic legacy. Nevertheless the results of these researchers have not found a general consensus. Then: how we can know about the aboriginal mathematics and astronomy?, and how many of this legacy does continue still present in our oral tradition?

The question arises in ascertain to the level of the greater part of aboriginal cultures in numbering, counting and astronomical knowledge and we can solve this question by collating the historical sources with the ethnographic evidences in agreement with the well known stages in the development of primitive thought.

2. ABORIGINAL KNOWLEDGE IN ORAL NUMBERING SYSTEMS

We know two lists of numerals, which could be used by the pre-Hispanic inhabitants of the Canaries:

NUMERALS	RECCO (1341)	SEDEÑO (1682)
1	nait, vait	been, ben
2	Smetti	liin, sijn
3	Amelotti	amiet, amiat
4	Acodetti	arba
5	Simusetti	canza
6	Sesetti	sumus
7	Satti	sat, sa
8	Tamatti	set
9	Aldamorana (aldamorava)	acot
10	Marava	marago
11	nait (vait) marava	venir marago
12	Smatta marava	linir marago
20		limago
30		amiago

These lists have been studied since the XIX century (S. Berthelot, 1842) by numerous specialists: *J. Abercromby, 1917, J. Alvarez Delgado, 1949, D. J. Wölfel, 1954, J. Barrios, 1997, or I. Reyes García, 1998*, and they offer contradictory opinions :

For J. Alvarez Delgado, 1947, p. 17 :

"... the canary indigenous not only knew some certain computing recourses, but too they had a complete and perfect numbering system..."

Moreover, Bonnet (I. Reyes García, 1998, p.21) conclude that :

"... We have doubts about this so perfect system could be used for the Canaries, a primitive people that did not use the commerce and that did not have the need of the carry out complex calculus..."

We can prove that the counting is possible without the knowledge of a complete numbering system, e g. among the New Guinea Buango and Tiv peoples (C. R. Hallpike, 1986). In the second stage of pre-operatoric calculus the names of numerals are identified with fingers, hands and other parts of the extremities (Papúes, Lengua tribes, ...). But this relation is unknown among the Guanche systems. I. Reyes García, 1998 propose a meaning of the word *amiat*: the numeral three of the Sedeño's list next to concept of "more than two". This interpretation provides us a link between the aboriginal numerals with the uniqueness stage in the mathematical thought development of primitive peoples. Moreover, to can assure the existence of a complete numbering system is necessary confirm the use of the some kind of register tool, as tallies or "quipus".

3. MENTAL COUNTING

But these tools are unknown among the goatherds of the islands. They realise a mental counting similar to that collected in the "chronicles":

"... y es de notar que, aunque sea gran cantidad de ganado... lo cuentan sin abrir la boca, ni señalar con la mano..."

Fray Alonso de Espinosa, (J. M. González, 1993, p. 22)

"... to be note that, although it could be a lot of cattle ... they count this without open the mouth neither mark with the hand..."

"... tienen los naturales de esta isla una habilidad extraña que, aunque sea gran cantidad de ganado, lo cuentan sin abrir la boca ni señalar con el dedo..."

Abreu Galindo, (Ibid id, p. 22)

"... the inhabitants of this island have a rare ability that, although it could be a lot of cattle, they count this without open the mouth neither mark with the singers..."

So, we can argue that our goatherds, which have inherit the aboriginal legacy *"no cuentan las cabras"* (they do not count the goats). They do not know the total account of their flocks. They are illiterate and they do not use tallies or another tool for the accountings. By this, we can not argue the presence of register tools among our ancestors.

4. THE TARJAS: THE TALLIES

Nevertheless, the "chronicles" inform us about the use of the aborigine *tarjas*, like the tallies of the Mediterranean shepherds:

"... hacían raias en tablas, pared o piedras, llamaban tara y tarja aquella memoria de lo que significaba..."
Marín de Cubas, 1986, p. 74

" ... they made scratches on tables, walls or stones, calling tara or tarja, the meaning of what it meant..."

Many authors: D. *J. Manrique, J. J. Jimémenez González, J. Barrios García or I. Reyes García*, confirm us such use. They could serve them as register tools, and to assure this evidence, they attend to the meaning of the word *tarja*, which they associate to the Berber legacy, confirmed by the string of beads found between the archaeological records. But, the Oral Tradition informs us about:

- The *tarjas o taras* are known in many zones of Europe.
- They were used as register tools since the paleolithic times.
- They are present in our century among the shepherds of the Iberian Peninsula, where they are named with different words: *calendas, nombra, fusta dels diumenges,...*.
- The word *tájara* is used in Fuerteventura in the *"medias fanegas"* accounting in the grain gathering, being an old practice, which appears reflected in ancient manuscripts.
- Those marks are similar to some others which have been used by *"venteras"* (selling women) and *"pescadoras"* (fisher women) in their daily deals, and, although the graphs remember the pre-Hispanic records or some words of the tamazigh alphabet, we can not conclude that:
- There exists an historic relation between our contemporary signs and those possible used in the aboriginal *tarjas*.
- These signs could serve to register accounting.
- There exits a pre-Hispanic legacy, since the contemporary graphs are more close to Mediterranean and Iberian tradition.
- The Guanche people could know a complete numbering system, because there no exists evidence of aboriginal words which could identify the counting action and the register tool as there exits in other languages (*score* in English, *fanada* in Arabian, or *nombra*, among the Catalonian shepherds).

5. CALENDARS AND ASTRONOMY

The "chronicles" inform us about the astronomical knowledge of our ancestors of Tenerife and Gran Canaria islands :

In Tenerife, A. de Espinosa, 1980, tell us that the guanches :

"... hacían entre año, el cual contaban ellos por lunaciones, muchas juntas generales..." .

"... during the year, which they measured with lunations, made a lot of general assemblies..."

Besides, Torriani, 1978 wrote that:

"... Contaban el tiempo de la luna con nombres diferentes, y el mes de agosto se llamaba Beñesmen ..."

"... the time of the Moon was counted with different names, and the moon of August was called Beñesmen..."

In Gran Canaria, we know according to Sedeño that:

"... contaban el año por 12 meses, i el mes por lunas, i el día por soles... Acababan su año a el fin del quarto mes..."

"... they counted the year by 12 months, the month by moons, and the day by suns... They finished the year at the end of the fourth month..."

J. A. Belmonte et al, 1994

According to these sources and the contemporary researchers: *J. Alvarez Delgado, J. A. Belmonte, A. Tejera, J. Barrios, N. Perera, C. Esteban, J. Jiménez,...* we can assert that:

- The pre-Hispanic people of the two central islands could know some kind of calendar calculation.
- To establish their calendars they could use the observation of the Sun rising and setting at different epochs.
- However, other astronomical events, such the rising and the setting of certain stars and asterisms, have also served as time markers.
- But, the ethnographic or archaeological records do not provide exact evidences about their counting systems. Only the Torriani's text allows us to think in an agricultural calendar next to those we know in some African cultures. In this case, we are assuming a stage in the development of the aboriginal though higher to the uniqueness one.

Moreover, we can collect the "chronicles" with the presence of this legacy in the Oral Tradition to determine some conclusions:

- Only a few of celestial bodies are known in the Oral Tradition, which are used as evening clocks, seasonal markers or weather forecasters.
- They coincide with those used in the Iberian tradition.
- There exists an evident parallelism between their respective names and uses.
- The agricultural year is arranged according to Catholic saints' days calendar and there no exists different account of the month next to seasonal calendar known among the Masai, Berber o "lagunaire" cultures.
- Only the weather forecasting associated with the "water rain" (Venus) seem an exclusive practice of the Canaries which admits a relation with the pastoral aboriginal legacy.

This practice is a clear example of *"Cabañuelas"*, popular weather forecasting, which have an unknown origin. They suppose an universal weather forecasting method, which show similar techniques in different countries. Their names in the European Tradition offer us similar meanings: *calendari, cabañuelas, canículas, cabichuelas, cavaneles, fer es conte de Salamó,....*

We know in the Canaries six different types of *cabañuelas* :

1. ***Canículas*** : *cabañuelas y contracabañuelas*, which are the practices more used. All of them admit an astrological origin, similar to the Iberian one, and they are known too among the North African cultures.

2. ***Calendari de la ceba***,(salt and onion) cabañuelas, which are used in all of the Iberian Autonomies. They are known in the North of Africa, moreover our practices are more linked to the Iberian tradition.

3. **Seasonal *cabañuelas***, which are formulated closed to the vernal solstice or the autumnal equinox dates. They are agreed to Calendar of Saint' days, as: *Saint John, in June 24, Saint Lawrence, in August 10, Saint Bartholomew, in August 24 and, Saint Matthew, in September 26.* There exists a different relation of the saint' days with the wing or rain auscultation of the weather which is the same in the Iberian Peninsula. There exits specific insular days for these *cabañuelas*, as the Mercedes day, in October 24 (Fuerteventura), the day of Saint Simon, in October 28 (El Hierro) or the day of *La Bajada de la Virgen del Socorro* in Güímar, Tenerife, in September 7. As those *cabañuelas* are formulated next to those dates when is observed in some days next to the dates when appears the "water star" or when was celebrated the Beñesmen. By this, we can assign them a possible aboriginal origin.

4. **Cabalistic *cabañuelas***, which are only known in Fuerteventura and they admit an identification with the Metonic cycle. Similar weather forecasting appear collected in the Spanish collection of proverbs

5. ***Cabañuelas* associated with the plants'bloom**. They are specific of the Canaries. The predictions attend to bloom of some endemic insular species: *dragos, verodes, piteras and tarajales* and they are clear example of aboriginal legacy in our Oral Tradition (*Leoncio Rodíguez, 1982, E. Murray, 1988*)

6. **The weather and the animals** Some animals can predict the climate variations in the following months: *las tostarás* (the partridges) in Fuerteventura, the wheat parasites in Fuerteventura, *las viejas* ("old women"), endemic fishes of the East Atlantic Sea, or the goats, that

"...when they mate strongly suppose the presence of a good year..."

M. Lorenzo Perera, 1983

Then, being that only this last *cabañuelas* admits a clear pre-Hispanic heritage, we can formulate the following final remarks:

- The Oral Tradition inform us about the European and/or Mediterranean heritage of our ethnographic knowledge in astronomy.
- This occidental legacy it is the exclusive one that we can observe in all the folk records associated with the agricultural practices.
- Only in the grazing we can find a clear presence of aboriginal traditions, as:
- the mental counting, that our goatherds realise without use register tools,
- the auscultation of some celestial bodies which have names associated with the grazing, or
- the weather predictions, with specific practices of cabañuelas linked to the cattle raising exploitation.
- According to the sources and the ethnographic records we can assert that the aborigine people of Canary Islands only could know primitive resources in Mathematics and Astronomy.
- Those were in agreement with the level of their pastoral societies, organised in tribes with some hierarchic stratification.
- They developed cattle-raising economies where the auscultation of seasonal changes was very important to can assure the cattle's support.
- Being that the matching of the goats establish the star of annual vegetative cycle, they could organise the calendar account according the following dates: Matching date, around the last days of June or first days of August in a similar form that our contemporary goatherds. This date could coincide with the *Beñesmen*. Birth of the *baifos* (little goats), around December or January. The safety of the cattle's health could be assured by the autumnal rains, which could be predicted with forecasting methods.The end of *baifos*' lactation, which happen in the our days around the first days of May, being that these dates appear collected by the "chronicles"

We can conclude that with this seasonal calendar, our ancestor had not needed a complex knowledge in counting, numbering or astronomical resources, as it seems.

REFERENCES

J. ALVAREZ DELGADO, *Sistema de numeración norteafricano*, C.S.I.C., Madrid,1949.

A. F. AVENI, *Observadores del cielo en el México antiguo*, Fondo de Cultura Económica, México, 1980.

S. BERTHELOT, *Etnografía y Anales de la Conquista de las Islas Canarias*, Imprenta Isleña, S/C de Tenerife, 1849.

J. BARRIOS GARCÍA, *Sistema de numeración y calendarios de los poblaciones bereberes de Gran Canaria y Tenerife en los siglos XIV y XV*, Tesis Doctoral, Universidad de La Laguna, 1998.

J. A. BELMONTE et al. «Canary Astronomy before the Conquest: The Pre-Hispanic Calendar», *Rev. Acad. Canar. Cienc.*, VI, 1994, pp. 133-156.

A. GALVÁN TUDELA, «Islas Canarias: Una aproximación antropológica», *Cuadernos de Antropología*, N° 7, enero de 1987.

J. M. GONZÁLEZ RODRÍGUEZ, *La sabiduría Popular: Técnicas y Conocimientos científicos tradicionales en Canarias*, Centro de la Cultura Popular, La Laguna, 1993.

C. R. HALLPIKE, *Fundamentos del Pensamiento Primitivo*, Fondo de Cultura Económica, México D.F., 1986.

HESÍODO, *Trabajos y días*, Alianza Editorial, Libro de Bolsillo nº 1201, Madrid, 1995.

J. J. JIMÉNEZ GONZÁLEZ, *Gran Canaria y los canarios*, CCPC, S/C de Tenerife, 1992.

M. LORENZO PERERA, *¿Qué fue de los alzados guanches?*, Secretariado de publicaciones de la Universidad de La Laguna, 1983.

T. A. MARÍN DE CUBAS, *Historia de las siete islas Canarias*, Real Sociedad de Amigos del País, Las Palmas de Gran Canaria, 1986.

M. MARTÍNEZ, *Canarias en la mitología*, CCPC, S/C de Tenerife, 1992.

E. MURRAY, *Recuerdos de Gran Canaria y Tenerife*, Pedro Duque Canarias, S.A., S/C de Tenerife, 1988.

F. NAVARRO ARTILES y A. NAVARRO RAMOS, *Aberruntos y Cabañuelas en Fuerteventura*, Cabildo de Gran Canaria, 1982.

J. PADRÓN MACHÍN, *El Hierro: séptima Isla*, Centro de la Cultura Popular Canaria, S/C de Tenerife, 1989.

J. REYES GARCÍA, *Estudio etnolinguístico de los antiguos numerales canarios*, Editorial Baile del Sol, La Laguna, 1998.

L. RODRÍGUEZ AFONSO, *Los árboles históricos y tradicionales de Canarias*, Aula de Cultura del Cabildo de Tenerife, S/C de Tenerife, 1982.

A. TEJERA GASPAR, *La religión de los guanches*, J. Luis Concepción Ed., La Laguna, 1988.

A. TEJERA GASPAR, *Tenerife y los guanches*, CCPC, S/C de Tenerife, 1992.

VIRGILIO, *Las Geórgicas*, Alianza Editorial, Libro de Bolsillo nº 808, Madrid, 1991.

THE AGE OF AQUARIUS: A MODERN CONSTELLATION MYTH

Nicholas Campion
Bath Spa University College, Bristol, U.K.

ABSTRACT

The belief in the coming of the Age of Aquarius is the clearest modern example of an ancient style of constellation myth. The core idea, that when the Sun rises in the constellation Aquarius at the spring equinox, an age of peace and equality will begin, originated with the Theosophists after 1875, although its apocalyptic roots can be traced back to classical and Christian eschatology. There is no agreed timing in the literature on the beginning of the Age: some dates are symbolic, others based not on precession but on planetary movements, and the range varies from 1470 to 3500. The meaning of the myth is therefore more important than the measurement. We may draw conclusions from this for traditional and non western ethnoastronomies

AN ANTHROPOLOGY OF ASTRONOMY

In 1991 Tristan Platt suggested that we are in need of an 'anthropology of astronomy'.[1] If there is one folk or ethnoastronomy which is still awaiting proper study then it is contemporary astrology. I know of only two recent English language papers which examine modern belief in astrology either from a sociological or anthropological standpoint, Feher[2] and Bauer and Durant, who conclude that 'popular belief in astrology may be part and parcel of late modernity itself'.[3] Indeed, we might argue that it is the most visible contemporary aspect of astronomy in culture, along with the cinematic genre of comet collision, alien invasion and space adventure movies.

One of the most well known of astrological claims, thanks to the famous song in the 1960s musical, *Hair*, is the prophecy that the world is about to enter the Age of Aquarius. This is perhaps the first major new constellation myth in western civilisation in the last two thousand years, the basis of which is the shift of the constellations in relation to the vernal equinox, upon which the so-called tropical zodiac, used by western astrology, is based. The length of each astrological age, of which the Age of Aquarius is the next, is generally put at either 2160 years,[4] a rounding up of the time taken for the equinoxes to precess through 30^0, or is rounded down to 2000 years.[5] The revival of a form of historiography derived from grand astronomical cycles may seem out of step with the modern world, but is part of a twentieth century trend identified by the Oxford historian G.R. Collingwood. Writing with specific reference to Marxism in 1946 he concluded that 'We have so far gone back to the medieval view of history that we think of nations and civilisations as rising and falling in obedience to a law that has little to do with the purpose of human beings that compose them, and we are perhaps not altogether ill-disposed to theories which teach that large scale historical changes are due to some mind of dialectic working objectively and shaping the historical process by a necessity that does not depend on the human will. This brings us into somewhat close contact with the medieval historians'.[6]

THE NEW AGE MOVEMENT

There is no consensus amongst astrologers either on the date or desirability of the coming of the Age of Aquarius, and within the prevailing belief in the Age, there is also an overt anti-New Age tendency. The most devastating critique was penned by the German astrologer, Walter Koch in 1958-9.

> 'Since astrology today has become a kind of substitute religion, many writers are seeking a field herein for the projection of their wishful world concepts and religious hopes. It seems likely that Rudolf Steiner first presented his all inclusive ideas in a lecture on doctrines of eras. Then came Hans Kunkel, whose fascinating style bewitched all readers, and finally the decadents whose calculations enshrined Hitler as the exponent of the Aquarian age'.[7]

Koch's critical assessment of astrology as a 'substitute religion' in the Aquarian Age context finds agreement from a Christian point of view from Martin Israel who regards it as 'a paganism brought up to date with gnostic accretions culled from psychic sources and heavily flavoured by theosophical speculations derived from unorthodox offshoots of the world's major religions'.[8]

THE BEGINNING OF THE AGE

There are substantial problems which render it difficult if not impossible to determine when each age begins and ends. According to current astrological tradition, each precessional month of around 2160 years, takes its character either from the (a) sidereal sign or (b) the constellation in which the Sun is situated at the vernal equinox. Increasingly, some astrologers are also relying on a third definition of the age's beginning, the ingress of planets into Aquarius in the tropical zodiac. The *sidereal* zodiac is defined according to the background of the fixed stars, whereas the *tropical* zodiac is defined by the equinoxes and solstices, particularly by the Sun's location at the spring equinox, the first point of Aries. The tropical zodiac is conventionally used in the west, the sidereal in India. However, as far as the sidereal zodiac is concerned, there is no agreement on the location of 0^0 Aries in relation to the stars, from which sidereal signs must be measured. The discussion concerning the location of 0^0 Aries in the sidereal zodiac tends to be based solely around issues of custom and tradition, and on which marker stars may have been used from the 5th century BC onwards. Neither do the constellations have any agreed divisions, beyond the essentially arbitrary ones devised by the International Astronomy Union in 1928. 0^0 Aries was fixed as the spring equinox in the tropical zodiac by Ptolemy.[9]

Since Ptolemy precession has posed a problem for astrology, undermining the conventional reliance on the tropical zodiac. The invention of the notion of the Age of Aquarius has done nothing to ease such uncertainty. Indeed, attempts to define the temporal limits of the Age are themselves riddled with doubt and opinions on the beginning of the Age have no basis in any agreed astronomical or historical consensus.

So far I have collected,[10] mainly from the astrological literature, ninety five published dates for the beginning of the Age, ranging from 1457-72[11] to 3500.[12]

THESE DATES FALL INTO THREE CATEGORIES:

1) Dates based on precession, whether of the constellations or sidereal signs. The majority of such dates are located in the twenty-fourth and twenty-fifth centuries. These do not always involve precession in relation to the constellations. For example, the 11th Rainbow Circle Astrology Camp, held in Wales from 6th-16th August 1998, heralded the 'opening' of the Age of Aquarius as May 1998, when the 'the solstices coincide with the plane of our Galaxy's Equator'.[13]

2) Dates based on planetary movements into either the constellation, sidereal sign or tropical sign of Aquarius. One such is 1962, the year of the great conjunction of planets in tropical Aquarius. On 5 February 1962 the American clairvoyant Jeanne Dixon announces the beginning of the Age of Aquarius together with the birth of the anti-Christ.[14] At the time of writing he is thirty seven years old and has yet to make himself known. However, dates which rely on the tropical zodiac have nothing to do with precession, and hence paradoxically nothing to do with the astronomical rationale for the Age of Aquarius.

3) Dates which are purely symbolic, having no astronomical basis. The most obvious of these is the millenarian proposition that the Age of Aquarius will begin in 2,000. Most astrological sources cite dates in the late twentieth and early twenty-first centuries in order to match millenarian dating.

The sheer variety of dates proposed for the beginning of the Age of Aquarius is surely of great significance for our understanding of the entire question. The unavoidable conclusion is that the belief that the Age of Aquarius is beginning at the present time, rather than in three of our hundred years' time, as precession demands, is therefore a manifestation of traditional millenarianism, the expectation that a New Age is about to begin. Of the main components of Aquarian Age belief golden ages first occur in Hesiod's *Works and Days*[15] (c.750 BCE), astrological ages in Plato's *Timaeus,*[16] while apocalyptic theory is derived from the books of *Daniel* and *Revelation*. [17]

The pseudonymous author Leo, writing in the 1930s or 40s, acknowledged the link when he said that 'Those who have been trained in another terminology would use the term, *The Millennium* to describe the spiritual reality of it'.[18] The religious nature of Aquarian Age belief is most evident in Alice Bailey's extensive writings. Bailey forecast that

> 'Humanity itself is rapidly arriving at the point where its *united will* will be the determining factor in world affairs and this will be due to the unfoldment of the mind through the success of the evolutionary process...The functioning of the Law of Loving Understanding will be greatly facilitated and speeded during the Aquarian Age which we are considering; it will eventuate later in the development of a world-wide international spirit, in the recognition of one universal faith in God and in humanity also as the major expression of divinity upon the planet and in the transfer of the human consciousness from the world of material things to that of the more purely psychic'.[19]

THE NATURE OF THE AQUARIAN AGE

The description of the nature of the astrological ages was given its fullest treatment in Vera Reid's *Towards Aquarius*, in which the sequence of Ages is expressed most strongly in religious terms. Typically, parallels are drawn between the animal ruler of the Age in question and the animals featured in the corresponding religious imagery. For example the Age of Taurus (c.4-2000 BCE) is said to be demonstrated in the widespread worship of the bull, the Age of Aries (c. 2000-1 BCE) saw the worship of the Ram and the Age of Pisces (1-2000 CE) brought the fish symbolism of Christianity.[20]

Many Aquarian Age believers may be less at home with the realities of power politics than with the religious or philosophical arena. Indeed, the prophecy has itself generated its own religious groups, such as Rael. Although Raelians would regard themselves as being philosophical rather than religious, they have been studied under the general heading of 'UFO religions'. Rael, born Claude Vorilhon, founded the group following an encounter of the third kind in 1973, followed by a visit to the aliens' host planet. Raelians believe that the Age of Aquarius commenced with Vorilhon's birth in 1946, and their prophecy of the future age accords perfectly with the astrological literature. According to George Chryssides, the Raelians prophesy that

> 'There will be one single society, a just and humanitarian society, in which everyone is born equal, with the same wealth, and rewarded according to merit. It will be a world of peace, and military forces will be redeployed for the maintenance of public order. Medical science will rehabilitate the social deviant. It is a world to be enjoyed: gone are the pointless restrictions imposed by the Christian Church: 'everything is permitted' so long as it is compatible with an advanced society and is not harmful to anyone. Enjoying the pleasures of the senses is to be encouraged: marriage is seen as restrictive, and sexual relationships are to be encouraged freely. Abortion is totally permissible, as is nudity: one should not be ashamed of one's body, since this was the original condition of Adam and Eve in the paradise of Eden. In the creators' planet to which Rael is taken, scientists have created robots who simulate nude human dancers and who are freely available for entertainment or for sexual relationships.' [21]

From this perspective, the arrival of the Age of Aquarius will, then, necessitate a political revolution more complete than any in the history of human civilisation, but unlike other revolutions, the external revolution will flow naturally and easily from the internal revolution which must take place in the psyches of each and every human being, even though there may still be an external crisis.

The nature of the future crisis was outlined by the society astrologer and hand reader Cheiro (who believed that the Age of Aquarius had begun in 1762 with the discovery of Uranus), in 1925. He wrote that 'in the meanwhile there will be many "Great Wars" until the final Armageddon - the War of Wars - that will end War'[22] and 'From now on, severe earth tremors and quakes will affect countries which have been more or less immune from such occurrences. Extinct volcanoes all over the world will become active, while tidal waves and cyclones will cause enormous destruction to property.[23] Over the next fifty years, (i.e. up to 1975) he adds, there would be massive geological upheavals with a new earthquake zone on the west coast of north America, the destruction of a large part of New York and glaciation in north America and Europe. Over the next fifty to hundred years (i.e., to 2075) Atlantis will rise from the Atlantic, north and south America will split, the Sahara will become an inland sea and north Africa, basking in a temperate climate, will become the centre of civilisation.

These prophecies, disseminated through New Age and literature, can give a particular form to apocalyptic warnings. For example, *Time*, 18 January 1999 carried a feature on 'the End of the World', citing Bryan Elder, 'an Arkansas hydraulics specialist'. Elder is quoted as predicting that 'There won't be any accidental survivors. Hell starts Jan. 1, 2000, when the lights go out'. The report continues, 'Then an alignment of the planets in May 2000 will burn up the earth, says Elder, who is hunting for a cave to take shelter in'.[24]

THE ORIGIN OF BELIEF IN THE AQUARIAN AGE

The process by which the idea of the Age of Aquarius developed can be simply traced. First, according to Robert Ellwood the modern concept of the New Age may be traced to the eighteenth century mystic Emmanuel Swedenborg (1668-1772), who he calls 'the major bridge between the old medieval alchemist or Rosicrucian in his dark laboratory, and the spiritualist seance on the American frontier of the modern Theosophical lecture'. Ellwood comments that Swedenborg's emphasis upon this invisible consummation with Christ must be a precursor to modern "New Age" or "Aquarian Age" ideas'. [25] Also, during the 18th and 19th centuries it became clear that precession was a valuable aid to the study of Indian history, in which respect the most substantial work was Max Muller's *Ancient Hindu Astronomy and Chronology*.[26] Around the same time, we find the gestation of the recognisable modern New Age movement. Already, in 1813 the French occultist Fabre D'Olivet had mentioned precession in connection with the Hindu Yugas in his commentary on the *Golden Verses of Pythagoras*.[27] In 1822 the English antiquarian Samson Arnold Mackey published his *Mythological Astronomy of the Ancients Demonstrated* in which he expounded at great length on the mythological significance of precession.[28]

However, astrologers were slow to catch on and I have found no reference to the Precessional Months as we know them prior to 1879, in the English astrologer A.J.Pearce's *The Textbook of Astrology.*[29] Pearce, who saw astrology in entirely scientific, non-mystical terms, put forward the theory of religious evolution which was subsequently elaborated in 1949 by Vera Reid. However, although he mentioned the previous ages of Gemini, Taurus and Aries, he made no mention of the Age of Pisces and uttered no prophecy of the Age of Aquarius. This was to be a creation of the theosophists, particularly Alan Leo (1860-1917).

Aquarius in the western, tropical zodiac, has no notable traditional associations with apocalyptic belief. In the 2nd century Ptolemy confined himself to a description of its physical effects, cold, windy and so on,[30] attributions which essentially do not change, even if further details were added, until around 1900. It was the theosophical astrologer Alan Leo who gave Aquarius its 'love of human nature', adapting to the sign to presumed nature of the age it was to rule.[31] The supposed features of the Aquarian Age attributed to the sign Aquarius are therefore modern and post-date the development of the idea of the age.

CONCLUSION

The preceding discussion points to three significant conclusions

1) Belief in the Age of Aquarius dates back no further than the late 19th century, and is essentially a modern invention.

2) Its main function is religious, being the promise of future salvation.

3) As far as archaeoastronomy is concerned, the dating of the beginning of the Age of Aquarius is so varied, that while each date has claims to irrefutable historical or impeccable astronomical evidence, it seems that it is not the measurement which is important, but the meaning. This conclusion may have significance for other areas of the history of astronomy, assuming that we can take modern astrology and make certain generalisations about ancient astrology, and about megalithic culture, a profoundly controversial step for many historians. I would suggest that such comparisons are legitimate as long as it is remembered that the resulting conclusions are speculative and may be useful in opening up new lines of enquiry rather than providing final answers. Clive Ruggles argues that we can make such comparisons, asking 'why should the archaeologist, and in particular the student of Neolithic and Bronze Age Wessex, be interested in the perception of astronomical phenomena? A general answer is that in many, if not virtually all, non-Western world-views celestial phenomena are not separated from terrestrial ones, but form part of an integrated whole with complex interconnections. The association may often be viewed as closer in nature to modern astrology than modern astronomy'.[32] Thus a study of modern astrology might actually offer insights into megalithic astronomy. For example, in relation to the argument concerning the alignment of megalithic structures with either precise stellar and lunar alignments, or with general directions for symbolic purposes,[33] we might argue that when astronomy is applied to mystical functions, meaning is more important than measurement. Hence it might incline to general directions rather than complex alignments. In other words there may be many sites which incorporate astronomical factors but without a precise alignment, a problem which creates further methodological difficulties. It might be the case that in the final analysis the precise intentions of the builders of certain monuments are unrecoverable.

NOTES AND REFERENCES

1. T. PLATT, 'The Anthropology of Astronomy', in *Archaeoastronomy*, (supp. to *The Journal of the History of Astronomy*), no 16 (1985), S83.

2. S. FEHER, "Who Holds the Cards? Women and New Age Astrology", in *Perspectives on the New Age*, ed. James R. Lewis and J.Gordon Melton, (Albany 1992), 179-188

3. M. BAUER and J. DURANT, "Belief in Astrology: a social-psychological analysis", *Culture and Cosmos*, Vol. 1 no 1, p 55-71, 1997.

4. V. W. REID, *Towards Aquarius*, (New York 1944), 73.

5. M. HONE, *The Modern Text Book of Astrology*, (London, 4th edn., revised 1972,1st edn., 1951), 278-300.

6. G. R. COLLINGWOOD, *The Idea of History*, (Oxford 1946), 56.

7. W. KOCH, "Vernal Point and Era of Aquarius", *In Search*, Vol. 2, nos. 1 & 2, (Winter 1958/9 & Spring 1959)..

8. M. ISRAEL, *The Quest for Wholeness* cited in *The Christian Parapsychologist*, Vol. 8 no 2, June 1989, p 69

9. C. PTOLEMY, *Tetrabiblos*, trans. F.E. Robbins, (Cambridge Mass., 1930), I.10.

10. N. CAMPION 'The Beginning of the Age of Aquarius', *Correlation*, Vol. 17, no 2, Northern Summer 1999.

11. T. MacKINELL, *The Rectification of the Aquarian Age*, (London 1981), 1.

12. E. TIED, 'The Aquarian Age', *Modern Astrology*, Vol. 23 (Vol. 9 new series), no 8, 348-350.

13. RAINBOW CIRCLE CAMP, 1990 advertising flyer, author's collection.

14. J. DIXON, *My Life and Prophecies*, (London 1969), 180.

15. HESIOD, *Works and Days*, trans. S. Butler, (London and Cambridge Mass., 1923).

16. PLATO, *Timaeus*, trans. R.G. Bury, (London and Cambridge Mass., 1931), 25B, 29C.

17. N. COHN, *The Pursuit of the Millennium*, (London 1957); N. COHN, *Cosmos, Chaos and the World to Come: The Ancient Roots of Apocalyptic Faith*, (New Haven and London 1993); N. CAMPION, *The Great Year: Astrology, Millenarianism and History in the Western Tradition*, (London 1994).

18. LEO, *Passing into Aquarius*, (London c.1930), 7.

19. A. BAILEY, *The Destiny of Nations*, (London 1949), 36,47.

20. HONE, *op cit*, (ref. 4), 278-300.

21. G. CHRYSSIDES, "Is God a space alien? The cosmology of the UFO-religions", paper presented at the Bath Spa University College conference on Cosmologies, May 1999.

22. CHEIRO, *The Book of World Predictions*, (London 1925), 178-9.

23. *ibid*, 184.

24. "The End of the World", *Time*, 18 January 1999, 44.

25. R. ELLWOOD, *Religious and Spiritual Groups in Modern America*, (New Jersey 1973), 64-6.

26. M. MULLER, *Ancient Hindu Astronomy and Chronology*, (Oxford 1862).

27. F. D'OLIVET, *Golden Verses of Pythagoras*, (published in French 1813, English translation 1917, 2nd edition,1975), 71.

28. S. A. MacKEY, *"Mythological" Astronomy of the Ancients Demonstrated*, (1st edn. 1822, 2nd edn. Minneapolis, 1973).

29. A. J. PEARCE, *The Textbook of Astrology*, (London 1879), I.10

30. PTOLEMY, op. *cit*, II.11.96

31. A. LEO, *How to Judge a Nativity*, (3rd edn. London,1922), 22-23.

32. C. RUGGLES, "Astronomy and Stonehenge" in *Science and Stonehenge*, ed. by Barry Cunliffe and Colin Renfrew (Oxford 1997), 204.

33. C. RUGGLES, *Astronomy in Prehistoric Britain and Ireland*, (London and New Haven, 1999)..

BIOGRAPHY

Nicholas Campion is pursuing research into 'Prophecy, Cosmology and the New Age Movement' at Bath Spa University College, England. He is the editor of *Culture and Cosmos*, the journal on the history of astrology and cultural astronomy, and is a consulting editor for *Archaeoastronomy*.

DATE AND PLACE OF ORIGIN OF THE ASIAN LUNAR LODGE SYSTEMS

Bradley E. Schaefer
Yale University, Astronomy Department and Physics Department
260 Whitney Avenue, New Haven CT 06511, USA

ABSTRACT

Throughout Asia, in ancient times, the astronomies of many of the great civilizations have prominently featured a system of lunar lodges. A lunar lodge is a section of sky whose boundaries are delineated with 28 asterisms spread out in a band that circles the sky. These lunar lodge systems are intriguing not only because of their frequent occurrence in Asian scientific thought but because of their great antiquity. Historical and archaeological evidence demonstrate that the Chinese and Indian lodge systems are over 3000 years old. However, the major problems of the date and place of origin have not been solved. This paper approaches these problems by using astronomical evidence concerning a variety of correlations involving the lunar lodges. For example, both the Chinese and Indian lodges separated by 14 asterisms are significantly paired 180° apart in right ascension, and the degree of this strong correlation will change with date due to precession. In general, the degree of any such correlation will be best near the date at which the asterisms were chosen. Another correlation relates to the magnitude of the determinative stars that are different between the Indian and Chinese system. I strongly conclude that the Indian system is derived from the Chinese system and that the Arab system is based on either the Indian or Chinese systems. The best estimate for the date of formation of the Chinese lodge system is 3300 BC with a one-sigma statistical uncertainty of 480 years. Similarly, the dates for the formation of the Hindu and Arab systems are 1750±640 BC and 200±600 BC respectively.

1. INTRODUCTION

A lunar lodge system (Major 1976) is a group of 27 or 28 asterisms spread out in a band around the sky, which roughly parallels the equator or ecliptic. In many of the systems, one star out of each asterism is chosen to represent its lodge. Those chosen are called the determinative stars for the lodges. These determinative stars have had a wide variety of symbolic and practical uses throughout Asia, but their most common usage is to divide up the celestial sphere. The dividing lines between the various sections of the sky are along hour circles, which pass through the determinative star. Hence the sky will be divided up into segments, much like an orange, where each segment is a lunar lodge.

China, India, Arabia, Cambodia, Persia, Thailand, Manchuria, Japan, Mongolia, and Coptic Egypt all have used different lunar lodge systems in premodern times (Needham 1959). Some of the lodge systems are clearly derivative from others. However, for three of the lodge systems (the Chinese, Indian, and Arabic systems), it is not readily apparent how the systems are related. These three lodge systems are distinctly different, yet the number of similarities is striking. The general idea of having 28 asterisms near the equator/ecliptic with similar functions is striking enough. Yet of the 28 asterisms in the Chinese and Indian systems, 17 of the asterisms are essentially identical, while 8 of the reference stars are identical. Similar comparisons can be made for the Arab lodge system. This correspondence is too close to have occurred by chance. Hence, all researchers have agreed that all lodge systems are genetically related. This implies that all lodge systems are ultimately derived from one system. In the past several centuries, many researchers have tried to deduce which civilization was the original founder. A survey of the available literature reveals 11 opinions for China, 6 opinions for India, 4 opinions for Babylon, and one opinion each for Egypt, Arabia, and "don't know". The actual result of this tally should not be taken seriously because almost all opinions were along "party lines" (i.e., Chinese scholars voting for China). The number of opinions is indicative of the hold that the origin question has over scholars. Yet, the spread of opinions is indicative that the literary and historical evidence is indecisive.

The most intriguing fact about the lunar lodge systems is their great antiquity. The names of the 28 Chinese lodges have been found on a lacquer vessel reliably dated to the fifth century BC (Xi 1981). Historical records in both India and China show that the two lodge systems had been fully organized by the start of the first millennium BC. Even earlier historical records in India and in China (dated roughly to the middle of the second millennium BC) mention various components of the lunar lodge systems (Needham 1959). This antiquity makes the study of the formation of the lodge systems interesting because it offers insight into the higher intellectual achievements (and their widespread diffusion) of an epoch for which we have little data. But exactly how old is the lodge system? The archaeological and historical evidence has shown it to be at least 3000 years old; however this is only a limit on the age. As earlier and earlier epochs are investigated, both the archaeological and historical evidence becomes sparser. It may be possible for astronomical evidence to fill this gap.

2. METHODOLOGY

Various nearly identical lists of determinative stars have appeared. I will adopt the list from Chu (1947) for the Indian lodges and the 'anciently' list presented in the K'ai-yüan Chan-ching for the Chinese lodges. The Arab lodges (Pellat 1955) do not formally have determinative stars, but for positional purposes I have selected a single representative star (either the only star in the asterism, the brightest star, the only star common to all listings of the asterism members, or a central star). To test whether the calculations below are sensitive to these choices, I have repeated the calculations for many published lists and find that my conclusions do not change in any substantive way.

I have identified several correlations relating to the positions and magnitudes of the asterisms and determinative stars within the systems. For each of the correlations, I have proven that the observed degree of correlation is highly improbable without some mechanism having intentionally been invoked at the time of selection of the asterisms and determinative stars.

Positional correlations will change over time due to precession. In general, the degree of correlation will be greatest at the time the stars were selected for that correlation. That is, as time moves forward or backward, the correlation will only get worse, and this can be formally proven. So, we merely need to find the epoch at which each of the correlations is best to determine when the lodge system was formed. Any such estimate must be taken statistically, with some quantifiable uncertainty in the derived date. To estimate these one-sigma uncertainties, I have performed extensive Monte Carlo modeling. A complication of this methodology is that derivative lodge systems will share determinative stars from the original system that will display a correlation with an earlier date as a legacy.

3. MAGNITUDE CORRELATION

In a comparison of the Chinese and Hindu lodge systems, one prominent difference is that the Indians tend to choose much brighter stars than the Chinese. This is seen by their choice of 9 first magnitude stars, as opposed to 2 for the Chinese; as well as only 2 stars fainter than 4.0 magnitude as opposed to 7 for the Chinese. Figure 1 is a histogram of the frequency of determinative stars of a given magnitude for the two systems. The shaded areas correspond to those determinative stars that are identical in both systems. Note that with one exception (α Hya), these unchanged determinative stars exclusively occupy the bright portion of the Chinese histogram. Alternatively, we could say that all Chinese lodges with faint determinative stars correspond to Hindu lodges with *different* determinative stars. The probability that this division occurred by chance is extremely low.

If we assume that the lunar lodge system was transferred from China to India, then this curious asymmetry has a simple explanation. When the Hindus received and modified the Chinese system, they left the bright determinative stars untouched. This course of action can easily occur if the receiving culture had lost the knowledge of why the faint determinative stars were chosen in the first place. In such a case, the receiving culture would tend to pick brighter stars that are more convenient. These new determinative stars would not have been chosen to satisfy lost positional criteria; and so the corresponding correlations in the receiving society's system will be of a lower degree than in the original system.

There is no similar simple explanation for the asymmetry in Figure 1 if it is assumed that the Chinese received the system from the Hindus. With this assumption, one would have to ask how the Chinese knew that the end product of all their modifications would be the asymmetry in magnitudes. Presumably, they could have picked some magnitude such that any star brighter than that magnitude which they wished to change had to be changed to a star which is fainter than the given magnitude. However, this possibility seems rather forced. Hence the magnitude asymmetry in Figure 1 offers a strong argument that the Indians received the lodge system from the Chinese.

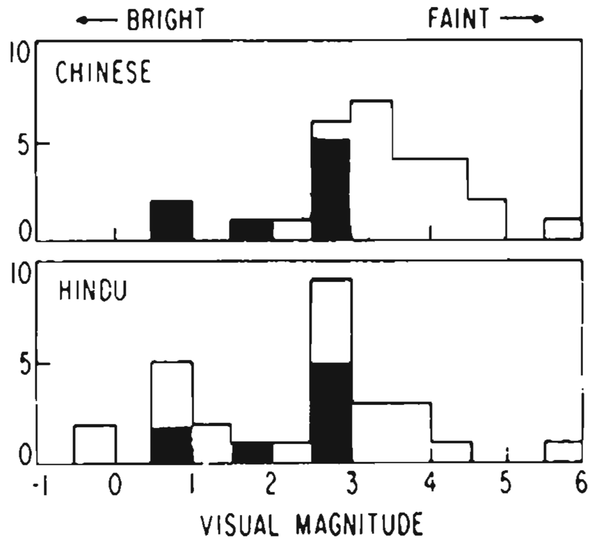


Figure 1

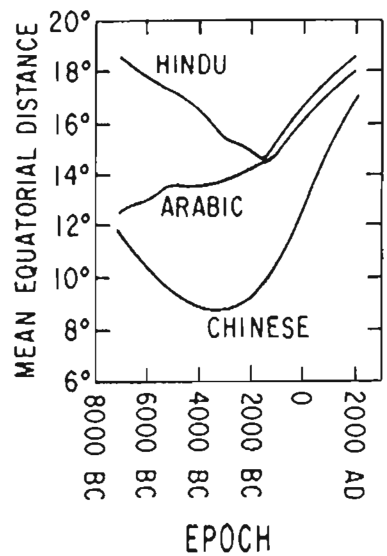


Figure 2

4. POSITIONAL CORRELATIONS

The Chinese and Indian determinative stars are concentrated close to the equator, with average distances of 8.7° and 14.6° at minimum. These values are sufficiently small that the stars must have been chosen roughly for their proximity to the equator or some other equivalent formulation. The average equatorial distance changes with time due to precession (see Figure 2), such that the Chinese and Indian systems have clear minima in 3200 BC and 1700 BC respectively. I identify these dates as measures of the foundation of the two lodge systems. My Monte Carlo simulations allow one-sigma uncertainties of 650 and 900 years respectively.

The extension of each lunar lodge is the difference in right ascension between its determinative star and that of the next lodge's determinative star. The average extension must be 360°/28=12.86°, while the actual extensions will vary about this average with some rms scatter (S1). At first glance, the extensions appear to be random with a large scatter around the average, for example the Chinese extensions ranged from 3° to 29° in 3200 BC.

However, there are few such large or small extensions, while the majority are within 3° of the average, so that the rms scatter is much smaller than would be expected by merely inspecting the few extremes. The S1 value for the Chinese stars is 5.8° at this time, and that is much smaller than if the stars had been chosen randomly (which would have $S1=12.4 \pm 2.4°$). Figure 3 shows that the minimal S1 value for the Indian stars is 4.8° (in 1800 BC) and for the Arabic stars is 2.9° (in 200 BC). These values are so low that the stars must have been chosen by some rule that enforces roughly equal spacing. The Chinese S1 plot (see Figure 3) does not show a minimum at any epoch, and such behavior is not uncommon from my Monte Carlo simulations where a correlation is not required to have a significant minimum. If a minimum is present, then its date must be near that of the origin with uncertainties quantifiable by my Monte Carlo analysis. Thus, I find the uniformity of lodge extensions to yield dates of 1800 ± 800 BC and 200 ± 600 BC for the Indian and Arab systems.

Biot (1840) suggested that the Chinese determinative stars were paired such that stars separated by 14 lodges were also separated by 180° of right ascension. I have calculated the effects of precession, generalized his analysis to different lodge separations, quantified the uncertainties, evaluated the significance of the correlations, extended it to the other lodge systems, and avoided several errors. I find that the Chinese system has a striking rms scatter about the 180° pairing ($S14=4.1°$), while randomly chosen stars will have $S14=30.5°$ (and will be <4.1 only $<0.05\%$ of the time) and stars chosen solely for a uniform extension will have $S14=12.4°$ (and will be $<4.1°$ only 0.5% of the time). So the Chinese must have specifically chosen stars for this 180° pairing. Again, the existence of a selection rule like this does not require that a significant minimum in the correlation exist. The lack of a significant minimum in the Chinese system thus means only that we do not get an extra determination of its origin date. However, both the Indian and Arabic systems do have significant minima in S14, both around 3500 BC (see Figure 4). This has a simple explanation as a legacy of the 180° pairing from the stars retained from the Chinese system. The Monte Carlo simulations show that the changes of determinative stars without regard for the 180° pairing will generally weaken the correlation and might create a minimum in time where there had been none in the original system, and the date of that minimum is near the origin date of the original system. The S14 minima also provide a second and earlier epoch (in addition to the epochs of 1700 BC and 200 BC) which demonstrate that the Hindu and Arabic systems are derivative.

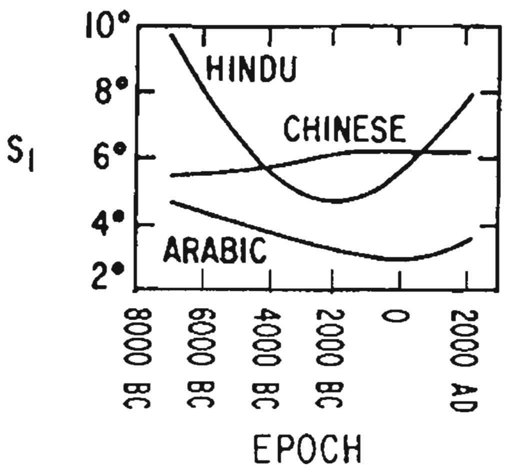


Figure 3

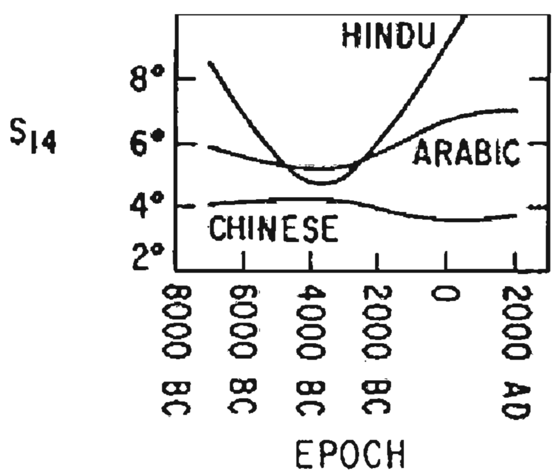


Figure 4

5. CONCLUSIONS

First, the Chinese lodge system was formed in the year 3300 ± 480 BC. This date is the weighted average of dates from the minimum equatorial distance and the S14 correlation for both the Hindu and Arab systems. This makes the lodge system 5300 years old.

Second, the Indian system was formed in 1750 ± 640 BC. This is based on the dates of minimum equatorial distance and S1.

Third, the Indian lodge system is derivative from the Chinese system. This is based on the magnitude asymmetry from Figure 1, the later formation date as deduced from the correlations, and the existence of a legacy 180° pairing.

Fourth, the Arabic system was formed in the year 200±600 BC. This is based on the observed minimum of the S1 parameter.

Fifth, the determinative stars were chose on the basis of their position near the equator and ecliptic as well as for roughly even spacing in right ascension. In addition, the Chinese chose the determinative stars on the basis of 180° pairing. Several ways exist to select stars with 180° pairing with simple timing measures. Nevertheless, this pairing may be the most sophisticated concept known to arise in the fourth millennium BC.

REFERENCES

J. B. BIOT, 1840, Journal des Savantes, 246-254.

C. CHU, 1947, Popular Astronomy, **55**, 62-78.

J. S. MAJOR, 1976, Early China, **2**, 1-3.

J. NEEDHAM, 1959, *Science and Civilisation in China* (Cambridge; Cambridge Univ. Press).

C. PELLAT, 1955, Arabica, **2**, 17-41.

Z. XI, 1981, Isis, **72**, 456-470.

ADAPA, ETANA AND GILGAMEŠ THREE SUMERIAN RULERS AMONG THE CONSTELLATIONS

Arkadiusz Sołtysiak
Department of Historical Anthropology
Institute of Archæology
Warsaw University, Poland

1. INTRODUCTION

Among the religious texts of the peoples of ancient Mesopotamia, preserved on cuneiform tablets, there are also found some stories concerning an initiation of sacred king. Originally they were probably related to suitable rituals. One can enumerate here three main texts of this kind: about Adapa from Eridu, about Etana from Kiš, and about Gilgameš from Uruk, three model personages of a ruler from three great towns of Sumer. The narration in all of them, as usually in initiation myths, can be regarded as composed of many levels, most generally anthropological, seasonal as well as astronomical one. This paper will be dedicated to the latter level and, first of all, to possible position of Milky Way and nearby constellations (from Hydra and Orion to Aquila and Scorpio) in cosmological meaning of the initiation of Sumerian theocratic elites' members. Because of lack of space, the critical apparatus will be strongly reduced.

2. ADAPA

Adapa, the main character of first narration, was the priest in Eridu, in the temple of Ea, the ruler of the ocean of sweet water. On account of his duty, once upon a time Adapa left Eridu for fishing. His sail began to drift towards the open sea. The text is broken in this part; after the gap we get to know the South Wind who wants to scuttle Adapa. She sends her brothers against the priest but he is stronger and breaks her wing.

For seven days the wind had not blow towards the land. It upset Anu, the god of heaven, who sent his messenger to Adapa and ordered the priest to come to the heavenly palace. «Aware of heaven's ways» god Ea gave Adapa instructions. Following them, Adapa put on mourning clothes and began to enter the way to the heaven. Approaching to the Gate of Anu, he met there two gods: Dumuzi and Giŝzida. They asked him why he had put on mourning clothes and Adapa answered that two gods had vanished from the country and that they were exactly Dumuzi and Giŝzida. Then both gods «looked at each other and laughed a lot»; owing to their mediation Anu received favourably the excuse of Adapa and gave him the bread of life. However, Adapa, bearing in memory the instructions of his god Ea, did not accept the bread of life nor the water of life and Anu ordered to send him back to the earth as a mortal man. The tablet breaks here.

The astronomical layer of this initiatory narration can be easily recognized. Adapa operates in the domain of two gods belonging to the cosmological triad who ruled the specified «paths» on the sky. The transition up high to the heaven of Anu can be interpreted as the move from southern path of Ea to ecliptical path of Anu along to the Milky Way. There is one very strong premise for such interpretation: two gods guarding the Gate of Anu are related to two very characteristic constellations: Hydra and Orion. The passage about their disappearance from the Earth can refer to their yearly cycle of visibility. Both constellations lay near equator in the distance of about 50° in Right Ascension (Betelgeuse to Alphard). Only for few days they are invisible simultaneously, just before the summer solstice in the epoch −1000, when Betelgeuse set heliacally May 2nd and rose June 24th in Babylon [Parpola 1983:410]. This peculiarity could be exploited in the ritual *taklimtu*, which took place about the summer solstice, and it is explained differently in the myth about the descent of Ištar to Underworld, related to this festival at least in Ist millennium BCE.

3. ETANA

The second story concerning the initiation of sacred king is known from very frequent but often broken tablets. An eagle and a serpent settled on the crown and at the base of a poplar. They shared their prey and fed their young by common effort. Things were running well until the eagle decided to break the oath and to devour the young of the snake. The snake returned to the nest and realized what happened, because the eagle left a trace: «with its talons it had [clawed at] the ground, and its dust cloud [covered] the heavens on high». It seems to be the close reference to the Milky Way.

Betrayed snake complained of the eagle to Šamaš. The Sun-God listened to the snake and said: «go along the path, cross the mountain where a wild bull [...] has been bound for you». The snake found a bull and crawled in its entrails waiting for the eagle, which noticed the carcass soon and flied down. The snake seized it, broke its wings and threw into a pit to die of hunger and thirst. In this place Etana comes into narration. He prayed to Šamaš for «the plant of birth» which could allow him to generate a son. Šamaš answered with the words directed previously to the snake: «go along the road, cross the mountain, find a pit and look carefully at what is inside it». In the pit Etana was expected to find the eagle who would show him the plant of birth.

Etana, when learned that the eagle would help him in the search for the plant of birth, for seven months nursed the animal and taught it to fly. Next they returned to Kiš together and Etana had a dream: «We were going through the entrance of the gate of Anu, Ellil, and Ea. We were going through the entrance of the gate of Sin, Šamaš, Adad, and Ištar. [...] I saw a house with a window that was not sealed. I pushed it open and went inside. Sitting in there was a girl adorned with a crown, fair of face. A throne was set in place, and [...] beneath the throne crouched snarling lions. I came up and the lions sprang at me. I woke up terrified». This dream is full of astronomical meaning. There is the gate of three cosmological gods, which means the entrance to the heaven. Its synonym is the gate of Sin, Šamaš, Adad, and Ištar — respectively the gods of Moon, Sun, Mars and Venus. The girl sitting on the throne, according to the description, is Ištar herself.

Summarizing, the astronomical meaning of the story about Etana is rather clear. There are sufficient indications that the constellations Hydra and Aquila may be acknowledged as the astral representations of two animals occurring there. These constellations are distant each other for about 170° and it can be said they lay almost opposite each other. Both constellations are situated on the equator, Aquila above, and Hydra below the ecliptic. Roughly speaking, the rising of one of them is more or less synchronous with the setting of the other. It can be the simplest explanation of their partnership (one of them is always visible and can «prey»), as well as their hostility (the upper culmination of one constellation stands for the lower culmination of the other).

In this context the aerial journey of Etana and the eagle can be interpreted as the move with Aquila from its rising (surely acronical, because Šamaš left the story when Etana and the eagle stroke up a friendship) until the upper culmination. Unfortunately, the comparative sources are not so numerous in comparison to the story about Adapa and then the possibility of speculations grows wide. Therefore let us stop in this moment.

4. GILGAMEŠ

The last and surely best known narration commented here is that about Gilgameš and his companion Enkidu. Their first deed was the expedition against Humbaba. This creature was posted on guard of Pine Forest by Enlil, the third god of already mentioned cosmological triad. Gilgameš and Enkidu reached the Pine Mountain. They took fright of Humbaba at first but Šamaš gave Gilgameš an advice how to conquer this creature and delivered him 13 winds which made Humbaba motionless and allowed to kill him.

Some data seem to suggest Humbaba was related to a constellation laying on the path of Enlil. Although this identification remains more uncertain than all those discussed above and below, it can be possible that the constellation of Humbaba was known under the name ^{mul}UD.KA.DU$_8$.A, which means «the demon with gaping mouth». In contemporary uranography, it is Cygnus with some part of Cepheus.

In contrast to Humbaba, the astral identification of the second antagonist of Gilgameš is unquestionable. When the hero went back from the Pine Forest, Ištar saw and desired him. Gilgameš, however, did not yield this courtship and refused. Furious Ištar went up to the heaven, to Anu and his spouse Antu. She demanded the Bull of Heaven. «Anu listened to Ištar speaking, and he put the Bull of Heaven's reins in her hands». The bull entered a river and defeated three hundred young men from Uruk. However, Enkidu «seized The Bull of Heaven by its thick tail [...] then Gilgameš [...] plunged his sword in between the base of the horns and the neck tendous». Next Enkidu «pulled out the Bull of Heaven's shoulder and slapped it into Ištar's face». This deed has to explain why the constellation Taurus represents only the head and one leg of the animal.

Eventually Enkidu died and Gilgameš decided to search for eternal life. He begun his journey to Ut-napištim, the only man who survived the flood, and reached the mountain on the East. There he met Scorpion–men which can be identified as the constellation Scorpio, albeit only weak premises are available in this case. Gilgameš told the guards that he looked for Ut-napištim who had received the eternal life from the gods. The Scorpion–men let Gilgameš to come through the gate.

The hero came into «the path of Šamaš» and entered into complete darkness. Twelve leagues stands for twelve double hours of walk — it denotes distances both in space and in time. Eventually Gilgameš «came out in front of the sun» — he passed the path of Šamaš under the earth and came out on the opposite region of sky. When he started at the East and in the gate of Scorpion–men, at present he should be at the West and in the region where the Milky Way crosses the ecliptic in the proximity of the point of summer solstice. There is a garden full of precious stones, where «Siduri the alewife lives down by the sea».

Gilgameš asked Siduri for a way to the abode of Ut-napištim, and she informed him about Ur-šanabi, the ferryman of Ut-napištim. After two weeks of voyage, Gilgameš and Ur-šanabi reached the island of Ut-napištim «in the mouth of two rivers». The southern direction and the domain of Ea, the ruler of sweet water, must be at stake here. The star of Ea was called ^{mul}NUN^{ki}, «the star of Eridu». Its identification is not sure, although there is no doubt that it laid at the far South: ζ Puppis or α Carinae (Canopus) can be taken into account. Canopus, as very bright star visible in southern Sumer, could be recognized as the far island of Ut-napištim.

The immortal sage told Gilgameš the story about the flood and informed him that it is impossible to receive the eternal life from gods. Gilgameš, however, pressed Ut-napištim and the sage decided to help him other way. He revealed a secret of gods: «there is a plant whose root is like camel-thorn, whose thorn, like a rose's, will spike [your hands]. If you yourself can win that plant, you will find [rejuvenation]». Gilgameš dived into the depth and acquired the plant. However, during the way back, Gilgameš saw a pool of cold water and dropped in to take a bath. At that time «a snake smelt the fragrance of the plant. It came up silently and carried off the plant. As it took it away, it shed its scaly skin». After this event, Gilgameš gave up.

5. CONCLUSION

The confrontation of mythical narrations and astronomical texts brought very interesting results. It has appeared that the stories concerning the deified mythical rulers of Sumer were full of more or less probable astral symbols — or rather the constellations in view of ancient people composed the illustrations of most significant religious narrations.

The summary of previous discussions has been presented in the table. The first remark which comes in mind, is that all represented (or supposed to be represented) constellations lay on or near the Milky Way. The Milky Way is reported as a path in most sources, although there are also some premises that it could be represented as a river or as cosmical tree, growing in the Underworld and reaching the heaven of Anu with its crown. The plant of birth or the plant of life relates to such tree and simultaneously it is connected with the heaven through the possible homophony *šamû* «the heaven» — *šammu* «a plant».

The confrontation of possible astral connotations of three discussed stories.

	ADAPA OF ERIDU	ETANA OF KIŠ	GILGAMES OF URUK		
Main astral characters	Ningišzida and Dumuzi	the snake and the eagle	Huwawa	the Bull of Heaven	Scorpion-men and Ut-napištim
Their identification	Hydra and Orion	Hydra and Aquila	Cygnus (?)	Taurus	Scorpio and Canopus (?)
Involved astral deities	Ea and Anu	Šamaš and Ištar (?)	Šamaš	Ištar	Šamaš
The heaven of	Anu	Anu	Enlil	Anu	Ea
Milky Way as	path	tree/dust trace	Path	a river (?)	a river (?)
Journey	transition through the gate	fly up high	way toward a mountain		transition through the gate and sea voyage

The Milky Way forms the *axis mundi* and the path to the abodes of gods. During their journey, all three heroes enter it, come through the gate and reach the heaven. Thus, no wonder that the characters met there can be related to the constellations close to the Path. It resembles very much the shamanistic journeys which lead along the Milky Way to another worlds. Much more interesting are the differences in three stories: the only characters occurring in all of them are Anu, the god at heaven, and the serpent. This last animal, however, appears in three completely different shapes. It strongly suggests that there was no uniform model of religious initiation which diffused from one center, but many local traditions developed in grounds of associations concerning common images of the sky and of the cosmology.

The stories about Adapa and about Etana are much simpler than that about Gilgameš. There is only one thread (in case of Etana only one remained) and both heroes aimed only at the heaven of Anu. Gilgameš, instead, operated on the paths of all three cosmological gods: on the northern path of Enlil he killed Humbaba, on the ecliptical path of Anu he struggled with the Bull of Heaven, on the southern path of Ea he was searching for immortality. Only in the case of second path the direct relation to the uranography was given: Gilgameš «seized the Bull of Heaven who came down from the sky». However, there are sufficient premises which make also other astronomical interpretations very probable. Solely the story about the expedition of Gilgameš against Humbaba was devoid of confirmation by astronomical sources.

ACKNOWLEDGEMENTS

I wish to thank Local Organizing Committee of Oxford VI and SEAC'99 Conference (especially Dr Juan Antonio Belmonte and Dr Cesar Esteban) for financial support which has enabled me to take a part in the conference. All original texts quoted after the translation of S. Dalley [1989].

REFERENCES

J. BLACK, A. GREEN, 1992. *Gods, Demons and Symbols of Ancient Mesopotamia. An Illustrated Dictionary*, London: Trustees of the British Museum.

S. DALLEY (transl.), 1989. *Myths from Mesopotamia. Creation, The Flood, Gilgamesh and Others*, Oxford – New York: Oxford University Press.

J. V. KINNIER WILSON, 1985. *The Legend of Etana. A New Edition*, Warminster: Aris & Phillips Ltd.

S. PARPOLA, 1983. *Letters from Assyrian Scholars to the Kings Esarhaddon and Assurbanipal. Part II: Commentary and Appendices*, «Alter Orient und Altes Testament», Neukirchen–Vluyn: Neukirchener Verlag.

E. REINER, 1981. *Babylonian Planetary Omens. Part Two: Enuma Anu Enlil, Tablets 50–51*, «Bibliotheca Mesopotamica» 2:2, Malibu: Undena Publications. [in collaboration with D. Pingree]

E. F. WEIDER, 1915. *Handbuch der Babylonischen Astronomie*, Leipzig: J.C. Hinrich'sche Buchhandlung.

HUNTING THE EUROPEAN SKY BEARS: HERCULES MEETS HARZKUME

Roslyn M. Frank
Institute of Basque Studies London
and
The Department of Spanish & Portuguese
University of Iowa, Iowa City, IA 52242 U.S.A.
e-mail: roz-frank@uiowa.edu

Investigations into the origins of the ancient constellations and advances in the field of ethnoastronomy over the past decades suggest that additional efforts should be made to explore the presence of pre-Greek astral materials with respect to stories told about certain non-zodiacal star figures making up the set of forty-eight ancient constellation figures. Based on the research model first proposed by Maunder in 1908 ([1908] 1922) and updated by Frank and Arregi (1998), the horizon plane of those who projected these non-zodiacal constellations can be simulated along with the temporal axis of the data, the window of spatial opportunity being a seven degree band stretching across Europe from 36° to 43° while the temporal window extends from 4000 BC to 2500 BC. Greek astral materials related to Hercules appear to draw on elements found in the earlier pan-European cosmovision linked to the belief that humans descend from bears (Frank 1996a, 1996b, 1996c), one that, in turn, is directly connected to the Harzkume Bear Son saga with its a non-solar oriented backdrop. Selected narrative elements found in each set of tales are compared in an attempt to determine to what extent they emanate from older pre-Greek sources as was done previously in the case of the Harzkume and Prometheus materials (Frank 1996c), keeping clearly in mind that past attempts to paint Hercules' adventures onto a solar-oriented cosmovision have been unsuccessful (cf. Krupp 1991, 1995).

Investigations into the origins of the non-zodiacal constellations forming part of the set of forty-eight ancient star figures (Frank and Arregi 1998; Gingerich 1984; Rogers 1998a, 1998b), as well as recent advances in the field of ethnoastronomy (Farrer 1992; Roberts 1987-8; Williamson and Farrer 1992) suggest that a new approach to the Greek materials is needed.[1] Methodologically speaking the approach proposed takes into account the recognized antiquity of certain of these non-zodiacal figures and then attempts to detect in them the presence of earlier pre-Greek astral traditions. In short, it alleges that evidence for these earlier traditions is woven into the narrative structure of the stories, the astral myths, transmitted to us by the Greeks. Concretely, the model argues that in the cycle of adventures attached to a hero called Heracles/Hercules we can identify motifs originally linked to a much older therioanthropic figure, half-bear and half-human.[2] In the earlier animistic cosmovision, anchored in celestial bear ceremonialism, this character plays the role of a shaman apprentice. Furthermore, the research model assumes that the cognitive strategies leading to the placement of a number of these pre-Greek non-zodiacal constellations, not just the two celestial bears and Hercules, can be traced back to a desire on the part of the story-tellers to project onto the sky screen key scenes, specific adventures, from this much earlier ecocentric narrative with its half-bear half-human protagonist and his assorted Spirit Animal Guardians.[3] The plot is one that pits two shape-shifting shamans against each other in a series of contests, i.e., ritual combats. On the one hand there is the young Bear Son shaman apprentice, equipped with a giant club and endowed with superhuman strength, an attribute derived from his father, a Great Bear. On the other, there is the role of the Bear Son's opponent, played by another shape-shifter, a cunning old shaman. The latter takes on various animal guises including his most emblematic, that of a serpent or three-headed dragon.[4] The adventure tale is grounded in a well-documented pan-European belief system with strong animistic overtones. It is one that assigns to humans an ursine genealogy, namely, a story of human origins based on the belief that humans descend from bears. As such, it is clearly a cosmovision with roots reaching back to pre-

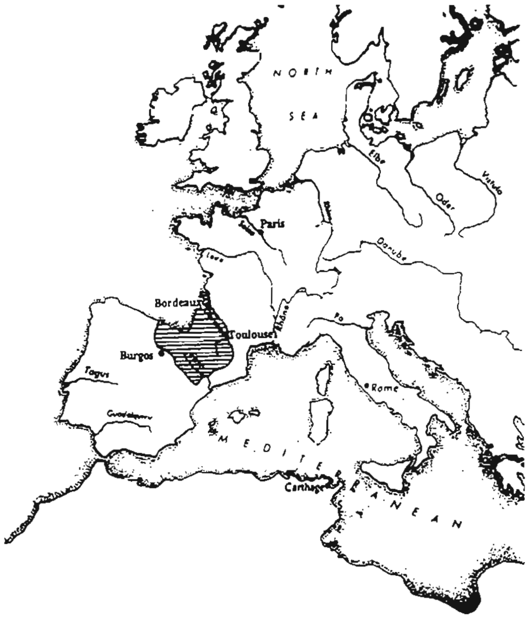


Figure 1. Basque-speaking Zone in the First Century AD. Source: Salvi 1973; Bernard and Ruffié 1976.

agricultural cognitive frameworks. Stated differently, the sources of the conceptual frame itself must be traced back to much earlier social practices and, therefore, the narrative's roots should not be sought in the anthropocentric and solar-oriented mythologies commonly attributed to (Proto) Indo-European speaking peoples, but rather in an older and far different set of narrative traditions. These have survived in Europe in the form of a vast corpus of folk tales and popular performance pieces that constitute the Harzkume or Bear Son saga. On that note, it should be stated that some of the most archaic versions of the narrative in question, those with striking shamanistic characteristics, have been preserved in the Pyrenean region, a zone characterized, linguistically speaking, precisely by the presence of a pre-Indo-European language, Euskera (Basque) **(Fig. 1)**. Yet the evidence points to the conclusion that previously the geographical distribution of such stories, i.e., those with strong shamanistic traits, covered an extensive zone stretching across much of Europe and, therefore, including the Aegean region.

Let us begin our search for the pre-Greek origins of Hercules' adventures by establishing the time-frame that should be assigned to the constellation figure itself and, hence, its possible antiquity. Basing our conclusions on strategies first proposed by Maunder ([1908] 1922) and updated by Frank and Arregi (1998), we discover that the horizon plane of those who projected the non-zodiacal constellations skyward can be simulated along with the temporal axis of the data. The results of this simulation show a window of spatial opportunity constituted by a seven degree band stretching across Europe from 36° to 43° while the temporal window for carrying out their projections remained open from roughly 4000 BC to 2500 BC **(Fig. 2)**.[5]

That the Greeks had no clear idea of the meaning of the celestial figure known today as Hercules, is demonstrated by the fact that Manilius describes him with the following disparaging remark: "Close to the polar bear and the icy north there is a figure that leans on one knee and he himself is the only one who knows the reason of this position'" (cited in Sesti 1991:349). Aratus's comments in his *Phaenomena* of c. 300 BC are equally enigmatic for he says that this figure is a mystery, describing it as "a phantom turning round and round" with both arms raised and his right foot leaning on the head of the Dragon (Draco). As Sesti (1991:349) rightfully points out, this "acceptance without understanding or knowledge is another demonstration that the science of astronomy was created elsewhere and only imported by the Greeks." Over the centuries they succeeded in restructuring it with their mathematics and geometric contributions as well as enriching it with overlays drawn from their own mythological repertoire.

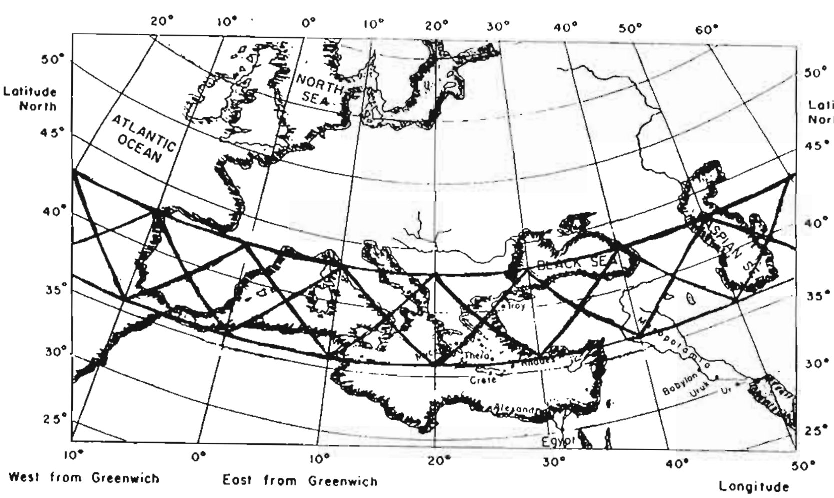


Figure 2. Simulated Band Width of Window of Opportunity. Source: Frank and Arregi 1998.

Indeed, whereas the star figure known to us as Hercules actually has an extremely ancient history, one that is not always well documented, information concerning the particular assignment of these stars to the Greek hero himself is really quite recent. For instance, Avenio says that the first person to assign the name of Hercules to these stars was Panyassis (fifth century BC) who was the uncle of the great historian Herodotus. The former wrote fourteen books about this hero and appears to have wanted to insert another Argonaut into the sky. However, all Greek astronomers, from Eudoxus, Aratus, Eratosthenes, Hipparchus down to Ptolemy, as well as Arab ones from al-Sufi to Ulugh-Beg, refer to Hercules as Engonasi, the One who Kneels. It was said that these stars represented the figure of a nude man in a kneeling position as he appears on the Farnese Atlas, the famous sculpture of the Titan holding up the globe of the constellations that, without a doubt, is no more than two thousand years old. It was not until 1485, when the Venetian edition of the astronomical fables of Hyginus was published, that we find the first astronomical depiction of Hercules embellished with details from Greek mythology: equipped with a club and a lion's skin, trying to slay a serpent wrapped in biblical fashion around an apple tree **(Fig. 3)**. In 1603 the astronomer Johannes Bayer compiled a star atlas in which Hercules appears with a club, a lion's skin, and a branch with the three-headed serpent hound, known as Cerberus, whose capture, according to most versions of the Greek tale, comprised the hero's last labor (Krupp 1991: 139, 299; Sesti 1991:349-51).

Figure 3. Hyginus 1485. Source: Flammarion 1882.

In short it would appear that the stories told about the Greek hero were grafted onto a cycle of preexisting astral traditions associated with the same star figure. Moreover, there are other reasons for believing that the strategic placement of the constellation in question is far older than the Greek versions of the narratives might suggest. For example, we find that the constellation figure which today appears to be completely upside-down to us, was in the correct position in the fourth millennium BC when it culminated on the northern meridian at midnight during the spring equinox and that, at that time, the North Pole was close to Thuban (Sesti 1991:349). Furthermore, as Maunder (1922:163-164) has suggested, the same astrally coded text that ended up placing the figure of Engonasi near Draco also might have painted another scene showing the same hero triumphing over his opponent, the Serpent, namely, in the star figure represented by Ophiuchus, the Serpent Holder.[6]

The strategic placement of these figures in the sky and as well as the Greek stories told about Hercules seem to draw on a number of interpretative motifs found in the Harzkume Bear Son saga, this much earlier pan-European folk narrative grounded in an ecocentric cosmovision and the belief that humans descended from bears (Frank 1996a, 1996b, 1996c). The master narrative in question, whose European variants number in the hundreds, relates an archetypal tale of initiation. Referred to as Harzkume or "Little Bear" in Euskera (Basque), in most other European languages he is simply called the Bear Son, although he sometimes surfaces as a semi-anthropomorphized character called John Bear or John Little Bear (cf. Frank 1996a). It is his vision quest and battles with the aforementioned shape-shifted shaman opponent that constitute the basis of the tale. In these encounters both characters repeatedly take on the form of animals, the Bear Son playing the role of the predator and his shaman opponent, the prey (Frank 1996b; Frank and Arregi 1998). It should be noted that the narrative itself constitutes the most wide-spread motif in European folklore, while in various villages across Europe scenes from the tales continue to be acted out annually in mime and dance (Frank 1998, 1999). In addition previous studies underline the possible significance of the interactive nature of such social practices. They suggest that key scenes from the tales were not only acted out on earth in song and dance, but that when this was done, the performance itself and the retelling of the tales involved the manipulation of sky texts: that as part of the same ecocentric cultural complex, certain scenes had been projected skyward and traced out on the sky screen using non-zodiacal star figures, some of which are still recognizable today (Frank 1998, 1999).

Before comparing several of the Bear Son's adventures to those attributed by Greek oral traditions to Hercules, we need to briefly review the research model utilized for analyzing the data. The governing hypothesis is that a number of these Greek motifs can be traced back to older pre-Greek astrally coded traditions that attached themselves to this particular hero. Furthermore the research model in question was tested earlier with positive results when it was applied to a similar data set: a comparative study carried out on the narrative structure of the tales told about Prometheus (Frank 1996c), the latter being a character whose adventures are intertwined with those of Hercules. Moreover in analyzing the narrative plot associated with Hercules, we must keep clearly in mind that previous attempts to map the twelve labors attributed to the hero onto a solar-oriented cosmovision have been totally unsuccessful (cf. Krupp 1991, 1995).[7] The underlying star figure, the constellation bearing the name of Hercules today, appears to antedate the rise of fully zodiacally oriented sky texts since the latter did not come into being among the Greeks until the first millennium BC. For example, Gingerich (1984: 219) argues that among the Greeks the zodiac does not appear to be wide-spread before 400 BC. Similarly, as Rogers (1998b: 81) states, the zodiac as we know it could not have been transmitted from Mesopotamia to the west until the mid-first millennium because it was not complete until then. Hence, given this temporal horizon it is far more likely that the narrative associated with the constellation in question -and transmitted to us by the Greeks- was, on the one hand, pre-Hellenic and, on the other, grounded in an earlier non-zodiacally oriented sky text that the Greeks inherited.

Turning to the manner in which Greek mythology portrays the astral hero, we find Hercules characterized as a man of superhuman strength, although the precise source of his extraordinary physical abilities is never fully explained.[8] This contrasts with the situation of the burly Harzkume, the Bear Son, whose physical prowess is easily explained by the fact that he is half-human and half-bear: his mother was a human female and his father, a Great Bear. As a result he partakes of both natures.[9] In the Greek version the animistic backdrop has dropped away and we find Hercules performing as a latter day Rambo. He is a warrior engaged in carrying out incredible search and destroy missions into enemy territory where he always triumphs over his animal adversaries. In another sense his character corresponds to that of a big game hunter brought in to rid the country-side of marauding beasts, although at times his master requires him to bring the prizes back alive. At first glance the Greek hero's actions appear to be framed by the norms and value systems inherent in an agriculturally-oriented society of the Greek city-states: the triumph of man over nature. Nonetheless, the evidence suggests that the cognitive model for these ritual battles should be sought in an older ecocentric cosmovision where this type of dualism is absent.

Results of extensive research carried out on literally hundreds of the extant versions of the Bear Son saga found throughout Europe (Cosquin 1897:1-27), allow us to identify the similar patterns operating in them, For instance, as the older tale slowly begins to loose its moorings in the earlier ecocentric and animistic cosmovision, the internal structure of the shamanically coded vision quest starts to disintegrate. This is accompanied by a loss of recognition of the initiatory nature of the tale. In such versions the main character often takes on a purely anthropomorphic form. And as the outlines of the figure of the Bear Son Ancestor fade away, his Spirit Animal Guardians frequently begin to disappear from view. In other cases they continue to be present on stage, but rather than being portrayed as the hero's helpers they take on negative characteristics. Indeed, the Bear Son's own Spirit Animal Guardians sometimes reappear as dangerous beasts, fierce enemies who prey on the flocks and hence must be exterminated. By this point the ursine hero is regularly replaced by a human male of gigantic proportions and superhuman strength. As a result, the prototypical plot begins to fragment (cf. Frank and Arregi 1998).

There is an increasing loss of awareness of the causal relations that once bound the episodes together as well as of the fact that the combats were originally purely ritual in nature, pitting two shape-shifting shamans against each other. This first character is primarily associated with a bear and the second, with a snake. Hence, both protagonists have dual natures, one theriomorphic and another anthropomorphic. At the same time the two characters' interdependence, their apparent antagonism, is subtly traced out by means of their role assignments: that of predator and prey. With respect to this division of roles, it is significant that in the Basque materials there are two lineages. One is linked to the residual folk belief that humans descend from bears and hence the archetypal figure of Harzkume. And then there is another lineage tracing the race back to a very different mythological figure with marked astral connections, an ancestor called Sugaar, the "Male Snake," from *suge* "snake" and *-ar* "male," who is the consort of the goddess Andra Mari, another very talented shape-shifter (cf. Barandiaran 1983). In addition, Sugaar appears to be an incarnation of the Herensuge, the Basque name of the Serpent Shaman in the cycle of tales under consideration. The elder shaman's name could be glossed as "Great Ancestor Snake."[10]

In animistic versions of the tale throughout the course of the narrative each shaman transforms himself first into one creature and then another. Thus, the archetypal encounters create a complex set of ecocentric confrontations between the predator animal (the shape-shifted Bear Son shaman apprentice) and its prey (the shape-shifted Serpent Shaman). For example, we find a mountain lion (played by the shape-shifted Bear Son shaman) hunting and killing a giant porcupine (played by the shape-shifted Serpent shaman). In more fragmented versions the hero no longer shape-shifts into a mountain lion to pursue its next meal. Rather he is portrayed emblematically, fully anthropomorphic, as the archetypal great *human* hunter triumphing over a fierce beast. The wild cat is no longer the shape-shifted hero himself, but rather his nemesis. Curiously, even in the more fragmented versions, whereas the main character regularly looses his ursine characteristics, his shaman opponent continues to be portrayed as a serpent or three-headed dragon.

At this stage the ecocentric plot which previously held the episodes in place and laid them out in a specific order, often disintegrates totally. And with the breakdown of the causal networks, we occasionally find recognizable exploits moving about in search of an appropriate human protagonist. In a certain sense these episodes can be considered merely narrative fragments, oral debris from the original saga, that nonetheless continue to live on as part of a larger corpus of folkloric motifs, as part of the oral repertoire available to the story tellers. For this reason, once these episodes have floated away from the main body of the text and detached themselves from ecocentric cosmovision that supported it, they wander about, somewhat aimlessly, until the story-tellers finally manage to attach them to one likely protagonist or another. In such cases the episodes take up residence, as it were, often out of order, in the ensuing narrative where they serve to enhance the life and deeds of a particular fictional hero or semi-legendary ancestor of the people or nation in question.[11] At times, in the same geographical zone episodes from the original text end up being transferred to more than one legendary or semi-historical personage and, hence, turn up incorporated into several different sets of adventures. In summary, the vast corpus of extant European Bear Son narratives allows us to document the way in which the archetypal motifs are reprocessed and tend to attach themselves to cycles of stories told about different heroes (Frank 1996c).

At this point we can turn our attention to the labors assigned to Hercules for some of the most obvious parallels holding between the pan-European Bear Son saga and the strong man of Greek mythology are found with respect to these reoccurring narrative motifs. In Greek mythology Hercules is demigod in human form. He is a man endowed with supernatural strength and equipped with a large club. Similarly, one of the Bear Son's key adventures concerns the manner in which he acquires his huge club. Moreover he acquires it early on, just after he sets out on his vision quest. This fact could serve to explain the placement of the corresponding celestial figure, a strong man equipped with a heavy club, at only a short distance from the circumpolar region associated today with the two Celestial Bears, Great Bear and Little Bear, and a Serpent (Draco).[12] As we have stated, the episode in which Harzkume acquires his great club is one of the most elaborated chapters of the Bear Son saga. Indeed, in the pan-European versions of the tale the hero himself is often referred to as «The Strong Man,» e.g., «*Der Starke Hans*,» or as «The Man with an Iron Club.» We should note that alongside King Arthur, whose name derives from the Celtic word *arth* meaning "bear," we encounter the folkloric figure of *L'Homme au Bâton de Fer.* The latter is considered a major legendary hero in Brittany, a region of Western Europe filled with remarkable megalithic sites, the most notable being located at Carnac (Cosquin 1887:1-27; Barbier 1991:142; Cadic 1919:249).

Finally, among the twelve labors attributed to Hercules there are several that would appear to have been lifted from the preexisting corpus of episodes linked to the Bear Son saga. In fact several of them occur in precisely the same order, although interspersed with extraneous episodes, or at least episodes not detected with clarity in the extant versions of the Harzkume saga. As we have seen, drawing on Greek mythology Hyginus and Bayer have portrayed Hercules holding the trophies of his celestial combats, a Lion skin and a Three-Headed Serpent Hound, Cerberus, who guards the entrance to the Underworld. From the vantage point provided by the Bear Son narrative, it would appear that the Greek tale has fused two characters together. The first is the Three-Headed Serpent, called Herensuge in Basque, and the second, the figure of the Black Wolf. In the Bear Son saga the female Black Wolf, sometimes portrayed as a Black Dog with a white star on its forehead, is killed by the Grey Mare, a centaur-like creature who also reappears in European performance pieces (Frank 1996b, 1998, 1999). This encounter seems to have a celestial counterpart in the scene portrayed by the non-zodiacal duo of Centaurus and Lupus. For the story-tellers the latter two star figures would have had a mnemonic function.

We should recall, too, that Greek iconography and myth show a hero encountering therioanthropic Centaurs. Similarly, the Greek materials represent Hercules slaying a many headed serpent, the Lernean Hydra, which has its narrative counterpart in the aforementioned Bear Son's Serpent Snake shaman opponent. These parallel adventures suggest that structurally the episodes in question may be cognate and not merely analogous.

In conclusion, given that the original cognitive template upon which Hercules adventures were conceptualized and projected skywards could not have been zodiacal, it becomes even more likely that certain episodes found in the Greek sky myths should be considered relatively recent ideological overlays, adaptations based on a much earlier pre-Hellenic astral narrative. The same holds true in the case of several motifs found in the astral tales told by the Greeks about the Eagle (Aquila) and Prometheus (Frank 1996c).[13] Also, we should bear in mind that, ideologically speaking, a celestial narrative with its primary focus on the path of the sun sometimes has as its corollary in the worship of a supreme authority figure, often conceptualized as a solar deity. Both elements form part of a cognitive paradigm associated with the rise of complex and hierarchically-structured city states. In contrast, the Bear Son cosmology itself hearkens back to shamanic practices and relationships characterizing the less complex and more egalitarian structures of tribal societies. In short, the stories associated with the non-zodiacal constellation of Hercules should be scrutinized more closely in order to discover further traces of the activities of these European proto-astronomers. In this simulation of events, it would have been these shamanic bards who, by manipulating the Bear Son story figures ritually, i.e, in story, mime and dance, projected the archetypal scenes skywards and in this interactive process managed to kept the celestial actors in plain view, fixed in their correct positions on the sky stage.

NOTES

1 This project has been supported by the Institute of Basque Studies, 53 Salisbury Mansions, St. Ann's Road, London N15 3TP, UK, a non-profit research trust dedicated to the promotion and dissemination of investigations related to Euskal Herria, the Basque Country, its people, language and culture.

2 While Heracles was the name given by the Greeks to this mythological hero, the Romans referred to him as Hercules. For simplicity's sake, the latter term will be used in the context of this study given that it is also the commonplace name of the constellation figure in question.

3 The present article represents the eighth in the series called "Hunting the European Sky Bears, " each examining a different aspect of the data.

4 In the story the number of heads varies greatly. While the assignment of three is quite common, so is seven and even twelve.

5 Cf. Frank and Arregi (1998) for a full discussion of the model employed.

6 Naturally when discussing the origins and narrative role of the three serpentine constellations in antiquity, we must remember that in addition to the major part played by the Serpent Shaman in the Bear Son saga, there is documentary evidence of similar, although not necessarily related, serpentine traditions in the Babylonian materials. At this stage the safest conclusion would be to state that the narrative genesis of the three snakes, Draco, Serpens and Hydra, is still quite unclear. In the case of the European materials, we may be looking at a cognitive fusion of two preexisting, yet separate, astral traditions (cf. Belmonte 1999: 99-101, 206-207; Rogers 1998b).

7 As Krupp (1991:139) has observed, quite astutely: «If the constellations of the zodiac were originally linked as symbols of a single celestial narrative, we might expect the plot [characterized by the twelve labors attributed to Hercules] to mimic the yearly adventures of the sun, perhaps with each zodiac figure representing a different episode. After reviewing what the Greeks had to say about the constellations of the zodiac, however, we have to abandon that notion. What at first seemed to be a complete and unified set of symbols —twelve figures that encircle the sky, mirror the months, contain the year, and direct the movement of the sun, moon, and planets— is actually an unmistokably unmatched set of stories.» Furthermore, at best only three of Hercules' twelve labors might be connected directly to zodiacal figures. His first labor, the slaying of the Nemean Lion, could be linked to Leo, while his seventh labor, that of returning with the Cretan bull could be associated with Taurus, even though sequentially the combat falls in the sign of Aquarius. The ninth labor involves acquiring the girdle of Hippolyta, the queen of the Amazons, and, as Krupp has suggested, perhaps this labor could be assigned to Virgo, but sequentially the exploit falls to Aries. Besides these three possible matches, nothing else fits. None of the other labors appears to bear any clear relationship to zodiacal figures. In short, attempts to link each labor with a zodiac constellation are extremely unconvincing (Krupp 1991:139). An additional point, rarely mentioned, is the fact that the narrative itself speaks of many different episodes and adventures. At some stage these multifaceted encounters appear to have been divided, clumped together rather arbitrarily, into twelve segments or chapters. It is far less clear

whether that reorganization was imposed on the narrative structure because of a conscious desire to give it a zodiacal reading. In fact the numerical organization of his punishment into precisely twelve parts may not respond to efforts to superimpose on the plot the twelve divisions of the zodiac, but rather to a ritual predilection on the part of the story-tellers and dramatists for deodecimality. For example, the Greek legends speak of the fact that the hero had to carry out the tasks assigned over a period of twelve years in order to expiate his crime (Martín 1996:214).

8 It is not surprising that when discussing the Bear Son's strength, scholars frequently describe him as a being endowed with Herculean force (Fabre 1989:53).

9 He is clearly both human and divine where the latter concept, constituted by his bearness, i.e., his animal nature, reflects and emphasizes a very different notion of "divinity" and union with the cosmos, one with which we are no longer familiar. Cf. Cajete (1994: 39-73) for a more consonant indigenous interpretation.

10 The compound expression *herensuge* is subject to several interpretations. While the second element in the compound is clearly *suge* "snake, serpent," the first element's referential field of meaning is somewhat more obscure since the word *heren* can be translated simply as "third," as the third object in a series, or, more temporally conceptualized, as three-times removed from the present, as occurs in the common expression *herenegun* meaning "three days ago," i.e., counting from today. The second interpretation of *heren* leads directly to the notion of a serpent ancestor: "a snake three-times removed." In Euskera, this is analogous to compounds such as *heren-ama* which refers to one's «great-grandmother,» that is, «a mother thrice removed" Thus, from a strictly literal reading of the term, in Euskera a *herensuge* can be considered «a snake to the third degree» (cf. Mugica Berrondo 1973: 116). This reading of the name of the Herensuge is more in accord with the other story of the mythical origins of the Basque people mentioned above: that they are the off-spring of the male snake called Sugaar and Andra Mari.

11 A related example of the folkloric appropriation of preexisting narrative fragments and their casting into new settings is that of the set of exploits told about King Mátyás (Matthias Corvinus 1440-1490), a highly respected ruler who, in fact, led the Hungarian resistance against the invading Ottaman Turks. As is well documented, "[c]ertain historic personages notoriously attract whole cycles of tales around their figure (Ortutay 1962: 539)." Cf. also Dégh 1965: 322-333.

12 In terms of story-telling techniques we might speculate on the following possibility: that by superimposing the figure of a strong bear-like man with a club on stars located near those of Little Bear, the scene in question could have served as visual support for the story tellers as they retold the cosmic tale of initiation year after year. Locating the burly fellow next to Little Bear would have allowed the teller of the tale to move the action along spatially through the star patterns. The lesson in observational astronomy would have been tied to an explanation of how Little Bear Harzkume grew up, became very strong, and, eventually acquired his huge club. Pointing to the stars known to us today as Hercules, the shaman story teller might have said: «There, do you see it? There's the club just over there.»

13 Additionally, we should keep in mind that the labors Hercules performs are done as penance for a crime, that of having killed his own children. Whereas the theme of crime and punishment is totally absent in the case of the Bear Son saga, the motif is a reoccurring one in Greek mythology. In such tales the hero must undergo trials to rid himself of his guilt, a theme that is repeated in the case of Prometheus.

REFERENCES

J. M. BARANDIARAN, 1983. *Mitología vasca*. Donostia: Txertoa.

J. BARBIER [1931] 1991. *Legendes basques*. Donostia: Elkar.

D. BASSI, 1989. *Mitologia Babilonese-Assira*. Milan.

J. A. BELMONTE, 1999. *Las leyes del cielo: Astronomía y civilizaciones antiguas*. Madrid: Temas de Hoy.

J. BERNARD, and J. RUFFIÉ, 1976. Hématologie et Culture: Le Peuplement de l'Europe de l'Oueste. *Annales, Economies, Societés et Civilisations* 31.4:661-676.

F. CADIC, 1919. *Contes et Legendes de Bretagne*. 2e Serie. Paris.

G. CAJETE, 1994. *Look to the Mountain: An Ecology of Indigenous Education*. Kivikí Press

E. COSQUIN, 1887. Jean L'Ours. In *Les Contes populaires de Lorraine*. Paris: F. Vieweg, Libraire-Editeur, pp. 1-27.

L. DÉGH, 1969. *Folktales of Hungary*. Chicago: University of Chicago Press.

D. FABRE, 1968. *Jean l'Ours: Analyse formelle et thématique d'un Conte populaire*. Carcassone: Editions de la Revue 'Folklore.'

C. FARRER, 1992. *Living Life's Circle: Mescalero Apache Cosmovision*. University of New Mexico Press.

C. FLAMMARION, 1882. *Les Etoiles et les Curiosités du Ciel*. Paris.

R. M. FRANK, 1996a. Hunting the European Sky Bears: When Bears Ruled the Earth and Guarded the Gate of Heaven. Vesselina Koleva and Dimitir Kolev (eds.). *Astronomical Traditions in Past Cultures*, Sofia: Institute of Astronomy, Bulgarian Academy of Sciences, National Astronomical Observatory Rozhen, pp. 116-142.

.... 1996b. Hunting the European Sky Bears: A Pan-European Vision Quest to the End of the Earth. John Fountain and Raymond E. White (eds.), *Proceedings of the Oxford 5 Conference on Archaeoastronomy: Cultural Aspects of Astronomy: An Intersection of Disciplines*, Santa Fe, NM, August 3-9, 1996. Carolina Academic Press (in press).

...........1996c. Hunting the European Sky Bears: The Grateful Eagle, Little Bear, Amirami and Prometheus. Carlos Jaschek and F. Atrio Barandela (eds.), *Actas del IV Congreso de la SEAC «Astronomia en la Cultura»/Proceedings of the IV SEAC Meeting «Astronomy and Culture.»* Salamanca, Spain: University of Salamanca, pp. 55-68.

.........1998. Hunting the European Sky Bears: Candlemas Bear Day and World Renewal Ceremonies. Sixth International Conference of the European Society for Astronomy in Culture (SEAC): Astronomy and Culture. Trinity College, Dublin, Ireland, August 31-September 6, 1998 (in press).

.... 1999. Hunting the European Sky Bears: A Diachronic Analysis of Santa Claus and his Helpers. The International Conference on the Inspiration of Astronomical Phenomena in Culture, Republic of Malta, January 6-14 (in press).

R. M. FRANK, and Jesus Arregi Bengoa. 1998. Hunting the European Sky Bears: On the Origins of the Non-Zodiacal Constellations. Sixth International Conference of the European Society for Astronomy in Culture (SEAC): Astronomy and Culture. Trinity College, Dublin, Ireland, August 31-September 6, 1998 (in press).

O. GINGERICH, 1984. Astronomical Scrapbook. The Origin of the Zodiac. *Sky and Telescope* 67 (March): 218-220.

E. C. KRUPP, 1991. *Beyond the Blue Horizon: Myths & Legends of the Sun, Moon, Stars and Planets*. New York: HarperCollins Publishers.

.... 1995. Pumping Sky. *Sky & Telescope* (July): 60-61.

R. MARTÍN, ed. 1996. *Diccionario de la mitología griega y romana*. Madrid: Espasa-Calpe.

E. W. MAUNDER, [1908] 1922. *The Astronomy of the Bible*, 4th ed.. London: The Epworth Press.

P. MUJICA BERRONDO, 1973. *Diccionario castellano-vasco*. Bilbao: Mensajero.

G. ORTUGAY, ed. 1962. *Hungarian Folk Tales*. Budapest: Corvina.

L. POLIAKOV, 1974. *The Aryan Myth: A History of Racist and Nationalist Ideas in Europe*. New York: Basic Books, Inc., Publishers.

A. ROBERTS, 1987-8. The Serious Business of Dogon Cosmology. *Archaeoastronomy: Journal of the Center for Archaeoastronomy* Vol. X: 148-153.

J. H. ROGERS, 1998a. Origins of the Ancient Constellations: The Mesopotamian Traditions. *Journal of the British Astronomical Association* 108.1: 9-28.

.... 1998b. Origins of the Ancient Constellations: II. The Mediterranean Traditions. *Journal of the British Astronomical Association* 108.2: 79-98.

S. SALVI, S. 1973. *Le nazioni proibite*. Firenze: Vallecchi Editore.

G. M. SESTI, 1991. *The Glorious Constellations: History and Mythology*. New York: Harry N. Abrams, Inc. Publishers.

R. A. WILLIAMSON, and C. F. FARRER, eds. 1992. *Earth & Sky: Visions of the Cosmos in Native American Folklore*. Albuquerque: University of New Mexico Press.

NEW ARGUMENTS FOR THE MINOAN ORIGIN OF THE STELLAR POSITIONS IN ARATOS' *PHAINOMENA*

Göran Henriksson
Astronomical Observatory, Uppsala University,
Box 515, S-751 20 Uppsala, Sweden
Mary Blomberg
Department of Archaeology and Ancient History,
Uppsala University, St. Eriks torg 5, S-753 10 Uppsala, Sweden.

About 350[1], the Greek astronomer Eudoxos wrote a detailed description of the positions of the stars and constellations relative to the great circles and to each other when close to the horizon. Some 75 years later the poet Aratos set Eudoxos' text to verse. The two works have the same title, *Phainomena*, which means simply the appearances[2]. The *Phainomena* of Aratos has survived, but from Eudoxos we have only the quotations in Hipparchos' commentary and a few other fragments[3]. A puzzling feature of both works is that many of the positions given for the stars are incorrect for the time when the *Phainomena* were written, a fact which has given rise to a number of explanatory theories[4]. Perhaps the best known is that of the Scottish astronomer Michael Ovenden who proposed that the information was correct for Crete in the early bronze age, ca 2500[5]. These theories have not gained general acceptance, primarily because the errors in the two *Phainomena* are not systematic. Some positions are correct, some are only a little off, while others are wide of the mark.

We have found evidence for Minoan systematic astronomical observations and have published our arguments that they navigated according to the stars and had a lunisolar calendar of the same type as the Mycenaeans and later Greeks[6]. On the basis of this evidence it is a reasonable hypothesis that the astronomical data contained in Eudoxos and Aratos stems from a tradition which originated with the Minoans in the Bronze Age. To explain the apparent errors in the *Phainomena* we made the following hypotheses: the two books derive from a didactic tradition created by the Minoans for teaching the positions of the stars. One reason for it was, as Ovenden proposed, stellar navigation. When the Mycenaeans achieved hegemony in Crete around 1450[7], they updated the method, replacing some stars which because of precession had moved away from their circles with others which had moved closer. The Greeks, in their turn, made another revision for the same reason.

To test the hypotheses we calculated the positions through time of the individual stars which according to Aratos and Eudoxos defined the Tropics of Cancer and Capricorn and the Celestial Equator. By this approach there is no need to know the observers' latitude. We do not consider it necessary to assume that the Minoans had developed a system of celestial spheres of the type created by the Greeks, which was the basis for Dicks' criticism of Ovenden's theory[8]. The Minoans could have selected, for example, stars which rose or set close to the six horizon points where the sun rose and set at the solstices and equinoxes. We have found these positions marked by the orientations of several Minoan structures that date to the middle Bronze Age[9].

Aratos and Eudoxos defined the Tropics of Cancer and Capricorn and the Celestial Equator by referring to parts of constellations, as in the quotations below:

"On it are carried both heads of the Twins"[10]

"of the Maiden a small part is above".[11]

Using the information from the *Phainomena*, the catalogue of *Ptolemy's Almagest*[12] and a modern stellar atlas, we tried to identify the individual stars which were meant. We could do this with varying degrees of certainty. The "heads of the Twins", for example, are certainly α and β Gemini. It is impossible, however, to be sure which stars Eudoxos meant for the Maiden (Virgo). We ended up with a total of 111 stars (Table 1), which is a conservative number as we tried to select as far as possible those which we could be reasonably confident were meant by the two authors. They are marked in the table with an asterisk.

Next we calculated the distance in degrees of each star from its circle at intervals of 250 years, from 3250 to the year zero, and constructed tables like Table 1 for distance spreads of from ± 1° to ± 5°. The astronomical calculations were performed with our own computer program, based on stringent formulas for precession, the obliquity of the ecliptic, and including the proper motion of the individual stars. We found ± 2½° to be the best interval and also a good working value as it is approximately equal to the width of a man's thumb. Table 1 shows when a star is within this interval and for how long. For example, α Lep came within 2½° of the Tropic of Capricorn between the years 1750 and 1500 and remained there until sometime after 250 but before the year zero. Although a few stars were within ± 2½° for many centuries (o Pup), others are there in the early years and then become more distant (η Cap). Still others are within the interval only later (ζ Peg). Some of the stars which first come within the interval at later dates are those which according to our hypothesis have been added by the Mycenaeans or the Greeks.

TABLE 1. *Stars within ±2½° of the Tropic of Cancer, Capricorn or the Celestial Equator at 250-year intervals from 3250 BCE to the year 0.*

Cancer	3250	3000	2750	2500	2250	2000	1750	1500	1250	1000	750	500	250	0
α Gem*	X	X	X											
β Gem*	X	X	X	X	X									
χ Aur								X	X	X	X			
θ Per*	X	X	X	X										
ξ Per*									X	X	X	X		
ι And*				X	X	X	X	X						
κ And*		X	X	X	X	X	X							
λ And*	X	X	X	X										
χ And					X	X	X	X						
ρ And*										X	X	X	X	X
π Peg*											X	X	X	X
κ Peg*														
ϕ Cyg*														
η Cyg*														
ε Cyg*	X	X	X	X	X	X	X	X	X	X				
β Oph*														
γ Oph*														
ι Oph*				X	X	X	X							
κ Oph*			X	X	X	X								
α Oph*				X	X	X	X							
ω Her									X	X	X	X		
β Ser*												X	X	X
δ Ser'								X	X	X	X			
λ Ser*						X	X	X						
α Ser*					X	X	X	X						
ε Ser*			X	X	X	X								
η Leo*													X	X
α Leo*	X	X	X	X	X	X	X	X	X	X	X	X		
31 Leo*	X	X	X	X	X	X	X	X	X					

ν Leo*	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ρ Leo*	X	X	X	X	X	X	X	X	X	X				
53 Leo*					X	X	X	X	X	X	X	X		
ι Leo*									X	X	X	X	X	
η Cnc*			X	X	X	X	X	X	X	X	X	X	X	X
θ Cnc*						X	X	X	X	X	X	X	X	X
γ Cnc*	X	X	X	X	X	X	X							
δ Cnc*			X	X	X	X	X	X	X	X	X	X	X	X
C. Equator	3250	3000	2750	2500	2250	2000	1750	1500	1250	1000	750	500	250	0
α Ari*			X	X	X	X								
β Ari*					X	X	X	X						
η Ari*					X	X	X							
θ Ari*						X	X	X						
ν Ari*				X	X	X								
ε Ari*				X	X	X	X							
μ Tau*													X	X
90 Tau*							X	X	X	X	X	X		
δ Ori*														
ε Ori*														
ζ Ori*														
ι Hya*														
β Crt*	X													
α Crt*	X	X	X	X	X	X	X							
γ Crt*				X	X	X	X	X	X					
δ Crt*							X	X	X	X	X	X		
α Crv*	X	X	X											
ε Crv*	X	X	X	X	X									
ζ Crv*		X	X	X	X	X								
β Crv*	X	X	X	X	X									
ι Lib'					X	X	X							
γ Lib*								X	X	X				
η Oph*			X	X	X	X								
ζ Oph*								X	X	X	X			
γ Aql														
ν Peg*														
θ Peg*														X
ζ Peg*										X	X	X	X	X
ξ Peg*								X	X	X	X	X	X	
γ Peg*									X	X	X	X		
τ Psc*														
ψ1 Psc*				X	X	X	X							
ψ2 Psc*					X	X	X	X						
χ Psc*					X	X	X	X						
υ Psc*	X	X	X											
ϕ Psc*	X	X	X	X	X									
ψ3 Psc*						X	X	X	X					
Capricorn	3250	3000	2750	2500	2250	2000	1750	1500	1250	1000	750	500	250	0
ϕ Cap*	X	X												
η Cap*	X	X	X	X	X	X								
ε Cap*														
κ Cap*														

δ Aqr*														X
68 Aqr*														
ι Cet*									X	X	X	X		
β Cet*														
$\tau 1$ Eri														
α Lep'								X	X	X	X	X	X	
β Lep*											X	X	X	X
β CMa			X	X	X	X	X	X						
$\xi 1$ CMa*									X	X	X	X	X	X
η CMa*														
ρ Pup*	X													
ξ Pup*	X	X	X	X	X	X	X	X					X	X
o Pup*	X	X	X	X	X	X	X	X	X	X	X	X	X	X
α Pyx*	X	X	X	X	X	X	X	X	X	X	X			
β Pyx*														
ν Cen							X	X	X	X				
ϕ Cen							X	X	X	X				
ζ Cen			X	X	X	X								
γ Cen	X	X	X	X										
τ Cen	X	X	X	X	X									
λ Sco*				X	X	X	X							
υ Sco*				X	X	X	X							
δ Sgr*							X	X	X	X	X			
ε Sgr*			X	X	X	X								
λ Sgr*													X	X
μ Sgr*														
ψ Sgr							X	X	X	X	X	X	X	X
τ Sgr					X	X	X	X	X	X				
ζ Sgr					X	X	X	X						
ω Sgr		X	X	X	X	X								
ε Lup				X	X	X	X							
λ Lup				X	X	X	X							
π Lup			X	X	X									
TOTAL:	25	26	35	43	50	48	44	37	32	31	27	23	19	18

We see that there are more than twice as many stars within 2½° of their respective great circles in the years around 2000, when the Minoan culture was reaching its height, than there are in the interval between 500 and 250, the time closest to when Eudoxos and Aratos were writing their *Phainomena*. This seems unlikely to be a random result. Still we decided to compare it with how the 1028 stars in the catalogue of *Ptolemy's Almagest* relate to the same circles for the same years (Table 2)[13]. We see that the percentage of stars in the catalogue which lie within ± 2½° of the circles is lower for both years and considerably lower for the year 2000. We interpret this to mean that a selection was made and more likely around the year 2000 than 500.

As to the second part of our hypothesis, that the system was modified as stars became more distant to their circles, we should keep in mind that such a system, based as it was on knowledge of the motions of the heavenly bodies, would almost certainly have had a religious dimension and this would have counteracted any modifications. If the choice of stars were made with

TABLE 2. *Porcentage of stars within ±2½° of the Tropics and Celestial Equator according to Ptolemy (n=1028) and Aratus and Euxodos (n=111) for the years 2000 and 500 BCE.*

	2000 BCE	500 BCE
PTOLEMY	16.5%	15.8%
ARATOS AND EUDOXOS	42.0%	20.5%

the rising or setting of the sun at the solstices and equinoxes as the guiding principle, then this suggests an original religious conception of a procession of figures, represented by the constellations, following the sun as it rose and set at the significant dates in the calendar. When the feasibility was recognised of using the figures to teach the positions of the stars for navigation, the parts which served this purpose best would have been selected. However the choice would not have been limited to the parts of the nearest constellations, but those of important nearby figures would have been included. Rules of thumb would have been devised so that such parts would have functioned in the system. This would explain the inclusion of Orion for example, which may have represented the sacred double axe (as described by α, γ, δ, ε, ζ, κ and β Ori).

Another factor which would have worked against any modification of the system is that the constellations, because they were regarded as divine and because of the imperceptibly slow rate of precession, were believed to be perfectly regular in their motions. In Aratos' words: "These you can see as the years pass returning in succession; for these figures of the passing night are all well fixed in the sky just as they are".[14] When the discrepancies due to precession became apparent, the likely explanation would have been that the observers of earlier times had been mistaken. However, because of the religious dimension to the system, we consider it unlikely that the Minoans would have altered it at all, but would instead have developed techniques to compensate for the changes due to precession.

Members of another culture with a different religion taking up the system would have been much freer to go in and make changes. If the take-over entailed translation to a different language, revision would have been more opportune. This calls to mind, of course, the Mycenaeans who most likely adapted the system for their uses just as they adapted the Minoan Linear A script for writing their language. Yet even in such a case, the choice of omissions and inclusions would probably not have been solely practical. A star would not have been removed from the list only because it moved to a distance greater than ± 2½° from its circle. In any case, a precise measurement such as *2½* would certainly not have been used by the Minoans, the Mycenaeans or the Greeks. This is a requirement imposed by the computer. These different factors explain why the number of stars within ± 2½° of their horizon points did not remain constant between the years 2000 and 250.

Our hypotheses make a lot of sense historically. If the system had been developed by the Minoans, the most likely time would have been early in the middle Bronze Age when their culture was developing rapidly in many areas. According to literary sources, they controlled the islands of the Aegean,[15] and we have much archaeological evidence from the same period for foreign trade between Crete, Mainland Greece, Egypt and the Near East.[16] We also know from the archaeological remains that the Mycenaeans gained hegemony in Crete and throughout the Aegean by the 14th century.[17] They would have needed the navigational skills of the Minoans and they had the opportunity to acquire them. However, by their time, some 600 years or more after the system had been developed by the Minoans, precession would have led them to replace of some stars which had become distant to their respective horizon points with others which had moved nearer. The Greeks, in their turn, would have repeated the process and for the same reasons.

We had a statistician at Uppsala University evaluating our data. He used the sign test and made the following assumptions[18]: 1) the stars were selected at a single point in time; 2) the selection can be approximated as an independent selection with replacement and 3) the year a star was closest to its circle could lie with equal probability in the future as in the past. The following stars were excluded as not helpful in determining when the initial selection was made: those never within 2½° (e.g., κ Peg) and those whose change in declination at approximately the year 500 was less than 2½° in a 1000 years (e.g., ρ And). The 17 less certainly identified stars were weighed as half and the stars which could be assumed to belong to the same selection were placed in one group (e.g., ι, κ, λ And). The number of such groups is 33. To weight the result negatively, the calculations were made using only the star in each group which appears latest (e.g., ι And). The year 600 was chosen for the null hypothesis, where the assumption that the initial selection was made after 600 could be rejected at the significance level of *0.05*. The result showed a systematic shift earlier in time from the year 350, and with 95% certainty either the initial selection of stars occurred before the year 600 or there must be another explanation for the shift. Due to the negative weighting of the data it is reasonable to assume a date considerably earlier than 600 for the original selection of the stars.

We also made statistical tests which included all of the 111 identified stars. The standard and average deviations of the distances from the three great circles and also the kurtosis and skewness were calculated for every 250 years within the time interval 4000 BCE-500 CE. The minima for the distributions of standard and average deviations gives the corresponding optimum year assuming that all stars were included in that year. The distribution of the standard deviation for each time interval is quite symmetrical and can be approximated by a parabola (Fig. 1). To get an estimation of the uncertainty in the determination of the year for the minimum standard deviation, three samples were chosen simply by taking every third star in the list of 111 stars. This gave three sets of 37 stars each and the fit to a parabola was made for each of the corresponding sets of standard deviations. The resultant years were 1642, 1608 and 1807, with mean value 1682 ± 62 years and standard deviation 106 years. If we compute the year for the minimum standard deviation for all the stars we get 1686 ± 62 years. The standard deviation is more sensitive to a few large errors than the average deviation. This can explain the different shapes of the curves for the minima in Figure 1. The year of smallest average deviation can be estimated to 1950, which means that not all the 111 identified stars were selected at the same time.

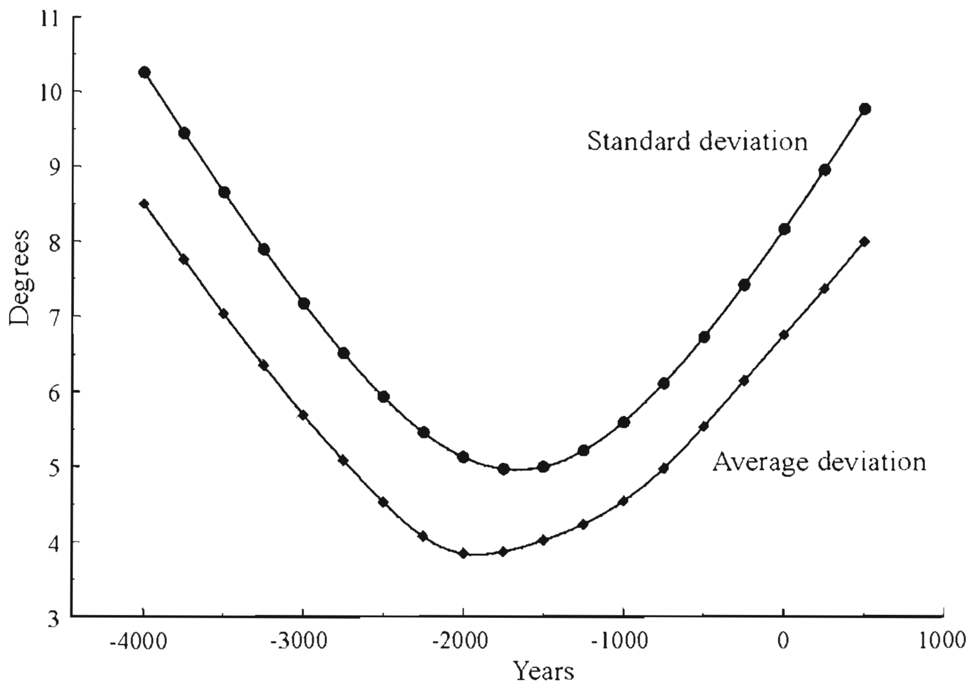


Figure 1. Standard and average deviations from the Tropics of Cancer and Capricorn and the Celestial Equator of the 111 stars identified as having been used by Aratos and Eudoxos to define those circles.

To estimate the year when the majority of the stars were chosen, we determined the variation in skewness and the so-called kurtosis, which gives a measure of the deviation of a distribution from a normal distribution (Fig. 2). These are important quantities in the theory of the Gram-Charlier Series.[19] The kurtosis is a measure of the peakedness or flatness of a distribution. Where it is positive there are more small errors in the observed distribution than in a normal distribution; where it is negative there are more large errors than in a normal distribution. In Figure 2 we can see a single positive peak at 2250. If we fit a parabola to estimate the optimum years we get 2282, 2430 and 2190 for the three sets of stars and the mean value 2300 ± 70 years with standard deviation 121 years. If we fit a parabola to the values of the kurtosis nearest to the peak for all 111 stars we get 2273 ± 70 years as the optimum year for the initial selection of stars. The distribution of the skewness has its lowest negative value around 2250 and its highest positive value around 300. This can be interpreted to indicate that stars were added or deleted several times during this interval of time.

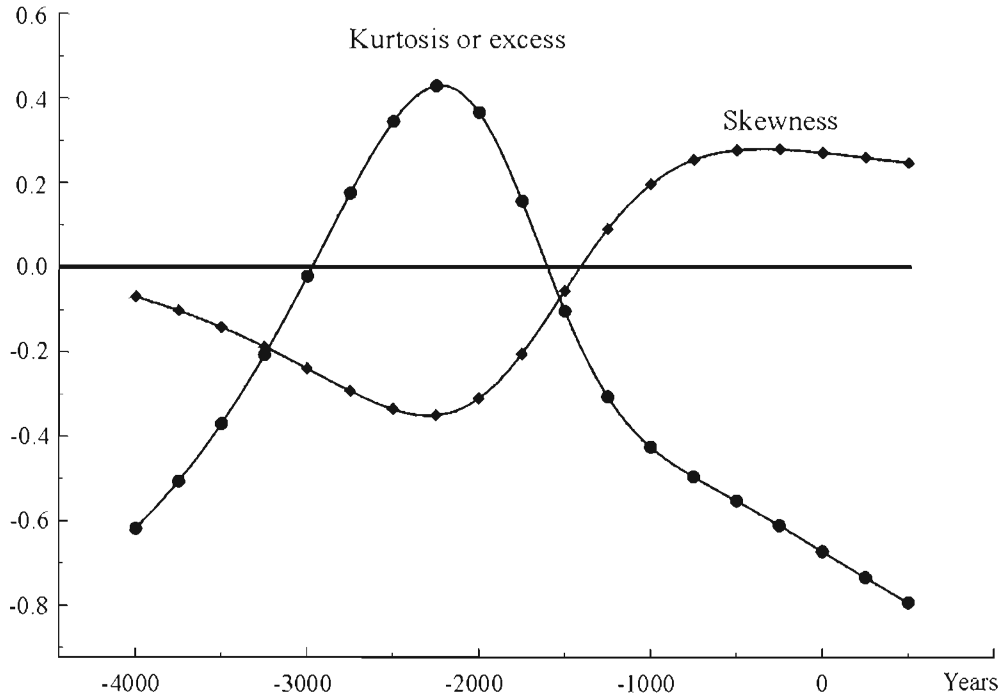


Figure 2. Corresponding kurtosis and skewness for the same data.

The origin on Crete of the system for learning the positions of the stars implies that the forms of the constellations and their distribution in the sky were largely Minoan creations, and what we know of the Greek constellations supports this. There are many indications that we are dealing with a very conservative tradition. Of the 48 constellations in Ptolemy's catalogue, all but two—Equuleus and Corona Australis—were used by Aratos and also by Eudoxos. For all but five the name was the same or was a Latin equivalent. Aratos used other names for Hercules, Cygnus, Pegasus, Libra, and Lupus. The origins of many of the names were so ancient that the Greeks knew little about them. The name of one—Corona Borealis or the Crown of Ariadne—came from Cretan mythology and there were Cretan-derived alternatives for the Bears—Helice and Cynosura, the nurses of Zeus. We still use all 48 of Ptolemy's constellations.

When the Mycenaeans took over Minoan astronomy, along with the calendar and stellar navigation, they probably changed some of the names of the constellations to those from their own mythology, and introduced new stars into the didactic system devised by the Minoans with others that were more timely. The Greeks in all probability made their additions and changes.

NOTES AND REFERENCES

1. All dates are BCE unless otherwise given.

2. We use the original spelling for Greek authors and titles except when citing works by modern authors.

3. Aratus: *Phaenomena*, ed. & trans. by D. Kidd (Cambridge 1997); *Hipparchi in Arati et Eudoxi Phainomena commentariorum libri tres*, ed. & trans. by C. Manitius (Leipzig 1894); *Die Fragmente des Eudoxus von Knidos*, ed. and trans. by C. Manitius (Leipzig 1894); *Die Fragmente des Eudoxus von Knidos*, ed. and trans. by F. Lasserre (Berlin 1966).

4. D. R. DICKS, *Early Greek astronomy to Aristotle*, (London 1970), 160-3.

5. M. W. OVENDEN, "Origin of the constellations", *Journal of the Brithish Astronomical Association* 71 (1960-61), 91-6; "The Origin constellations", *Philosophical Journal* 3 (1966), 1-18.

6. M. BLOMBERG and G. HENRIKSSON, "*Minos Enneros*. Archaeoastronomical light on the priestly role of the king in Crete", in *Religion and Power in the ancient Greek world. Proceedings of the Uppsala symposium* 1993 ed. by Hellström and B. Alroth (Uppsala 1996), 27-39; ibid, "Evidence for the Minoan origins of stellar navigation in the Aegean" in SEAC 97: *Proceedings of the fifth international conference of the European Society of Astronomy in Culture* (Gdansk 1999), 61-76; G. HENRIKSSON and M. BLOMBERG, "Evidence for Minoan astronomical observation from the peak sanctuaries on Petsophas and Traostalos", *Opuscula Atheniensia* 21 (1996), 99-114; ibid., "Petsophas and the summer solstice", *Opuscula Atheniensia* 22 (in press); ibid., "Elements of Greek astronomy and religion in Minoan Crete", in *Proceeding of the fifth "Oxford" international conference on archaeoastronomy, Santa Fe September 1996* (in press).

7. J. DRIESSEN and C. MacDONALD, *The Troubled Island. Minoan Crete before and after the Santorini eruption* (Liege 1997).

8. *op. cit.* (note 3), 161.

9. HENRIKSSON and BLOMBERG, *op cit.* (note 5).

10. *Aratus* (note 2), line 481.

11. *Hipparchi in Arati et Eudoxi Phainomena commentariorum libri tres* (note 2), 1.2.18.

12. *Ptolemy's Almagest*, trans. and annotated by G. J. Toomer (London 1984)

13. *Ibid.* 341-399.

14. *Aratus*: Phaenomena (note 2), lines 451-3.

15. *Thucydides: History of the Peloponnesian War*, ed. and trans. by C. F. Smith (London 1928), 1.4.

16. *Bronze Age trade in the Mediterranean*, ed. by N. H. Gale (Jonsered 1991), passim.

17. Driessen and Macdonald, op. cit. (note 6).

18. R. J. LARSEN and M. L. MARX, *An introduction to mathematicak statistics and its applications* 2nd ed. (Englewood cliffs 1986). We would like to thank Stefan Israelsson for his help with this statistical evaluation.

19. R. J. TRUMPLER and H. F. WEAWER, *Statistical Astronomy* (New York 1953), 74-8.

AN ASTRONOMICAL INTERPRETATION OF FINDS FROM MINOAN CRETE

Peter E. Blomberg
Stockholm, Sweden

BACKGROUND

Arguments are presented that the figurines found on the Minoan peak sanctuaries on Petsophas and Traostalos, eastern Crete, are symbols for celestial bodies and are further evidence that those two hilltops were places for the observation and study of the heavenly objects. The orientations of the two sites and the proposal that they were used for observing celestial events, for keeping a calendar and for learning stellar navigation have been presented earlier.[1] The finds have not been discussed in the literature from an astronomical point of view.

Petsophas (H. 255 m) was first excavated early this century[2] and Traostalos (H. 515 m) in the 1970s[3]. The identification of both sites as Minoan Peak sanctuaries and the dating of them to the periods MM I - LM I (ca 2000-1600 BC) is generally accepted. That is the time when the Minoan culture was at its height. There is no evidence for any activities at the two sites during LM II-III, which means during the period of the Mycenaean hegemony. On both hilltops many small terracotta figurines were found. More than 2000 have been recorded: mainly animals, small human figurines and human anatomical parts. There was also a small structure at each site.

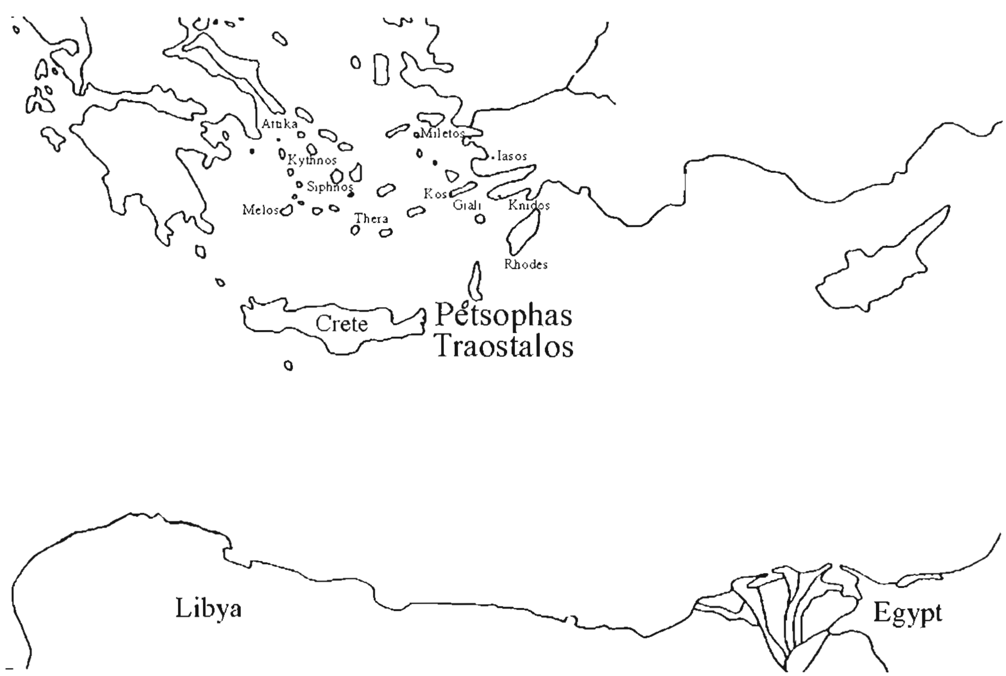


Figure 1. Map of Eastern Mediterranean with Petshopas and Traostalos

Both of these places have free view of the horizon from the Northwest over the East to about Southeast and both lie close to the Mediterranean shore (*Fig. 1*). There is clear evidence in the archaeological record that the Minoans in this area had contact with other peoples to the East and Southeast, e.g. the Egyptians.

The British archaeologist J. L. Myres was the first to publish the finds from Petsophas.[4] Very few finds from Traostalos are published but they are of the same types as those from Petsophas.

THE PREVAILING INTERPRETATIONS

The human anatomical parts have been interpreted as votive offerings in a healing cult and the animals as offerings in an agricultural fertility cult. The human figurines have been considered to represent either Minoan divinities or the persons who used the sanctuaries for religious reasons. Two or more cults are thus thought to have existed on these two hilltops: one healing cult for humans, one farmers' cult of fertility and, most likely, some other cult involving the human figurines. Many articles with minor variations of these views have been published and very few later scholars have questioned them.[5]

In order to see if the finds from Petsophas and Traostalos conform to those from the later healing cults, tables were made comparing the finds with those from four sanctuaries with known healing cults, three dedicated to Asclepios and one modern church to the Holy Spirit. The finds are from Athens[6], Corinth and Lerna[7], Tessennano[8], and the modern church to the Holy Spirit on the site of the Minoan peak sanctuary on Vrysinas[9], See *Table 1* for the items where the differences are significant.

We can see that there are major differences between the finds from these Minoan sites and those from the sanctuaries with healing cult. Some simple items, such as arms and legs, may hint at a healing cult, but some of the most common items in healing cults, such as eyes, ears and all parts involved in human reproduction, are lacking from the Minoan hilltops. The great scholar of Greek religion Martin P. Nilsson stressed this difference[10]. There are also several peculiar bodily parts found on the peaks but not found in the later healing cults, e.g. female lower half, male lower half, male upper half, male right half.

TABLE 1. *Items found on Petsophas and Traostalos compared with finds from later healing cults. Only those parts are included where there are significant differences.*

	PETSOPHAS AND TRAOSTALOS	HEALING CULTS
Arm	253	14
Body, female, lower part	5	0
Body, male, lower half	1	0
Body, male, upper part	1	0
Body, male, right half	6	0
Face	2	12
Feet	6	99
Hand	27	55
Head, sex unknown	57	1

	PETSOPHAS AND TRAOSTALOS	HEALING CULTS
Head with flying hair	3	0
Head, male	11	110
Limbs, parts of statuettes	728	10
Full human body on base	8	0
Sitting human	1	2
Statuette, female	120	26
Statuette, male	128	15
Statuette, unknown sex	17	77
Torso, female	17	0
Torsos, male	39	1
Torso, no head, no arms	9	0
Body part, half, unknown sex	0	1
Body part, unknown sex	0	37
Breasts, female	0	43
Ear	0	44
Eyes	0	146
Face, half	0	2
Fingers	0	5
Genitalia, female	0	6
Genitalia, male	0	185
Head, boy	0	18
Head, grotesque	0	1
Heads, half, male	0	9
Head, upper part	0	1
Hips	0	2
Internal organs, excluding heart	0	51
Jaw,	0	2
Mouth, neck, nose, teeth	0	11

	PETSOPHAS AND TRAOSTALOS	HEALING CULTS
Part of a statue	0	32
Statuette, back of human	0	1
Statuette, child or "temple boy"	0	5
Statuette, female, banqueter	0	A number
Statuette, grotesque	0	1
Statuette, horse and rider	0	2
Stomach, abdomen	0	5
Thigh bone	0	1

We can conclude that the constitution of finds from Petsophas and Traostalos do not agree with that from the later healing cults. The spread of the figurines all over the plain around the buildings on the peaks, the simple structures, the lack of an altar and bones from animal offerings do not indicate that the two sites were sanctuaries to any farmers' cult. All of the cattle figurines are bulls; no cow has been identified. It is also clear that not all of the animal figurines represent animals that would have been of economic interest to farmers. Weasels and tortoises can not have had the same importance as sheep but are shown with the same amount of detail and in the same size. The sanctuaries for the healing cults were normally placed near springs. The location of Petsophas and Traostalos, however, are at sites, without any water nearby.
These facts place in question the prevailing interpretation for the finds.

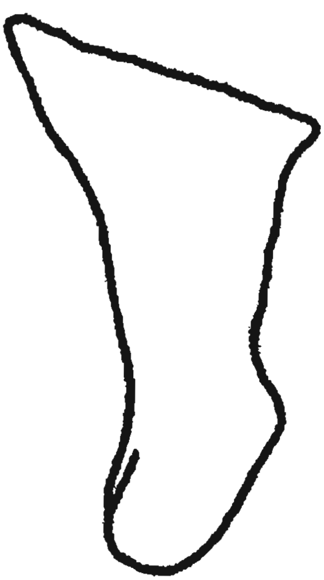


Figure 2. Bull's leg. Compare the Egyptian icon for the Big Dipper and items: AM AE 1006, BM 1907/10-19/25[22]

AN ASTRONOMICAL INTERPRETATION

Blomberg and Henriksson have shown that part of Aratos' description of the sky is based on old star positions, some of which were correct during the Middle Bronze Age,[11] indicating an old tradition for the study of the stars in Greece, a tradition that seems to derive from the period when our figurines were made. Aratos' description may thus be used as comparative literary material for an astronomical interpretation of the figurines from these sites. Especially important is the way the constellations and stars are described as moving through the night, following upon each other.

When studying these figurines we should remember that in classical Greek ζωΐδιον (diminutive of ζῷον), is used for a small figurine, a painted or carved statuette, *as well as* for a sign of the Zodiac[12]. The word is also used for animals, as in the signs of the Zodiac. This can indicate that small statuettes were used to picture the constellations and the word became the same for both the statuettes and for the constellations they depict, as the statuettes were regarded as constellations.

Some correspondences amongst the figurines, known iconographical symbols, and astronomical texts:

To the Southeast of Crete we have Egypt with calendars based on the positions of the heavenly bodies. Especially relevant are those that described how the time passed during the night, the so-called diagonal calendars[13]. Here there is a parallel in their symbol for the Big Dipper, a bull's leg. Such separately made bull's legs – it is clear that they were made separately - are amongst the figurines found on the two hills (*Fig. 2*)[14].

When the constellations were formed it seems that few individual stars had their own names. They were identified instead by their position in the constellation, for example the heads of the Twins, the knees of the steadfast Charioteer etc.[15] Some of the brightest stars, however, may also have had their own names, for example Arcturus in Boötes[16]

Amongst the terracotta figurines from the peaks there are a number, which seem to be counterparts to the constellations. Compare especially:

FIGURINE	CONSTELLATION	ANCIENT REFERENCE	FIGURE
Female sitting	Cassiopeia	Aratos l. 189. Compare item HM 3426[17]	
Animal, hind part in loop,	Cetus	Aratos[18]	3
Goat - Agrimi	Capricornus	Aratos l. 285	4
	Capricornus' horn[19]	Hipparchos 3.2.6,3.3.7[20]	
Bird with folded wings	Aquila	Aratos l. 315	5
Bird with outspread wings	Cygnus	Aratos l. 487	6

When Aratos described the movements of the stars during the night he used a part of a constellation to identify an individual star or a small group of stars, parts we can recognise amongst the finds:

ARATOS TEXT	FIGURINE TYPE	ARATOS	FIGURE
"The Phantom sinks all save knee and left foot"	A foot up to the knee	590-595	7
Arctophylas sinks wholly "save his never setting left hand"	A hand and forearm	721 f	8
"so the weary hands and knees and shoulders of Andromeda are parted"	Half human body	704 ff	9

In some cases we have constellations that earlier had different names and thus can be identified:

EARLY NAME	MODERN NAME	COMPARE item no.	ANCIENT ref. and comments
Tortoise	Lyre	FM GR 173/1907	Aratos l. 268
Shoe (Καρκίνοζ)	Cancer's claw	HM 3461	Aratos l. 147, means also claw.
Beetle (Καράβοζ)	Cancer	HM 3468	

Figure 3. *Creature, hind part in loop*, Cetus, Compare the map in the Loeb Aratos edition pages 444-447 and item: AM AE 1846.

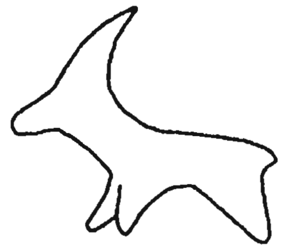


Figure 4. *Goat - Agrimi* - Capricorn.
Aratos I. 285.
Compare: BM 1907/1-19/34. FM GR 172/1907.

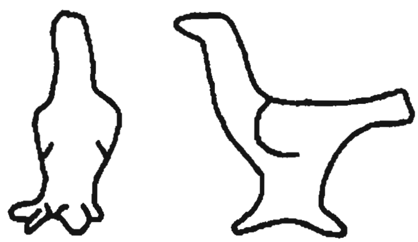


Figure 5. *Bird with folded wings* – Aquila.
Aratos l. 315.
Compare: BM 1907/1-19/59, and 19/36.

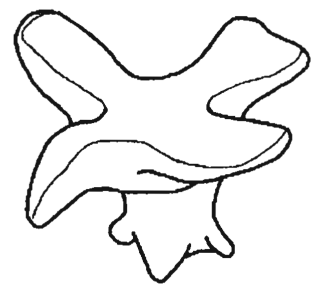


Figure 6. *Bird with outspread wings* - Cygnos.
Aratos l. 487.
Compare: HM 3463, AM AE 996.

Figure 9. *Right half of human body.*
Aratos 704 ff.
Compare: HM 3443, HM 3444.

Figure 7. *Lower leg with foot.*
Aratos 590-595.
Compare: HM 3458, HM 3459.

Figure 8. *An arm.* Aratos 721-724.
Compare: HM 3447, HM 3448.

Figure 10. *Head with long hair.* - A comet.
Κομήτης means *Head with long hair.*
Compare: HM 4855, HM 4856.

Cancer was figured like a tortoise in Egypt around 4000. In the Egyptian records of about 2000 BC it was described as a scarabaeus, "This was the Greek καράβοζ, with its nest-ball of earth in its claws" i.e. the horned beetle.[21]

It may well be that Minoan contact with Egypt had some influence on how they saw the sky, as they seem to have had a constellation Sheep and a Bull's leg. However, we do not know which group of stars they called the Sheep. The Minoan figurines which have been identified as sheep could also have represented the constellation Aries, even if both male and female sheep are found.

There are indications that other celestial phenomena were shown as well, for example comets. The Greek word Κομήτηζ means *Head with long hair*. It is proposed that the figurines showing a head with long hair represent a comet (*Fig. 10*).

We find, in fact, that almost all figurines can have the same ideological explanation. More than 90 % of the finds can be seen as representing constellations, parts of constellations or other heavenly objects as they are described or known from texts or figures.

It has thus been shown that one explanation can account for figurines from the peak sanctuaries. I may also add that none of the figurines contradict this explanation.

SUMMARY

It is argued that the Minoans on Eastern Crete from about 2000-1600 BC (MM I - LM I) used figurines to study and learn the motions of the heavenly bodies. The figurines are understood as symbols for constellations, parts thereof and other bodies in the sky, such as comets. Of the more than 2400 small figurines found on Petsophas and Traostalos over 90 % agree with such a use. In the study of the figurines, Aratos' text *Phainomena* was used as parts of his description of the constellations seem to be based on old traditions, the oldest being from the Middle Bronze Age. His information on how the constellations follow upon each other during the night is of special interest in understanding some of the figurines, i.e. the anatomical parts.

NOTES AND REFERENCES

1. G. HENRIKSSON & M. BLOMBERG "Evidence for Minoan astronomical observations from the peak sanctuaries on Petsophas and Traostalos", *Opuscula Atheniensia*, 21, (1996), 99-114. M. BLOMBERG & G. HENRIKSSON, "Evidence for the Minoan origins of stellar navigation in the Aegean"in *SEAC 97: Proceedings of the fifth international conference of the European Society of Astronomy in Culture* (Gdansk 1997), 67-76.

2. J.L. MYRES, "Excavations at Palaikastro, II. §13 - The Sanctuary-Site of Petsofà", *Annual of the British School at Athens*, 9, (1902-1903), 356-387.

3. C. DAVARAS, "Crete", *ArchDelt*, 33, B: 2, (1978) Chronika, 392f., s.v. *Petsophas* and *Traostalos*.

4. MYRES (supra n. 2). Almost all figurines from Myres' excavation are published in B. Rutkowski, *Petsophas. A Cretan peak sanctuary*, (Studies and monographs in Mediterranean archaeology and civilization, series. I, vol. I), (Warsaw 1991). All objects discussed in this paper are shown in that book.

5. MYRES (supra n. 2); RUTKOWSKY (supra n. 4), 52-57.

6. S.A. ALESHIRE, *The Athenian Asklepion, the people, their dedications, and the inventories*. (Amsterdam 1989).

7. C. ROEBUCK, *The Asklepion and Lerna*, (Corinth 14), (Princeton 1951), 111-146.

8. S. UNGE SÖRLING, "A collection of votive terracotta's from Tessennano (Vulci)", *Medelhavsmuseet, Bulletin* 29, (Stockholm 1994), 47-54.

9. The metal votive plaques in the church according to inventory made by the author 18 June 1998.

10. M. P. NILSSON, *The Minoan-.Mycenaean religion and its survival in Greek religion,* (Acta Re. Societatis humaniorum Lundensis IX), 2nd ed., (Lund 1968), 74.

11. M. BLOMBERG and G. HENRIKSSON, "New arguments for the Minoan origin of the stellar positions in Aratos' Phainomena", in *Proceedings of Oxford VI*, (La Laguna 1999). In this study two editions of Aratos' Phainomena are used: Loeb classical Library, transl. By G.R. Mair, (Cambridge 1955) and later printings; D. KIDD, *Aratus Phaenomena*, (Cambridge Classical Texts and Commentaries, 34) (Cambridge 1997).

12. ARIST. *On the Cosmos*, 2.392a 12-14, Metaph. 1073b 20, Aratos l. 544, E.J. WEBB, *The names of the stars*, ed. I. Bulmer-Thomas, (London 1952), 82 n. 1.

13. B.L. VAN DER WAERDEN, *Science awakening II The birth of astronomy*, (Leyden and New York 1974), pp. 14-16; O. NEUGEBAUER and R.A. PARKER, *Egyptian astronomical texts*, I-III, (London 1960, 1964, 1969).

14. MYRES (supra n. 2), 376.

15. ARATOS l. 480ff.

16. HENRIKSSON and BLOMBERG, 1996, (supra n. 1), 113.

17. All comparative material is shown in Rutkowski, (supra n. 4), the objects are referred to by their inventory number. The following abbrevetions are used: HM Heraklion Archaeological Museum; FM GR Fitzwilliam Museum, Cambridge; BM British Museum; AM AE Ashmolean Museum, Oxford.

18. Compare the Cetus constellation shown on the star map in the Laeb edition of Aratos, 444-447.

19. RUTKOWSKI, (supra n. 4), 36 and pl. 49.13. The correct inventory is BM 1907/1-19/29.

20 HIPPARCHUS; *Hipparchi in Arati et Eudoxi Phaenomena commentariorum libri tres ad codium fidem recensuit Germanica interpretatione et commentariis instruxit Carolus Manitius*, (Leipzig 1894).

21 R.H. ALLEN, *Star-names and their meaning*, New York 1899, second reprint 1936, also published under the title: *Star names, their lore and meaning*, (New York, 1963). Compare also Webb (supra n. 12), 143f.

DID THERE EXIST THE BALTIC ZODIAC?

Jonas Vaiškūnas
Lithuanian Museum of Ethnology, Moletai, Lithuania
j.vaiskunas@moletai.omnitel.net

INTRODUCTION: ABOUT THE LITHUANIAN ZODIAC IN THE HISTORICAL SOURCES

We don't find direct information about the Zodiac signs neither in the Lithuanian nor in the Latvian ethnoastronomical materials. But some historical sources give us reason to presume that Zodiac was familiar in pre-Christian Lithuania.

This presumption is based on the information of two historical sources and analysis of ethnographic and folklore materials. The first trace was noticed in the book by E. S. Picolomini «*Description Of Various Events And Places*» published in 1477. The author of the book conveyed the story by J. Prahensis (1431) - *'Going further he found a tribe which worshipped the sun and kept an enormous iron hammer very respectfully. The prophets were asked what they meant by this worshipping and they answered that very long ago the sun wasn't seen for long months, because the mighty king had caught it and locked in the toughest tower. Then the* ***signs of Zodiac*** *came to help. They took a huge hammer and destroyed the tower. They released the sun and gave it back to people. So such tool is worth respect with the help of which people got back light.'* (Manhardt 1936, 545).

The second trace is from the compilated chronicle by a German author Johannes Friedrich Rivijus. He stated that in Vilnius there was **Perkūnas** sanctuary with a square altar. The altar was made of 12 steps each of them was devoted for one zodiac sign. «*Every month when the rising or setting sun entered a sign, fires of sacrifice were lit on that step. The highest step belonged to Cancer and the lowest to Capricorn. But the real sacrifice was not being burnt, it was supposed that only imitations made of wax were being burnt...*» (Velius 1997, 357). J. F. Rivijus copied this information from the 16th century Lithuanian history by Augustinas Rotundas.

THE SIGNS OF ZODIAC IN CALENDAR RITES

As the historical sources stressed upon the ritual and calendar role of the zodiac signs it was tried to find the traces of 'zodiac rituals' in the known ethnic calendar rituals of the 19th - 20th centuries. The motivation of research is based on the typical mythological thinking, where all the main cosmogonic acts should be repeated ritually during certain calendar festivals. Presuming that the zodiacal constellations familiar to the Lithuanians might have been mostly zoomorphic, attention was paid to the survived rituals with animals and some folklore texts.

The carnival rituals on Christmas and Shrove Tuesday can undoubtedly be treated as annual cosmic rituals of releasing the Sun. The Lithuanians have Christmas ritual of dragging a log through the village having disguised as animals and beating that log. Later they burn it: This ritual might be related to the ritual of setting the Sun free. In the opinion of the Lithuanian ethnologist P. Dunduliene, the burning of a log could symbolize the victory of the Sun against the chthonic powers (Dundulienė 1991, 53).

Disguising as animals is similar for the Shrove Tuesday when the same procession follows not the log but a peculiar «Cart of the Sun». A wheel of a cart was fixed horizontally on a two-wheeled cart or on runner of sleigh, and a stuffing of some mythical figure was attached to it. Flails were in the place of hands. And when the figure rotated, the flails tossed about and protected itself from the participants of the carnival who attacked it. The wheel might symbolize the sun. And the stuffed figure could be explained as a mythical creature, which made harm to the Sun. Later the stuffed figure was being burnt or drowned.

It is important to mention the fact that on the next day after Shrove Tuesday, there was a tradition to drag a log round the village (like on Christmas). There is evidence that 12 masked men used to drag the log (Balys 1993, 106). The sameness of rituals of disguising as animals and dragging a log on Christmas and Shrove Tuesday let us integrate the distinctive details of these festivals into one common plot:

Zoomorphic disguising ⟶ **log dragging, beating and burning** ⟶ **setting the Sun free**

Zoomorphic disguising ⟶ **destruction of the mythical figure on the wheel of a cart** ⟶ **returning of the Sun**

Admitting this hypothesis, the masks of Christmas and Shrove Tuesday festivals could be assumed as potential signs of Zodiac. These masks of animals were characteristic to the Lithuanian and Latvian carnival: a goat, a horse, a rider on a horse, a crane, a bear, a bull. The most popular masks in Lithuania were the masks of ***a goat***, ***horse*** or ***a rider*** and ***a crane***. And they could be assumed as pretenders to the signs of the Lithuanian zodiac.[1] Analysis of some shepherds' calendar ritual songs even strengthens the chances of a goat to be a sign of Zodiac. It also reveals another personage of zodiac - ***an armed man***. The content of a traditional Lithuanian Christmas song «*A Nine-horned Deer Is Coming*» made it possible to include the ***deer*** into the group of mentioned personages. The ethnologist N. Laurinkienė analyzed the semantics of the archaic Lithuanian calendar songs and distinguished the most characteristic motives and symbols of the cosmogonical myths and cosmological images. There are three zoomorphical characters among them. They are: ***a deer, a horse and a peacock*** (Laurinkienė 1990, 71-83).

SIGNS OF THE ZODIAC ON ANCIENT SCOOP

Presumptions based on the analysis of historical sources and ethnographic materials were confirmed unexpectedly after the research of an ancient ritual scoop from Grodno (Gardinas) with the reflections of 12 signs of zodiac. Precise circumstances of finding that scoop are not known. All that is known about it is that it was found in the basement of some church during the World War II and appeared in the exposition of the museum of history and archaeology. In November of 1956 the scoop was sent to Moscow for restoration. Since 1978 the scoop has been kept in the main exposition of the Byelorussian folk creation museum in Raubichi.

The scoop was covered with polychrome. Before the restoration of the scoop some even older pictures were noticed on it. There were burned narrow lines, which made pictures. The polychromatic painting on the outer side could hardly be seen. According to the style of painting it was ascribed to the local tradition of the Grand Duchy of Lithuania of the 17th century. The scoop was dated back to the 15th century. Still it is not known who and when dated it. The inner side of the scoop has preserved the polychromatic paintings. Though they are not informative, they are only humble ornaments. Ancient pictures are laid out on the outer surface of the scoop in the line of 10-cm height. There are 12 pictures each of them is framed by a geometric ornament.

The survival of the scoop shouldn't be surprising because it was made of a knob of a birch. The wood of a birch knob is especially thick and it doesn't absorb water. Also the scoop was covered with wax.

It seems that the scoop was being regularly used according to its direct purpose, i.e. it was used for drinking. That's why the first picture closest to the handle has nearly been abraded. The scoop had to be rather heavy because its diameter is about 0.5 m.

The signs on the surface of the scoop are laid in the consecutive order. The reflections of the sun on every sign suggest us the idea that these reflections are closely related to the way of the sun among stars, i.e. zodiac. Reflections 10, 11 and 4 counting clockwise from the handle of the scoop are directly associated with the traditional signs of zodiac such as Sagittarius, Capricorn and Gemini. And the location of these signs among all the other reflections lets us assume that it is not just a coincidence. There should be 5 signs between Gemini and Sagittarius. We find exactly the same number of signs on the scoop. The dislocation of the signs in the clockwise direction and their association with the zodiac signs prove that the sign that follows Sagittarius is the 12th sign Capricorn. Such dislocation of three identified signs permits us to assert that the pictures on the scoop are undoubtedly the signs of zodiac. Starting clockwise from the handle of the scoop we have these signs:

1. (The reflection of the sign is difficult to discern) - 'Pisces'.

2. A fur-coated figure - 'Aries'.

3. A rider (riding from the right to the left) - 'Taurus'.

4. Two human beings holding each other by the hands, the one on the right keeps an arrow or a bludgeon above his head and we can see the sun and its rays between their heads and legs - 'Gemini'.

5. A bird that reminds a peacock (orientated to the left) with a disc of the sun above its back - 'Cancer'.

6. A bird that reminds a peacock similar to the mentioned one in 5, only it is orientated to the right with a disc of the Sun above its back - 'Leo'.

7. A bird that reminds a crane or a stork (orientated to the right) with a disc of the Sun above its back - 'Virgo'.

8. Two Suns (one in the left bottom corner of the frame with the rays like swastika and the other with the straight rays in the right top corner) - 'Libra'.

9. A big and a small deer - 'Scorpio'.

10. A warrior with a pike in his right hand above the head and a disc of the Sun with straight rays under his hand - 'Sagittarius'.

11. A galloping goat (from the right to the left) and a disc of the Sun with straight rays above its back - 'Capricorn'.

12. A galloping horse (from the right to the left) and a disc of the Sun with straight rays above its back - 'Aquarius'.

These signs confirm the reality of the previously reconstructed signs of zodiac and let them correlate with particular constellations. At the same time 6 other signs out of 7 unrecognized signs are identified. The contours of the signs let us relate these figures with particular star groups. As the starting point of the reconstructed zodiac coincides with the 'Pisces' constellation we can assume that we have things to do with the system of the zodiac signs of our era. This fact is one more important argument, which proves that the Zodiac on the scoop is not an elementary import from the Roman Empire. The starting point in the Pisces shows that this system had to be used actively and based on the local practice of astronomical observations.

SEMANTIC OF THE RECONSTRUCTED SIGNS AND THEIR RELATION WITH CELESTIAL BODIES

An important argument strengthening the hypothesis that the Lithuanians used to relate the above mentioned symbols with the signs of Zodiac since ancient times, might be the information proving direct association of these symbols with the dome of heaven and celestial bodies. There is such information in the Lithuanian ethnological material. Let's discuss more characteristic symbols of zodiac.

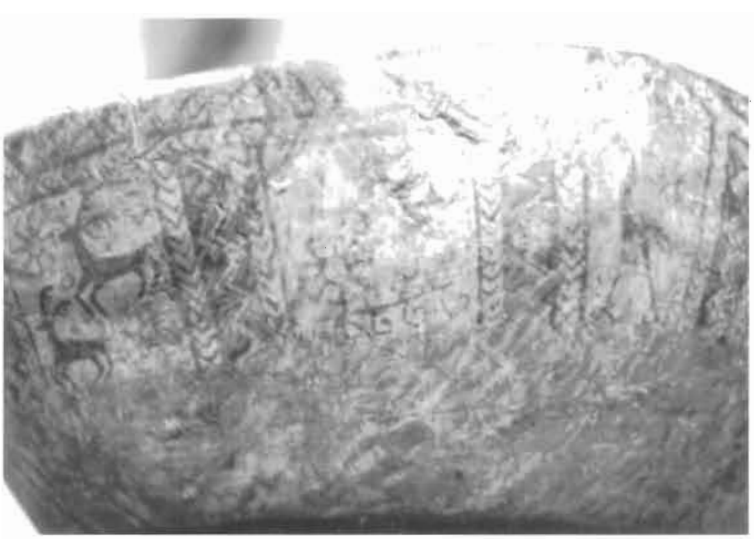
▪ **Horse.** 1) A constellation by this name is noticed in the Lithuanian, Latvian and Byelorussian ethnoastronomical materials: in Lithuanian - ***Arklys***; Latvian - ***Kumel'š***; Byelorussian - ***Konj*** *'Horse'*. Moreover, the information from Latvia enables to indentifity this constellation rather reliably. The constellations of ***Wolf*** and ***Horse*** were known in Latvia. They said that *«when one of the constellation appears, another disappears.»* The Latvian researcher of culture A. Goba identifies Wolf with Leo and horse with Pegasus (Goba 1990, 285-286). Our material makes this identification even more precise when relating the constellation of Horse with the constellation of Aquarius (Aquarius and a part of Pisces to be more precise) which is below the constellation of Pegasus. It is known that a group of stars that is to the right above the square of Pegasus was called by the name of Horse by the Babylonians (Rogers 1998, 22-24). The Lithuanian tradition to depict Horse below the Greek Horse - Pegasus is rather suited to show the figure of a horse in this part of the firmament. 2) In the Lithuanian fairy-tales we can find the plot about the horse emerging from the sea or flying horses. A cosmic horse is depicted in calendar songs. He leans upon the sky with his ears, he counts stars with his eyes, he sweeps the estate and all the roads with his tail, and he breaks up pits with his legs. In the Latvian songs it is mentioned that the Sun rises at the saddle, the Moon rises at the bridle, and ***Auseklytis*** (Venus) rolls at the and of the bridle-rein (Laurinkienė 1990, 77-78). We can guess from this description that this star horse is in the sky ecliptic, i.e. in the belt of Zodiac. This is how it could be explained why the sun, the Moon and Venus appear in it. 3) The Lithuanians had a calendar festival called ***Kumeliuko krikštynos*** *'Foal's christening'* or ***Krikštai*** *'Christening'*. It was celebrated all night through at the end of January or at the beginning of February. The time of this festival coincides with the heliacal setting of Horse (Aquarius) constellation. The semiotic A. J. Greimas assumes this festival to be of lunar character at it is considered to be an ancient Lithuanian New Year festival (Greimas 1990, 320-322).

▪ **Deer.** There is a Christmas song *"A Nine-horned Deer is Coming"* about an unusual deer with nine horns. Fire is burning and smiths make a golden goblet, a golden ring or a wreath made of pearls. All those objects made of noble material symbolize the Sun (Greimas 1990, 468). There is a fragment of a legend recorded in south Lithuania (1984) about a white deer with a nice wreath fallen from the sky. This is it: "<...> *children, wait and look through the windows - a deer will come. <...> he will be very nice <...> white white <...> with a wonderful wreath <...> his feet will be white, so distinguish him... They say, he fell from the sky, so the clouds washed his tail and coloured his hoofs. And when deer appears from the forest then Christmas come"* (Ragevičienė 1996, 9). Deer is identified with Scorpio and his appearance before Christmas correspond with the heliacal rise of Scorpio constellation.

▪ **Crane**. On the first days of April Virgo constellation sets in west before the sunrise. After the Sun set it rises in the east (cosmic setting and rising). According to ornitologists this is the time (end of March and beginning of April) when cranes return to Lithuania. At that time they start their so called "dances". Birds choose a dry place where they gather in the daybreak or evening - glow.

▪ **A rider on a horse**. 1) In the Lithuanian ethnoastronomical material there is noticed a constellation of *Jojikėlis 'Rider'*, but it is identified with Cassiopeia not with Taurus. 2) In Samogitia the stars of Taurus were linked with a horse and called *Kybelka 'Jade'* (Vaiškūnas 1996, 141-142). 3) In the 1249 contract of the German Order with Prussian it is mentioned that the Prussian prophets during burial ceremony raised their eyes to the sky asserted that they saw the deceased flying on the his horse in the middle of the sky to the other world (Velius 1996, 238-239, 240-241). 4) At the end of April (round St. George's day) at the time of the heliacal setting of the Pleiades the Lithuanians say: *"The Pleiades in the glow, the horse in the furrow"*. This could be linked with the imagination that a part of Taurus constellation hiding behind the horizon together with the Pleiades is imagined to be a horse. By the way, St. George is supposed to be the guardian of horses and depicted as a rider on a horse. In the Latvian tradition besides St. George there is an old personage *Ūsin'š*, who is also considered to be the guardian of horses and is depicted as a rider on a horse. *Ūsin'š* is identified with the ancient Indian deity of dawn *Usas*, ancient Greek *Eos*, Romanian *Aurora* and other.

▪ **Twins.** 1) D. Poška (1823) refers to the constellation ***Dwynaytey*** *'Twins'* which was known in Samogitia and he draws a link among this constellation and two idols Lelum and Polelum who were supposed to be known in Poland and Lithuania (Poška 1959, 362-363). 2) Archaic personages closely related with the Indo-European cult of divine twins are characteristic to the Baltic mythology. The Lithuanian mythical characters ***Dievo sunēliai***, Latvian ***Dieva deli*** *'sons of God'* correspond to the ancient Greek ***Dioskurs*** and Indian ***Ašvins***. In the plots of Latvian songs ***Dieva deli*** *'sons of* God' are related with the dome of heaven, the Sun, the Sun's daughters and the Moon.



▪ **Sheepskin**. A sheepskin plays a very important role in various Lithuanian traditions and rituals. One of the most characteristic Cristmas masks is called *"Black Hirsute"*. It is a man wearing an inside out sheepskin. Hair and shags are supposed to be symbols of sexual energy, fecundity and

wealth. Such primitive way of carnival masking is known nearly in all European nations.

▪ **Goat.** In the Lithuanian folklore the Goat is linked with the sky, ***Perkūnas*** *'God of Thunder'* and atmospheric phenomena. Not so long ago the Lithuanian and Latvian shepherds performed a ritual with a goat before All Saints Day. The intention of such ritual is a wish to expect snow as soon as possible and that would mean the end of cattle pasture. For this purpose shepherds used to lead a goat 3 times round a birch. During the ritual it was necessary to lift a goat a bit. Sometimes they even used to bend a birch, to tie a goat and to lift it. It is supposed that during this ritual shepherds sang a song *"Go goat for water"*. The story of the song is about a goat, which goes for water and meets an armed man. The man hurts the goat's leg. Lifting a goat on the tree might be related with the evening culmination of Capricorn constellation, which happens in November. It seems that shepherds try to hasten the culmination of Goat and to call winter's snow at the same time. 2) Historical sources say that the Prussians used to sacrifice a goat at the end of a year. That would correspond to the phenomenon of the Sagittarius heliacal setting. It is known that analogical tradition was familiar for the Babilonians. When the Sun entered Saggitarius constellation, Babylonian prophets put on festive clothes made of goat skins and sacrificed a goat for gods.

▪ **Peacock.** In the songs of Lithuanian and other European nations a peacock plays the role of cosmological and astral image (Laurinkienė 1990, 81-83); Tokarev 1988, 273-274). In the Lithuanian fairy tales there is also a miracle bird with shining golden feathers. This bird is mentioned in the plots together with a horse and a very pretty girl, who can be related to ***Aušrinė*** *'Morning Star'* - Venus. The hero of the tales releases the girl, the horse and the bird from the captivity of some chthonic creature (Velius, 1994, 116-129). That could correspond to the appearance of Venus after a period when it was temporary invisible and also heliacal rise of Horse and Peacock constellations. This situation is possible at the time of spring and autumn equinoxes.

CONCLUSIONS

The reality of mythical zoomorphic personages reconstructed on the basis of historical sources, ethnographical and folklore materials, the same with Zodiac signs is confirmed by respective pictures on the ritual scoop from the Middle Ages. The semantic analysis of the signs based on the folklore, ethnographical and ethnoastronomical data permits us assert that they were closely related to the calendar practice and astronomical observations. So we can come to a conclusion that a peculiar zodiac might be known and used for practical purposes at least among the prophets in pre-Christian Lithuania. The possibility that the information about Zodiac might have come from the countries of the Mediterranean does not deny the originality of this zodiac and possible original adaptation to the local traditions. If such interception ever happened that had to be very long ago. Otherwise, the new information wouldn't have had time to modify and join local mythical and ritual structures. On the other hand not only the Baltic but also all European nations have a tradition of arranging carnivals to celebrate the Solstice of the Sun and that gives ground to assume, that Zodiac, as animals circle system, might have been known to various European nations. The stimulus of its formation had to be the need for precise calendar calculation, and its theoretical basis was the Indo-European mythology. We suppose, that the research of the culture heritage of the old European nations. Has big perspectives and can reveal new and important information for the history of astronomy and to the whole history of culture at the same time.

ACKNOWLEDGEMENTS

I would like to thank Dr. Sergej Vitjazj (Archaeology department of Institute of History at Minsk Scence Academy), for the given possibility to get acquainted with the signs on the ritual scoop. Thanks to Ms. Rosita Urbonavičienė for the help preparing the English version of this paper, also to Vytautas Musteikis (Lithuanian Folk Culture Centre) and Mr. Rimas Kavaliauskas for technical preparation of video illustrations. I am grateful to organizers of Oxford VI and SEAC 99 general conference for the financial help which made possible to present this paper to the society of science. Many thanks to the mayor of Molėtai Valentinas Stundys and Molėtai department of Culture and education and personally to the head of the department Nijolė Zabulėnienė and her deputy Gintautas Matkevičius for moral and financial support of my researches.

NOTES AND REFERENCES

J. BALYS, 1993. *Lietuvių kalendorinės šventės*, Vilnius, Mintis

P. DUNDULIENĖ, 1991. *Lietuvių šventės: tradicijos papročiai, apeigos*, Vilnius, Mintis

A. GOBA, 1990. *Cejš uz Bitarīnu*, Rīga, Sprīdītis

A. J. GREIMAS, 1990. *Tautos atminties beieškant: apie dievus ir žmones*, Vilnius-Chicago, Mokslas & A.Mackaus knygų leidimo fondas

W. MANNHARDT, 1936. *Letto-Preussische Götterlehre*, Riga, [repr.: Hannover, Dören, 1971].

N. LAURINKIENĖ, 1990. *Mito atšvaitai lietuvių kalendorinėse dainose*, Vilnius, Vaga

D. POŠKA, 1959. *Raštai*, Vilnius.

A. RAGEVIČIENĖ, 1996. Kai dar baltieji elniai iš dangaus krisdavo, Šiaurės *Atenai*, 1996 12 14, No 48 (342).

J. H. ROGERS, 1998. Origins of the ancient constellations: I. The Mesopotamian traditions, *J. Br. Astron Assoc.* 108, 1.

S. A. TOKAREV, edit., 1988. *Mify narodov mira*, Moskva, Sovetskaja encyklapedija (in russian)

J. VAIŠKŪNAS, 1996, Litauische Sternkunde // *Proceedings of the Second SEAC Conference Bochum, August 29th - 31st, 1994* / Edited by prof. W.Schlosser.-Astronomisches Institut der Ruhr-Universität. p.139-149.

N. VĖLIUS, 1994. Velnias ir Aušrinė, *Lietuvos mokslas*, vol. II, 1(2).

N. VĖLIUS, compiler, 1996. *Baltų religijos ir mitologijos šaltiniai*, vol.1, Vilnius, Mokslo ir enciklopedijų leidykla.

N. VĖLIUS, compiler, 1997. *Lietuvių mitologija*, vol. 2, Vilnius, Mintis.

NOTES

1. It is interesting to notice that in some places of Lithuania the people with masks were called «*zodijai*». This might be an allusion to the Greek «*zodiakos*».

BULGARIAN TRADITIONAL COSMOGONICAL AND COSMOLOGICAL BELIEFS
(after ethnographic data from AD 19th to 20th)

Dimiter Kolev
National Astronomical Observatory "Rozhen"
Bulgarian Academy of Sciences, Sofia, Bulgaria

INTRODUCTION

People's world outlook inevitably begins with the ideas about the origin and the order of the world. It was natural for those who organise and transform the environmental structures and substances, to ask about the origin and the arrangement of the world as a whole. The Bulgarian folklore records and the folk arts data can be grouped in the standard clusters: i) cosmogonical ideas about the origin of the celestial bodies and the world; ii) cosmological ideas about the organisation of the sky and the earth; iii) vertical arrangement of the world as a world tree.

FOLK COSMOGONY

The ideas about the God-Creator prevail. The most original legend[1] about the creation of the celestial luminaries reads: once, "*when the world was not created yet*", Little Christ was playing with soil marbles. Child-Christ tossed up the balls and Father-God set them on fire - the biggest turned into a sun and the rest - into a moon and stars. Finally, the soil dust tossed up by the child in handfuls, formed the Milky Way. Another legend[2] tells that God created the stars together with the human beings and the two populations are equal now. Non-biblical explanations also exist: the sun and the moon were created by "*the nature*" and the other stars are their children; the celestial bodies shine "*reflecting the sunlight*" or even "*with their own light*"[3]. Some people in the Rhodope Mountains imagined the stars as "*little moons*" that broke off the moon[4].

The beliefs about the earth's creation are similar to each other, evidently due to the influence of the Christian ideology, where it is the biblical notion about the creation of the earth that is more elaborate. However, their main peculiarity is the dualism[5]- the earth is a result of a joint action of God and Devil. Here are some variants[6]:

- in the very beginning there was only a sea and God and Devil had no place to sit on. God asked Devil to bring some soil from the sea bottom (*variants*: sand, yeast or sea foam). The two Creators made a bank and began to pull it; the earth extended and the sky could no longer cover it. The hedgehog (*variant*: the bee) advised God to pinch and pull (*variant*: to hit with a stick) the earth - thus mountains and valleys appeared, and the earth size diminished. God planted a walnut-tree in the centre of the earth and after that He created the man (from soil) and the animals;

- the primeval earth was so large that the sky could cover it only after God had folded up the surface of the earth thus forming mountains and valleys;

- Devil hid some soil under his tongue. God blessed the soil to grow and Devil spat out the soil which formed the earth's relief;

- the sky covered the earth like a heavy lid. The people heaved the sky up and dropped it down, and the marks which it left on the earth became valleys;

- the heights on earth appeared when flour spilled out of God's torn bag (a similar legend about the creation of the Milky Way exists too[7]).

COSMOGONICAL NOTIONS AND FOLK COSMOGRAPHY

The traditional notions are geocentric. The sky was thought of as a cover of a stew-pan. Here are some of the ideas[8] about the world arrangement:

- the earth is imagined to be *"as flat as a pancake"*, but it can also be *"like a watermelon or even a ball"*; usually the earth is round but it may also be rectangular;

- the earth is a blackthorn bush in whose twigs the water *"wriggles like a snake"*;

- the flat earth lies on the back (or on the horns) of an ox or a buffalo; above it the moon, the planets and the sun rotate;

- the world is like a big copper pot: the earth is the bottom and the sky is its lid;

- the sky covers the earth and the surrounding sea; or the sky covers only the earth and not the sea;

- the earth is a circular dish whose edge is held tightly in the embrace of a huge snake with its tail in the mouth.

People imagined the support of the earth in different ways[9]. In their notions the earth:

- floats on water or even on *hot water* (a reminder of hot mineral springs?);

- lies on the back or the horns of an ox whose legs are *"in the underground world"*; or the earth is propped up on the horns of several oxen; on the back of another animal: e.g. a cock, turtle or mythical monster - lamya (dragon);

- lies on the arms of a tree whose roots are in the water;

- lies on the pitchfork of a blind old man;

- lies on top of two or even twelve stone pillars; they are *"in the underground water"*;

- lies on a pillar placed above the water or on an ox's head placed on the top of the pillar; an original view is that *"the head rotates and the earth revolves together with it"*.

Finally, there are notions that the earth is not supported by anything but floats *"in the air"*.

There are some "estimates" of the earth size too. The earth's end is not so far away since it takes the sun only one day to cross it. A measure of the world size is also the time one needs to cross it: one, three, 60, 80, 100 and even 129 years. The sky, too, cannot be so far for the sound of the *"celestial chariot"* is clearly audible[10]. The sky itself has always been considered to be something tangible, made of *"soil"*, *"tin"*, *"something firm"*, *"very thick glass"*, *"solid thick seven-ply rind"*, *"buffalo skin"*, *"copper threshing-floor"*[11]. The sky and the celestial events seldom occur in folk riddles (2-4% of all) but the notions about the arrangement and the shape of the world are easily detected there as well[12]. The sky is: *"a blue (green) leaf "*, *"a slate covering the whole world"*, *"a blue bowl put on top of the earth"*, *"a bottomless pool"*, *"threshing-*

floor", *"field"*. The stars are likened to *"golden nails"*.

The next views about the structure of the sky can be found in the folklore data[13]:

- all luminaries are on the sky;

- only the Milky Way is placed *on* the sky while the other luminaries are *below*;

- only the stars are *on* the sky while the sun and the moon are *suspended from* the sky;

- all celestial bodies *hover freely below* the sky;

- the luminaries *are nailed* to the lowest sky fold. There is also a religious arrangement according to which on the lowermost fold of the sky is the paradise, above are the angels and the saints and God is above all. The sky has two (a paradise and a hell) or three levels and God is above them.

Once created, the world underwent a change - the separation of the sky and the earth. Their physical closeness was considered a conjugal bond. There was a great drought before their marriage, but after that a fruitful rain fell; then the sky was separated from the earth and their marriage was dissolved. The legends give different reasons for this. The most frequent motif is that a human being treated the sky disrespectfully, whereat the angry God lifted the sky up. Versions state that *the sky itself* decided to lift. The moon, too, was raised to the sky because of disrespectful attitude towards it.

Another reason for the separation was the intensive light and heat of the sun when the sky was close to the earth. God raised the sky in order to prevent all beings from burning[14]. A "piquant" legend tells of a woman who took great pleasure in making love with her husband but the sunlight and the moonlight did not allow the lovers to hide away, so she soiled the moon's face with cow dung, and the angry God raised the moon[15].

The explanation of the moon phases is also manifold[16]:

- a man stands on the moon turning a mirror;

- we see the flat moon at different angles when it turns around the earth;

- the moon drops bits of itself and then collects them back;

- God punished the biblical Cain to stay on the moon forever; Cain *"dies"* every fifteen days and *"comes back to life"* in the next fifteen days.

The sun is an object of special interest[17]. Once there were two suns - a summer and a winter one; another belief tells that there is only one sun but it changes its path and the intensity of its shine. The anthropomorphization of the sun, the moon and some stars is widely used in folk mythology. The sun is always masculine and often bears a proper name. The moon is the little brother of the sun and the Evening and the Morning Stars are their sisters (the moon favours the first, and the sun the second sister). The sun has only a mother - probably an archaic notion dating back from the matriarchy, when only maternity was certainly known.

THE WORLD TREE (ARBOR MUNDI) IN THE BULGARIAN TRADITIONAL CULTURE

The idea of the world tree can be traced back both in the oral folklore and in the folk arts[18]. The concept of a three-level vertical division of the world is found in various genres (especially in folk songs, tales and on wood-carvings). Already in the cosmological notions the world consisted of three vertical levels - Under-, Middle- and Upperworld, all of them populated. The Underworld is chthonic and inhabited also by *zmey*-s (dragons). It can be reached only through a cave, and the Upperworld - only with the help of an eagle (most often a she-eagle)[19]. The eagle as a mediator is widely used in fairy-tales of Aarne-Thompson types AT301A and AT329.

In folk songs the typical image is of a branchy tree rising up to the sky, often cypress, rooted in the ground (or water), with birds in the crown. The cypress (as a species) probably signifies a combination with Christian notions because the cypress with a bird on it is a symbol of eternal peace. Numerous variants of the world tree as "a tree of life", "a family tree", etc. also exist in the folk songs.

Reaching the sky by climbing up a tree or a plant stem is a common motif in many tales (e.g., no. 1889 and *1930F* in the Catalogue[20]). We can see the most impressive image of the world tree in the classic fairy-tale of AT301A type "*The Three Brothers and the Golden Apple*". The vertical segmentation of the world here is more complex compared to the typical model. The hero firstly falls down to the Underworld through a tree hollow. Then a black ram carries him *further down* to a lower world. Down there he finds a huge tree with an eagle nest on its top, and a snake living among the tree-roots trying to get to the eaglets. The hero rescues them from the snake and the grateful she-eagle (or the eagle couple) takes him directly back to his "upper world".

The motif is widely used in different genres of the folk arts: embroidery, textile, wood-carving, stone-cutting, and forging art. It is found on tombstones dated to the 18th and 19th century in a form of cypress with a wide base and often - a bird on the top. We see painted or carved images of the world tree on church porticos. These are the most canonical examples - with a dragon in the roots and a bird (or even a two-headed eagle) on the top[21]. Elements of world tree imagery can be found also in forged metal objects such as candlesticks[22] and in the ornamentation of metal ends of rifle butts from the 19th century[23]. Other astral symbols - solar images, signs and symbols like circles and quadrates, crescents, stars are also found on gravestones[24]. The astral symbolism can be traced back to the Early Middle Ages in Bulgaria. It is a result of the syncretism achieved by the Orthodox Christianity[25].

COMMENTS: THE LIFE OF THE CONCEPTS AND ETHNIC PARALLELS

The Bulgarian beliefs are a unique mixture of pagan notions and Christian cosmovision and cosmography (including also apocryphal ones). The only way to propagate these ideas until the end of 19th century remains the patriarchal oral tradition. It follows from the low level of literacy (10-30% of the citizens in 14th century[26], before the Turkish invasion (1396), and only 11% as a whole and less than 3% among the women[27] in 1887, shortly after the Liberation (1878). We can expect the same to have been true even in the time of wide dissemination of the Bogomil ideas (10th-13th centuries) that influenced much the people's world outlook. One of the regulations of this popular even in Western Europe "haeresis Bulgarorum" was the self-dependant care for the soul salvation that requires to read the sacred books *personally*[28]. Nevertheless, in my opinion, the wide spread of the Bogomil ideas was rather a result of *group readings* by the preachers in the Bogomil communities.

The diversity in the Bulgarian cosmography can be explained, among other factors, with the inner and outer *isolation* of the people during the long Turkish rule. The "world frames" for the Bulgarian serfs as a rule did not exceed the neighbouring villages that were usually sparsely populated. This accounts also for the non-canonical adoption and re-telling of the Christian dogmas in a way close to the traditional world outlook, properly named by Bulgarian researchers "*common Christianity*" or "*Christianised paganism*". It was noted a long time ago that the attitude of the Bulgarians to the Christianity was rather ambiguous. The forced conversion to the new religion in A.D. 865 and the gap between the ruling stratum and the peasantry did not assist a deeply rooted and conscious adoption of the religious doctrine. It is no accident that during the Middle Ages a number of heresies became popular. On the other hand, during the long foreign oppression, the religion became *not a realised theoretical ideology* but simply *an ethno-distinctive characteristic and a means of survival* of the Bulgarian people. Deprived of its Christian temples and rituals, the people turned to the still alive pre-Christian practices.

Our interest in the cosmogonical and cosmological beliefs draws the attention to parallels with other notions and traditions. The legend about Little Christ and the origin of the celestial bodies shows some similarity to a passage of the apocryphal gospel "*Jesus' childhood*", well known in medieval Bulgaria[29]. The passage tells of how five-year-old Jesus made birds from mud and breathed life into them. More curious is, however, the direct analogy between the Bulgarian legend and the Bushmen's tale "*How a girl created the stars*"[30]. The girl picked up a handful of ashes from the fireplace and tossed it up to the sky. The ashes became the Milky Way. She then tossed up some sweet roots and they turned into stars. We can also find an analogy between some Bulgarian notions about the folding of the originally flat earth and an etiologic legend of the African tribe Kamba (a Bantu people of Kenya) *"How the mountains and the rivers appeared on the earth"*[31]. In this tale the giant hunter Mvuka folded the flat earth during his hunting-dance. These evident similarities are a good example of convergent thinking of quite different peoples. The Bulgarian belief that the people who live in the Upper- and Underworld put a belt not on their waists but on the neck and the knees respectively, bears a direct analogy with some Asiatic (Altaian and Tuvan) notions; some Bulgarian notions about people's attitude to the moon bear straightforward similarity to Caucasian (Georgian) motifs [32].

The indisputable influence of the Manicheism, the Paulicianism and the Messalianism was surely facilitated by the dualistic ideas existing among the people due to their contacts with Euro-Asian traditions (however, the Bulgarian dualism was fairly moderate compared to the extreme dogmas of the Manicheism[33]). I shall note only some parallels. In the Chinese treatise *"Huai-nan-tzu"* two deities arise simultaneously from the initial chaos[34]. The Altaian mythological plot[35] about the two heroes - Ulgen and Erlick, who created the earth, practically coincides with the apocryphal writings and with some Bulgarian legends. The "subordinate" hero Erlick dives in the primordial sea, takes out some soil and the elder brother creates the earth and the human beings. We also know about a tradition dated back to the Second Bulgarian Kingdom (1187-1396) and earlier to the Proto-Bulgarians, to have *a pair* of rulers - perhaps this, too, arose from some very old dualistic ideas[36].

I will note one more peculiarity of the people's interpretation of the biblical and Gospel writs. In the time of the Conversion in Bulgaria the Christianity was already a strict, highly theorized system leaving no room for profanation of the triune God. Nevertheless, the "permitted" iconography of God was soon forgotten both in Eastern and in Western Europe. The image of the white-haired, severe old man on clouds spread widely. In their narrations the Bulgarians went further - God approached them closely, became *a cultural hero*. He taught peasants agriculture, building, weaving. He entered their homes as a guest, put them to moral tests, etc. Men also visited God and His children (!) in the sky (motif no. 1930F* in the Catalogue, ref.20). The rural scepticism did not trust even the Holy Writ about the infinite creative power of God. "Heretical" legends like *"Nothing can be created only at a glance"* and *"God is a sinner just like everyone"* appeared[37].

The notion about the world tree (and other astral symbols as well) in the folk culture bears also some peculiarities that may have their roots in the traditions of the Bulgarian predecessors - Slavs and Proto-Bulgarians. Since the physical vertical is a unique direction, we cannot expect great diversity in its representation. But we have already seen the more complicated form of vertical organisation in the tale *"The Three Brothers and the Golden Apple"*. I can mention here another similarity between that motif and the Kazakh, Kirgiz, Adygeyan and Tatar notion of the mythical bird Karacus[38] which plays the same role as our she-eagle (it is curious that a toponym "Karacus" still exists in the Rhodope Mountains). The reduction of the world tree to a pillar is widespread among steppe Asiatic tribes. The apocryphal notion about the seven pillars that support the sky is most probably a reflection of this tradition. The same idea is at the root of the folk astronym for the Pleiades - *Seven pillars*. Since the Pleiades serve as a substitute for the world axis, such a possibility is admissible[39].

REFERENCES

1. Y. KOVACHEV, "Folk astronomy and meteorology", in *Collection of Folklore*, (1914), vol. 30, 1-85; *Bulgarian Folklore. Vol.11. Folk sagas and legends* (Sofia, 1963), 231. *(in Bulg.)*

2. D. MARINOV, *Selected works, vol.1. People's faith and religious folk customs*, (Sofia, 1981 = *Coll. of folklore*, 1914, vol. 28), 51. *(in Bulg.)*

3. Y. KOVACHEV, *op.cit.* (ref. 1), 21.

4. At. KALINOV, *Village Orekhovo* (Sofia, 1988), 277. *(in Bulg.)*

5. *Bulgarian Folklore. Vol.11. Folk sagas and legends* (Sofia, 1963), 467; Y. IVANOV, *Bogomil's books and legends* (Sofia, 1970 [=1925]), 357; D. ANGELOV, *The Bogomil movement in Bulgaria* (Sofia, 1980). *(in Bulg.)*

6. Y. KOVACHEV, *op.cit.* (ref. 1), 49, 53-54; *Bulgarian Folklore. Vol.11.* (ref. 5), 227; Y. IVANOV *op.cit.* (ref. 5), 329; D. MARINOV, *op.cit.* (ref. 2), 74.

7. Y. KOVACHEV, *op.cit.* (ref. 1), 26; *Bulgarian Folklore. Vol.11.* (ref. 5), 295-96; *also*: D. KOLEV and V. KOLEVA, "The stellar sky in Bulgarian folk tradition", in *Proceedings of the IVth SEAC Meeting "Astronomy and Culture", Sep. 3-6, 1996, Salamanca, Spain* (Salamanca, 1997), 69-80.

8. Y. KOVACHEV, *op.cit.* (ref. 1), 50-51; D. MARINOV, *op.cit.* (ref. 2), 74-75; T. NACHEVA and H. KALAYDZHIEVA, "Studying the astronomical knowledge of the oldest inhabitants in the Middle Rhodopes", *Interdisciplinary studies*, (1991), Vol. XVIII, 69-79. *(in Bulg.)*

9. Y. KOVACHEV, *op.cit.* (ref. 1), 51-52; D. MARINOV, *op.cit.* (ref. 2), 74-75.

10. Y. KOVACHEV, *op.cit.* (ref. 1), 18, 51.

11. Y. KOVACHEV, *op.cit.* (ref. 1), 15; D. MARINOV, *op.cit.* (ref. 2), 39; Iv. GEORGIEVA, *Bulgarian folk mythology* (Sofia, 1983), 52. *(in Bulg.)*

12. *Bulgarian Folklore. Vol.12. Proverbs, sayings, riddles* (Sofia, 1963), 505; St. STOYKOVA, *Bulgarian folk riddles* (Sofia, 1984), 83; Hr. STOILOV, "Classification and stylistic explanations of the Bulgarian folk riddles", in *Collection of Folklore*, (1914) vol. 30, 137. *(all in Bulg.)*

13. Y. KOVACHEV, *op.cit.* (ref. 1), 16; D. MARINOV, *op.cit.* (ref. 2), 39.

14. Y. KOVACHEV, *op.cit.* (ref. 1), 17.

15. *Bulgarian Folk Poetry and Prose. Vol.7. Sagas, legends, proverbs, riddles*, (Sofia, 1983), 569. *(in Bulg.)*

16. Y. KOVACHEV, *op.cit.* (ref. 1), 30-31.

17. *Bulgarian Folk Poetry and Prose...* , *op.cit.* (ref. 15), 40.

18. Iv. GEORGIEVA, *op.cit.* (ref. 11); Iv. GEORGIEVA, "The Cosmic Tree in the Bulgarian spiritual culture", *Centuries*, (1982), vol. 1-2, 25; L. PARPOULOVA, "The miraculous trees in the Bulgarian fairy tales", *Bulgarian folklore*, (1980), vol.3, 12. *(in Bulg.)*

19. Y. KOVACHEV, *op.cit.* (ref. 1), 52; D. MARINOV, *op.cit.* (ref. 2), 75.

20. L. DASKALOVA-PERKOVSKA, D. DOBREVA, Y. KOTSEVA and E. MITSEVA, *Bulgarian folklore tales. A Catalogue*, (Sofia, 1994). *(in Bulg.)*

21. IVA LYUBENOVA, "Cosmological motifs in the Bulgarian stone-cutting art from 18th and 19th centuries", *Interdisciplinary studies*, (1990), vol. XVII, 181-193. *(in Bulg.)*

22. Iv. ENCHEV-VIDYU, *Bulgarian folk cross* (Sofia, 1994), samples 172, 625. *(in Bulg.)*

23. V. DEMIREV, "Mythological motifs from Bulgarian national revival", *Centuries*, (1986), vol.1, 66. *(in Bulg.)*

24. IVA LYUBENOVA, *op.cit.* (ref.21), fig.12; Iv. ENCHEV-VIDYU, *op.cit.* (ref. 22), samples 49, 249, 713.

25. Zh. ALADZHOV, "Celestial, astral and cosmogonic signs on finds from Early Bulgarian Middle Ages", *Interdisciplinary studies*, (1991), vol. XVIII, 214-220. *(in Bulg.)*

26. V. GYUSELEV, "Education and literacy in Bulgaria during 13th-14th cen.", *Historical review*, (1983), vol.5, 21- 44. *(in Bulg.)*

27. T. PANOV, *Psychology of the Bulgarian people* (Veliko Tarnovo, 1992 [=1914]), 196 *(in Bulg.)*.

28. D. ANGELOV, "The Bogomil movement and its educational role", in *History of the education and the pedagogic ideas in Bulgaria*, ed. by N. Chakarov (Sofia, 1975), 75-84. *(in Bulg.)*

29. *Old-Bulgarian literature. Vol. 1. Apocrypha* (Sofia, 1982), 138. *(in Bulg.)*

30. *Tales of the peoples of the world.Vol. VI.Tales of the African, Australian and Oceanian peoples* (Moscow, 1990), 16. *(in Russ.)*

31. *ibid*, 20.

32. Iv. GEORGIEVA, *op.cit.* (ref. 11), 14.

33. Y. IVANOV, *op.cit.* (ref. 5); D. Angelov, *op.cit.* (ref. 5).

34. B.L. RIFTIN, "Chinese mythology", in *Myths of the peoples of the world.Vol 1* (Moscow, 1987), 625. *(in Russ.)*

35. V.V. IVANOV, "Dualistic myths", in *Myths of the peoples....Vol 1* (Moscow, 1987), 408. (*in Russ.)*

36. A. KALOYANOV, *Bulgarian Myths* (Sofia, 1979), 53. (*in Bulg.)*

37. *Bulgarian Folklore. Vol.11.., op.cit.* (ref. 5), 253-54; 338-44.

38. V.B., "KARACUS", in *Myths of the peoples of the world.Vol 1* (Moscow, 1987), 622. (*in Russ.)*

39. D. KOLEV, A. KALOYANOV and V. KOLEVA, "The Pleiades in the Bulgarian folk culture", in *Proceedings of the 5th SEAC meeting, held in Gdansk, Poland, 1997"* (Warsaw, in press).

METEORITES OF CAMPO DEL CIELO: IMPACT ON THE INDIAN CULTURE

Sixto R. Giménez Benítez[1,2]
Alejandro M. López[1]
Luis A. Mammana[1]
[1] Facultad de Ciencias Astronómicas y Geofísicas de la Universidad Nacional de La Plata, Argentina
[2] Fellow of Study of the Comisión de Investigaciones Científicas de la Prov. de Bs. As. (C.I.C.)

ABSTRACT

This work is a critical revision of the statements and deductions that have been taken as certain until the moment, about the impact on the Indian cultures of the Chaco (Argentina), of the remarkable meteoric dispersion of Campo del Cielo (aprox. 4000-2000 BC.), confronting them with the modern ethnography and our own field work. It is also to specify the relationship degree between the toponymy of the area and the astronomical phenomenon in question.

INTRODUCTION

The Gran Chaco is located in the center of South America. It partially embraces the south of Bolivia, Paraguay and the north-eastern Argentina. It is a sedimentary plain covered with parks and subtropical savannahs. The soil, free of stones, is composed of layers of sand and mud. Inside the Gran Chaco, to the south of the Argentinean provinces of Chaco and Santiago del Estero, is the meteoric dispersion of Campo del Cielo. This was originated by the impact of big metallic meteoroid, probably about 5800 years ago. The peculiar characteristics that it presents (size and alignment of the craters, great mass and high content of iron of the fragments, etc.) have got the attention during a lot of time. The knowledge of this event that pre-Columbian inhabitants possessed is usually mentioned. This is acceptable if we consider the attraction that the celestial phenomena have always exercised on the man, in particular one that as this should have had cataclymic proportions. For these reasons, it is important to settle down on firm bases the reaches of the impact of this dispersion on the Indian cultures of the Chaco.

THE METEORIC DISPERSION OF CAMPO DEL CIELO

Twenty-six are the craters documented in Campo del Cielo. The most outstanding is the crater Rubín de Celis (depth > 5.5 m). The known meteoric fragments are metallic (hexaedritas[1]), being the most important: Mesón de Fierro (~ 20 tn) and El Chaco (37 tn).

The expedition of Cassidy (1968) carried out gutters in the crater Rubín de Celis. Their study suggests that the original depth of the crater was of ~ 13.8 m under the local level of the land. Bags of vegetable coal were found at different depths. The age measured with ^{14}C of this coal, was estimated in 5800 ± 200 years. The most probable thing is that this vegetable coal was wood burned in the forest fire caused by the fall of the meteorite. Therefore, the approximated maximum age of the formation of the crater (and probably their real age) is the measure with the ^{14}C.

HISTORICAL ANTECEDENTS

The exploration of Campo del Cielo was impelled by the search of the Mesón de Fierro -large table of iron- (expeditions of Mexía de Miraval (1576), Maguna (1774), Francisco de Ibarra (1779) and Rubín de Celis (1782)). It was believed that the Mesón was the blooming of a silver vein, first, and one of iron later. After the expedition of 1782 their rake was lost. In 1803 Don Diego de Rueda came out in its search, but he was not successful. The expedition commanded by Don Fernando Rojas (1804) gave found a metallic fragment similar to a "standing dry log". In 1923, the Dr. Nágera carried out the first work dedicated to the craters of Campo del Cielo[2]. In 1962 and 1963 several scientists, headed by the Dr. Cassidy and accompanied by the Argentinean geologist Dra. Villar, carried out expeditions to the area [3][1].

ETHNIC GROUPS OF THE AREA

To determine what ethnic groups inhabited the region of the Chaco, and to try to describe their evolution in the last five thousand years is an arduous task[4][5]. The region has been a corridor among the Pampas and the Amazon area, on one hand, and between the Andean area and the Mesopotamia, for another. This darkens the information of the chroniclers. It is necessary to add the great confusion in the used denominations. The process inhabited began, seemingly, about 7000 years ago[6] when it stopped to be a marshy area to become a group of parks and savannahs[7]. In the area of Campo del Cielo we can find, basically, *guaycurúes* (*mocovíes* and belatedly, *tobas* and *abipones*), and *huárpidos* (especially *matarás* and *vilelas*). There are references to a possible sporadic presence of *chiriguanos*. Rubín de Celis (1783) mentions that the area was inhabited by meleros (harvester of wild honey), and tribes of wandering indians who look for a wild root called *koro*, that they only chew continually, being for them of first necessity. The cacique Marcos Ledesma related us that the dried root of the *koro* (wild tobacco) was chewed by the *mocovíes*. They think of it as a remedy and it intervenes in numerous occasions of importance. This (and their nomadism) makes us think that those wandering Indians of Celis were *guaycurúes*.

MYTHICAL TALES

The works on the meteorites usually suppose that this impact had great influence in the ethnic groups of the area. In most of the cases there are not concrete sources, and no work is in charge of this aspect of the meteoric dispersion more than incidentally. Of all the works, that of Antenor Álvarez[8] is the most precise in this respect, and probably the source of the other ones of this century. As an introduction it presents us a page dedicated to the Indian' myths that, according to him, are related with the phenomenon. These mythical aspects were not his central interest, but in spite of it, he makes some very important statements:

1).The meteorite was *known from old* by the Indians of the area.

2).They had *pilgrimage paths* to the place, covering a region of about 200 kms.

3).There it took place an *"indefinite" solar cult* associated to the *Mesón de Fierro*.

4).They believed this iron *mass detached from the sun*.

5).They believed in the *transfiguration*, to the dawn of certain day of the year, of the *meteorite* in a *tree of "radiant and brilliant iridescent*, that *chimed as a hundred bells"*[1].

Álvarez mentions, on purpose of the asseverations 1, 2 and 3, a work of J. Lubbock[9], which refers only, in general terms, to the solar cults of the primitive man. These opinions, together with some comments of Dobrizhoffer[10] on a possible solar cult among the *abipones*, could have him inspired. The precisions given by Álvarez about the supposed cult to the meteorite are very attractive. We believe we have found the source from which he builds his story: Father Guevara [11], talking about the *mocovíes* says: "To the stars they have for trees whose beautiful branches knit of lucid rays and sparkling shines". Then he speaks to us of their beliefs regarding the fall of the Sun: "Second time the sun fell [...] Then it was when everywhere fire floods ran, and flames that all burned it". In these quotes we can find reasons that remind us the text of Álvarez, but in a different context. In particular, in the description that the latter carries out about the "metallic" tree, he uses words very similar to those of the first paragraph of Guevara. This paragraph also got R. Lehmann-Nitsche's attention[12]. He considers the text confused and he relates it with another paragraph of Guevara: "The *mocobíes* faked a tree that they called *nalliagdigua* in their language, of height so limitless that it went from the earth to the sky. For him, of branch in branch winning bigger elevation always went up the souls to fish in a river"[2] [11]. Starting from this last one, Lehmann-Nitsche suggests that the first paragraph of Guevara lacks some words and should be read: "The stars have are for flowers of the celestial tree, whose beautiful branches knit then of lucid rays and sparkling shines" (it would speak of the sky tree). We believe possible that Álvarez has joined together in a story these mentions of the sky tree with the references to meteoric fragments with trunk form [8]. Älvarez assumes that the meteorite was made by a detachment of the sun: "Also tell the tradition of this tribe (*toba*) that, one day the Sun had fallen from the sky , setting on fire the forests and that the tribes survived becoming caimans; legend that was born, without a doubt, because the fall of the superb meteorite".

There are not in the descriptions of the explorers and chroniclers[10][11][13], nor in the indian beliefs any print about a cult to the meteoric masses as the one mentioned by Álvarez. According to the ethnographic works[14][7] although some tribes of the Chaco personifies to the celestial bodies and evidences of a celestial deity exist among the *guaycurúes*, there are not evidences of regular astral cults. Lehmann-Nitsche, when talking about the *mocovíes*[12][15], makes a sole mention about the meteors, according to the one which when a fleeting star passes from north to south is indication of strong wind of the north; if she leaves a long splendor she announces misfortune. In the article on the *vilelas*[16] only mentions that the meteors are considered as the fall of a star. Their only meaning is to announce north wind, unless it is specially remarkable, in which case it announces an or several deaths in the region toward which goes the meteor. Lastly, the article dedicated to the *chiriguanos* makes mention that the meteors are excrements of stars (*yastarepoti*), adding that this voice also names[17] to kind of a mushroom, being so these would be seen once as meteors fallen to earth. The article points out that the voice *mbairéndi* means comet (and that this acts like guide), similar to the voice *baerendi* (of *mbae*, thing, *hendi*, to glow) that gives Nordenskiöld[18] for meteor (adding this last one that the fall of one points out the death of a capitanejo -minor chief-). Braunstein[19] mentions that *katés ihwelí* (hang star) it is the *toba* voice for comet, and that the meteors are seen as powerful shamanes when dying, being believed that they always fall with great noise on a palm (*fwicúk*). According to this work the voice for firefly is *fwicohnah*. Métraux[14] comments that the comets are taken in the Chaco like announcements of epidemics, and the fall of a meteorite like the death of a shaman.

In Campo del Cielo, some few establishmentsn of *mocovíes* subsist, strongly acculturated. We carry out two visits (in January and April of 1999) to one of them: Toldería Cacique Catán, to some 35 kms of the city of Charata, province of Chaco. In general, the meteorites did not seem to occupy a specially outstanding place in their beliefs. Nolazco, cousin of the Indian Chief Marcos Ledesma, referred us that *wokani nahani* was the name for the fleeting stars, of *wokani*: star (*mocoví*: *avaccanni*, Tavolini [20]; *wacani*, López [21]) and of *nahani*, to fall. He also commented that these phenomena announced droughts or floods. And when landing, the fleeting stars got deep resulting in a mine. M. Ledesma confirmed this adding that when a star falls, "Luck falls" bringing luck to anyone. Both associated the phenomena, with some hesitation, to Mesón de Fierro and Laguna de la Virgen (a possible meteoric crater). They described with the word *niaratik* ("falls down and goes up") the movement of impact and arise of these "meteoric mines". They also said that both Laguna de la Virgen and Mesón de Fierro have "a powerful". At least, through interviewed *mocovíes*, we have seen nothing in connection with Álvarez' ideas. The association of fleeting stars with misfortune, recorded by ethnographers at the beginning of this century still remains doubtful; standing out the idea of luck or fortune in connection with meteoric fragments

Álvarez[8] states that primitive settlers might have used meteoric iron for their weapons and instruments. For that, he quotes the book *L'Homme avant L'Histoire*[22], where we find no reference to that. Álvarez also makes reference to Zuberbuhler and Dr. Sohle's comments who affirm Indians used meteoric iron to make arrow tips and boleadoras (putting everything together with wax). However, Álvarez admits that ethnographers who worked in this area didn´t mentioned anything about the use of meteoric iron. Even today there is no evidence of any piece made in this material in archeological collections. When asking about iron instruments, our informers agreed in that the early Indians made their boleadoras wrapping in leather a mass made up by bee wax and pieces of metallic pots. This procedure is remarkably similar to the one described by Zuberbuhler and might have been performed using little meteoric pieces. Nonetheless, we could not get confirmation of this through our informers.

TALES ABOUT CATACLYSMS

Álvarez associates the mythical tales about the destruction of the world due to the Sun fall with the meteoric event. Taking into account that the rest of connections between indians and meteoric dispersion does not seem to be as evident as he supposed, the identification of the cataclysm tale and the latter is even more doubtful.

In the Chaco area four kinds of cataclysms are the most relevant: "fire", "cold", "darkness" and "flood". Each of these events causes the "death" and metamorphosis of human beings and animals[23][7]. In general, these ideas are supposed to be derived from high Andean cultures, which overlap in the Chaco area with the own view point of paleolithical hunters. According to Imbelloni[24], these Andean apocalyptical ideas are related to the concept of the four ages of the world held by those high cultures. On the other hand, Pettazzoni points out that long nights cataclysms are well known among many of the North and South American tribes.[25]. We are interested in the cataclysms due to fire, darkness, and objects fallen from the sky. We will mention some of the most outstanding versions:

Cataclysms due to fire: *Matacos*[26]: 1) Earth destruction caused by a fire shower. 2) Retelling of a big fire that covers the whole area of Gran Chaco. *Toba-pilagá*[27]: The moon is attacked by jaguars and gets reddish (bleeding), pieces in fire fall to the Earth producing a big fire. *Toba*: 1) Big fire for Sun fall[14]. 2) Fire destroys all the Earth. Some are saved by going up to the sky and becoming constellations.[28]

Cataclysms due to objects which fall from the sky[27]: (*Pilagá*) The world is destroyed by stones shower (and hail) which falls from the sky. Nigth falls and everything is cold.

Cataclysms due to storm and deep darkness[27] :(*Toba-Pilagá*) deep darkness, a cloud covers the sun. At last it clears away, moving to the North.

We must remember that the sequence: objects in fire which fall from the sky-Big fire-Darkness-Cold, summarizes the series of events after an impact. It´s clear that the versions which better fit to this are the ones of *Pilagá*, who, within the *guaycurú* indians, are the ones who have remained stuck to old traditions for more time [14]. On the other hand, although the paralelisms between the Chaco and Andean tales are not few, the unity observed in the latter about the four ages and the four cardinal points is not present in the Chaco tales.

Even if the motive for the sun fall and other cataclysms seem to have been very strong in the past, they have weakened considerably. Although we have asked our informers on many ocassions about these motives, we could not get any retelling. The Indian Chief M. Ledesma, explicitly denied the fact that the sun had ever fallen, even when in his negation there was an implicit acceptance of the cataclysmic power of an event of that nature would have: "The sun never fell, if that happened, all of us would die. The sun is very hard". After that he told us that stars could indeed fall, "when there is danger". As regards the other kinds of cataclysms, we can only point out a tale which could have been associated to destruction due to hail (which as we have seen, it is related to the destruction due to objects which fall from the sky). Marcos Ledesma told us that the *mocovíes* were stopped in their route to the south for a heavy and unpredictable hail. A "Powerful" who was in a "hole" prevented them from going on. Therefore, they went back to Chaco. Marcos places the episode at the beginning of the century, coinciding with the Catán Indian Chief´s draw back from Santa Fe. (after which they settled in the area they still are).

TOPONYMS

We consider that the the toponimic system of these tribes is one of the most resistant elements to European penetration and therefore is a really interesting reservoir of their culture[29]. Besides, their toponyms reveal, most of the time, deep connections with their cosmological ideas.

Most of the works on Campo del Cielo affirm (considering Álvarez´s ideas) that since the XVIII Century the craters area is known as *Piguem Nonraltá* (translated as Campo del Cielo/Heaven´s Field), and Rubín de Celis Crater as *Piguem Nollhiré* (translated as Pozo del Cielo/Heaven´s Hole). From this, it is usually deduced that natives associated both places with meteoric dispersion. We find that the word *Piguem* in *Guaycurú* languages names, certainly, the sky[21][30]. The terms most similar to *Nonraltá* and *Nollhiré* we found, in the *Guaycurú* languages were: Field: *Nonorak -toba*-[31], *Noennagá -mocoví*-[32], hole: *Nollairé -toba*-[31]. The ones Abregú gives seem to be ones which are most like Álvarez´s, specially *Nollairé*. Thus, we can affirm that the names *Piguem Nonraltá* and *Piguen Nollhiré* are in a *Guaycurú* language. However none of our informers could recognize the words *Nonraltá* or *Nollhiré* as belonging to their language. Maybe for the degree of acculturation of the natives in the area. On the other hand, according to Abregu, the term *Nonrá* means "big" in the *Toba* language. Marcos Ledesma told us that in *Mocoví* the Campo del Cielo area is named *Nohenahá nondig'á*. The first of these terms seems to be equivalent to Tavolini´s *Noennaga* (field), the second should correspond to "big", due to the fact that Marcos told us the area had that name for being big. This could support the opinion which holds that the origin of the name Campo del Cielo is related to the big size of the area. Ledesma´s sayings could illustrated a recent episode, retold by the Director of Sudoeste Chaqueño Museum, Oscar González: an area nearby named Pampa del Cielo, might have received its name from European immigrants, after a big flood, because of the fact that only remained "water and sky". On the other hand, there are (even when works on the topic seem not to have taken notice about them) other places named Campo del Cielo in the Chaco area; for example Campo del Cielo in Formosa.

Early expeditions have given us other native names. Several chroniclers refer to the area where Campo del Cielo is as *Otumpa* desert. Ibarra´s expedition journal (1779) mentions a hole named by natives *Utumpa* [8]. The word could be related to *atun/hatun* -big in *Quichua*- and *pampa* -plain or field in *Aymara*-[33][31]; that is to say Big Field. It could also derive from the *quichua* word *thutumpi*, "prairie, plain"[31]. Maybe, both denominations (*Otumpa/Utumpa*, and *Piguem Nonraltá*) make reference in different languages, to the same prairie. Another name is *Uchu-Pallana* which refers to a place (expedition 1779). We believe it could be related to the *quichua* words: *uthku/hutqu*: Hole and *pallana*: name of children game which implies throwing stones in the air and picking them up while they are falling. It comes from *pallay* (pick up from the ground with your hands) means thing to be picked up, or place where it will be picked up. On the other hand for Chaco inhabitants there exists a great connection between stars and harvest (specially carob harvest).

CONCLUSIONS

The first conclusion we come to is the fact that there has been very little cross-information among anthropologists and ethnologists on the one hand, and the historians involved in meteorites research on the other .

Many of the commonly accepted affirmations, specially those referred to the "cult" which natives might have made to the meteorite, are highly speculative. We can not conclude that Chaco tales are doubtlessly the result of meteoric impact. However, we can not avoid pointing out that those tales have a structure that makes that interpretation possible. In fact, there exist tales of neighbouring ethnias built on natural phenomena which can still be recognized (due to their shorter age)[16]. On the other hand, the possible connections with Andean tales do not leave out the possibility that both might have been built having the same natural phenomenon as one of their sources.

To deepen the comparison of the area toponyms with other similar ones but not related with the meteoric dispersion, promises to be one of the best ways. This way has given us clues of the fact that the name Campo del Cielo is not necessarily related with a celestial phenomenon. In this area words from *guaycurú*, *lule-tonocoté*, *quichua* and *aymara* can be expected.

It is extremely necessary to carry out a more thorough field work in the Campo del Cielo area, both ethnological and archaeological. The former, to rescue the elements next to disappear in *mocoví* and *vilela* traditions, and to be able to set comparisons with Lehmann-Nitsche's works (this local tales are, besides, invaluable regarding the toponyms related to meteorites). Furthermore, archaeology in this region still is in an initial stage. New works could help to make more accurate relationships of these ethnias with meteoric iron.

REFERENCES

1. L. M. VILLAR, *La Dispersión meteorítica en la Argentina y Chile*, Ciencia e Investigación, Julio, 1968, pp. 302-314.

2. J. J. NÁGERA, *Los Hoyos del Campo del Cielo y el Meteorito*, Direc. Gen. Minas Geol. Hidrol., Publ. 19, Bs. As., 1926.

3. W. A. CASSIDY, L. M. VILLAR, T. E. BUNCH, T. P. KOHMAN, D. J. MILTON, 1965, *Meteorites and Craters of Campo del Cielo, Argentina*, en Science, vol. 149, 1965, pp.1055-1064.

4. B. SUSNIK, *Dimensiones migratorias y pautas culturales...*, Instituto de Historia, Fac. de Humanidades, Univ. Nacional del Nordeste, 1972.

5. E. J. A. MAEDER, *Las dimensiones demográficas del Gran Chaco...*, Separata de Investigaciones y ensayos num 37, Academia Nacional de la Historia, Bs. As., 1988.

6. S. COLAZO, *Las poblaciones nativas del Chaco*, Universidad Nacional del Nordeste, Facultad de Humanidades, Depto. de Historia, Resistencia, Chaco, 1991.

7. E. CORDEU, *Aproximación al horizonte mítico de los tobas*, en Runa, vol. XII, partes 1-2, Bs. As., 1969-1970.

8. A. ÁLVAREZ, *El Meteorito del Chaco*, Peuser, Bs. As., 1926.

9. J. LUBBOCK, *Los orígenes de la civilización y la condición primitiva del hombre*, Traducción de la cuarta edición inglesa, Madrid, 1912.

10. M. (S.J.) DOBRIZHOFFER, 1784, *Historia de los abipones*, Traducción de Edmundo Wernicke, Univ. Nac. del Nordeste, Fac. Humanidades, Dep. Historia, Resistencia, Chaco, 1967-1969.

11. J. (S.J) GUEVARA, 1764, *Historia del Paraguay, Río de la Plata y Tucumán*, en *Colección de obras y documentos relativos..., por Pedro de Ángelis,* Tomo I, Plus Ultra, Bs. As., 1969.

12. R. LEHMANN-NITSCHE, *La Astronomía de los Mocoví*, Revista del Museo de La Plata, Tomo XXVIII (Tercera serie, Tomo IV), Mitología sudamericana VII, Bs. As., 1924-25, pág. 78.

13. P. LOZANO, 1773, *Descripción corográfica sobre el Gran Chaco Gualambá*, Pub. Núm. 288, Univ. Nac. de Tucumán, Depto. Inv. Reg., Pub. Especiales del Inst. de Antropología, 1941.

14. A. MÉTRAUX, 1948, *Ethnography of the Chaco*, en *Handbook of South American Indians, Vol. 1*, Cooper Square Publishers, Inc., N.Y., 1963

15. R. LEHMANN-NITSCHE, *La Astronomía de los Mocoví (segunda parte)*, Revisto del Museo de La Plata, T. XXX (3° serie, Tomo VI), Mitología sudamericana XII, Bs. As., 1927, pág. 145.

16. R. LEHMANN-NITSCHE, *La Astronomía de los Vilelas*, Revista del Museo de La Plata, Tomo XXVIII (Tercera serie, Tomo IV), Mitología sudamericana XI, Bs. As., 1924-25, pág. 216.

17. ROMANO y CATTUNAR, *Diccionario chiriguano-español y español-chiriguano,...* Tarija, 1916.

18. NORDENSKIÖLD, *Indianerleben. El Gran Chaco (Sudämerika)*, Leipzig, 1912.

19. J. BRAUNSTEIN, *Revisión de la Astronomía Toba de Lehmann-Nitsche*, en actas de la sesión de "Etno-Astronomía", Simposio "Arqueoastronomía y Etnoastronomía de las Américas", 46° Congreso internacional de Americanistas, Julio 1988, Amsterdam), CAEA, Bs. As., 1989.

20. S. LAFONE QUEVEDO, *Apéndices a la Gramática Mocoví [del padre Tavolini]*, en Revista del Museo de La Plata, IV, 1892, pág. 265.

21. S. LAFONE QUEVEDO, 1896, *Vocabulario castellano-toba por el padre Bárcena...*, en Revista del Museo de La Plata, VII, pág. 243.

22. J. LUBBOCK, *L'Homme avant L'Histoire*, París, 1867.

23. B. SUSNIK, *"Los aborígenes del Paraguay" VI. Aproximación a las creencias de los indígenas*, Museo Etnográfico "Andrés Barbero", Asunción, Paraguay, 1984-1985.

24. J. IMBELLONI, *Religiones de América N° 10: las Edades del Mundo, sinopsis crítica de ciclografía americana*. Boletín de la Academia

Argentina de Letras, Tomo XI, N° 41, pp. 131-261, Bs. As., 1943.

25. R. PETTAZZONI, *Miti e Legende*.

26. J. WILBERT & K. SIMONEAU, *Folk Literature of Southamerican indians, Mataco vol. 5*, Relatos N° 58, 61 y 62, UCLA Latinamerican Center Publications, Los Angeles, 1975.

27. J. WILBERT & K. SIMONEAU, *Folk Literature of Southamerican indians, Tobas vol. 1 y 2*, Relatos N° 18, 19, 21, 37, 38, 39, 40, 41, 46, 47, 54, 57, 58, 59, 60, 61, 65, 67, 68, 69, 70, 71 y 72, UCLA Latinamerican Center Publications, Univ. of California, Los Angeles, 1975.

28. R. LEHMANN-NITSCHE, *La Astrońomía de los tobas (segunda parte)*, Rev. del Museo de La Plata, T. XXVIII (3° serie, Tomo IV), Mitología sudamericana X, Bs. As., 1924-25, pág. 181.

29. J. PALMER, *Wichí toponymy*, en *Hacia una nueva carta étnica del Gran Chaco VI (informe de avance 1993/94)*, Centro del Hombre Chaqueño (CHACO), 1995.

30. L. BRUNO, *Estudio comparativo vocabulario toba y pilagá*, Facultad de Filosofía y Letras, Centro de Estudios Lingüísticos, U.B.A., 1965.

31. C. ABREGÚ VIRREIRA, *Idiomas aborígenes de la República Argentina*, Espasa Calpe, Bs. As.-Mexico, 1942

32. F. TAVOLINI, *Mocoví (tomo I)*, Taller de Publicaciones del Museo, La Plata, 1893.

D. BRAVO, *El quichua santiagueño [reducto idiomático Argentino]*, Ministerio de Educoción de la Nación, Universidad Nacional del Tucumán, Facultad de Filosofía y Letras, 1956.

NOTES

1 The italics are ours.

2 Lehmann-Nitsche identifies this river with the Milky Way.

CULTURAL CONCEPTS OF THE MILKY WAY

Phyllis Burton Pitluga
Adler Planetarium and Astronomy Museum, Chicago, USA

INTRODUCTION

The Milky Way's white band of light across the dark of night is a unique and unambiguous pattern in the night sky. The Milky Way has been seen and described by people around the world. Its description in ethnoastronomical records cannot be confused with groupings of stars or with the five moving planets. Can perceptions of the natural world be used as a diagnostic tool to reveal human dispersal?

In opening this line of inquiry there are recognized limitations in generalizing. How wide a range and how far back in time is a diagnostic connection possible? Is it possible to determine cause from coincidence through analyzing the associated myths? Using cognitive archaeology[1] to compare different cultures across six continents and several thousand years, we would expect to find dissociation between cultures at great distances and would also expect to find cultures developing independent concepts. Also, the Milky Way itself is not the same everywhere along its path nor is the view of it the same from the different hemispheres. Ultimately the cultural astronomical data must mesh with archaeological, linguistic and DNA data.

Excellent sources of cultural concepts of the Milky Way exist in the familiar genre of archaeoastronomy literature. Richard Allen's "*Star Names, Their Lore and Meaning*" [2] is a good place to get a quick overview. A chapter in Ed Krupp's *Beyond the Blue Horizon* [3] and an article by Arnold Lebeuf, "The Milky Way, a path of souls,"[4] both contain examples of cultural interpretations of the Milky Way and both have subcategorized these interpretations. Lebeuf states in his abstract: "Legends and myths concerning the Milky Way are astonishingly similar to each other on all continents and throughout history. ... It is always very difficult to decide, and in most cases unsolved, if those similarities are the result of historical diffusion, or the fruits of parallel reasoning on a common set of evidence. ...the first step towards an eventual solution is certainly the collection of variants."

Oceania is missing in the current collections of variants. Also, Oceania is where the most recent migrations into previously unoccupied lands took place. These migrations occurred roughly between 1 A.D. and 1000 A.D. To test the persistence of a concept across space and time this author began retrieving information about the Milky Way from Polynesia, Micronesia and Melanesia. It is a work in progress. The purpose of this paper is to report on the information gathered so far. To follow the locations of places, it will be useful to have a map of the Pacific in front of you.

CURRENT THINKING ABOUT COLONIZATION OF THE PACIFIC ISLES

Decades of research have gone into understanding the prehistoric settlement of the Pacific. Much has been learned, much is still debated and much is still unknown.[5] The archaeological record is necessarily spotty. Yet, archaeological evidence indicates that by 800,000 years ago people were traveling by steerable boats out beyond Borneo and Java to, at least, the island of Flores. By about 50,000 years ago Australia had been settled by aboriginal people. By 6000 years ago people in the Papua New Guinea highlands were digging ditches to assumedly control swamps for crop cultivation.[6]

Today the Aborigines speak a language called Papuan.

Over the next several thousand years, waves of people from Southeast Asia migrated into Western Melanesia. Today, people speaking an Austronesian language (derived from a common ancestral language spoken about seven thousand years ago) are distributed from Taiwan in the north, throughout the Philippines, Indonesia, Malaysia, southwestward to Madagascar off Africa, eastward along the north coast and offshore islands of New Guinea, the Bismark Archipelago, Solomon Islands, and to all of the Pacific islands of Melanesia, Micronesia and Polynesia, out to Easter Island off South America. Austronesian immigrants interacted and intermarried with the older indigenous populations who were already proficient in raising food crops and had developed water transportation for inter-island trade.

Austronesians began to settle ever eastward about the second millennium B.C. From around 2000 B.C. to 1500 B.C. the distinctive Lapita pottery style spread from the Bismark Archipelago eastward through the Solomon Islands, Santa Cruz Islands, New Hebrides, New Caledonia, out to the Fiji Islands, Tonga, Vavau, Niuatoputapu and stopped in Samoa.[7] Among the debates is whether or not Lapita pottery is the marker of the first appearance of Austronesian speakers in Melanesia. In efforts of scholars to recover the great colonization-of-the-Pacific story in human history they are currently addressing a few questions. One of those is "what does historical linguistic research tell us about the location of the probable homeland of the Austronesian speaking peoples and their ancestral culture as revealed by vocabulary that can be reconstructed for the ancestral language." [8] The question being pursued here is tangential to the linguistic one. Rather than asking "what is/was this object *called*" we are asking "how is/was this (celestial) object *interpreted.*"

Another question of scholars is: did people stop their ever-eastward thrust into the Pacific for some 1500 years until about 1 A.D. or was there a slow but steady diffusion that hasn't revealed itself in the archaeological record.[9] The archaeaological evidence does show occupation sites all across eastern Polynesia extending from the far east in the Marquesas Islands from 1 A.D. northward to the Hawaiian Islands in 300 A.D., southward to Easter Island in 400 A.D. and on to New Zealand in 1000 A.D. [10] This is a vast area colonized by a culturally-linked peoples over a period of about 1000 years. This is also the region for which good documentation of their astronomical identifications exists.

PRINCIPAL SOURCES ON POLYNESIAN ASTRONOMY

The most thorough record of pre-historic and continuing identifications, knowledge and use of the celestial realm was gathered by Maud Worcester Makemson, Chairman of the Department of Astronomy at Vassar College in the 1930's. It is presented in her 1941 book *The Morning Star Rises.*[11] She was inspired by Professor Martha Warren Beckwith of the Folklore Foundation at Vassar College. It was Beckwith's *Hawaiian Mythology*, originally published in 1940, that first drew my attention to a common view of the Milky Way held all across Polynesia.[12] From the Beckwith and Makemson sources alone we can quickly gather together the foundation information. The following Milky Way identifications are geographically ordered from south to north and east to west. This is also, roughly, the sequence of first-occupation dates for island groups, from the latest to the earliest. However, secure archaeological dates are meager.

SOUTHERNMOST: New Zealand 1000 A.D.

Milky Way *(Te Mangoroa)*, *(Tangotango)*

Living Water *(Wai-ora)*, Great Ridge of Heaven

Long threashhold of wide space *(Paeroa-o-whanui)*

Long Shark and many sharks moving together *(Mango-roa)*

In the Milky Way: Long Fish *(Te-ika-roa)*, The fish of Maui *(Te-ika-Maui)*

In?: Great Fish *(Te-ika-nui)*, Parent fish of *Tangaroa*, Land-fish (lizard) of-the-sky

Dark spots: The Flounder *(Te Patiki)*, Cavern of the Flounder *(Te Rua-patiki)*, Stingray of *Titipa (Te Whai-a-titipa)*
Place whence wind comes *(Naha)*

NORTHERNMOST: Hawaii 300 A.D.

Milky Way: King shark *(Ku-kama-ulu-nui-akea or Kalake'e-nui-a-Kane)*

Stars of Heaven or row of stars *(Lelani)*, Backbone of the Lizard *(Kuamoo)*

Dark spots: volcanic rock *(Pu-lele-hua-kawaewae)*

EASTERNMOST: French Polynesia

Tuamotus:

Milky Way: Sacred Ocean of *Kiho-Tumu*, Tail of the Lizard *(Vaero-o-te-moko)*

In dark rift: The-Long-Shark *(Mango-roa)*

Dark spots: caverns of mist, Shark *(Te Aku)* near Scorpious

Tahiti:

Milky Way: Living Water of Life *(Vai-ora)*

Dark spots: star fishes and two Triggerfish that eat mist *(Maa-atai)*

Handsome Blue Shark beloved by *Ta'aroa* bathes in Milky Way

MID-POLYNESIA: Cook Islands

Rorotonga: Milky Way: water monster *(Te-Mokoroa-i-ata)*

Mangaia: Milky Way: Long Lizard of Morning *(Moko-roa-i-ata)*

WESTERNMOST: Western Samoa

Futuna: Dark Spot: Coal Sack, Fish? *(Suma)*

Tonga: Dark Spot: Fish (near Southern Cross) Coal Sack

MILKY WAY DATA FOR MELANESIA AND MICRONESIA

In the 1970's, Rubellite Kawena Johnson and John Kaipo Mahelona added to the research of Makemson and extended it farther westward.[13] The section specifically addressing the Milky Way does not give meanings for the Indonesian, Micronesian and Polynesian words. There is a discussion (initiated by Makemson) of the possible existence of a parallel between the Polynesian view of the Milky Way (as life-giving waters of *Tane* and/or with a shark and/or lizard) and the Indo-European view (as a "snake river"). Other sources of astronomical identification are in the several books about navigation. They address star names but not the Milky Way.[14, 15]

The following *new information* was gathered by the author through culling references at the Field Museum in Chicago, talking to their curator of Oceania -John Terrell, making contact with those conducting research in Melanesia and Micronesia through the appropriate ListServ, and contacting planetarium staff in Oceania. This information is organized for Western Polynesia, Melanesia, Micronesia then Philippines, each from east to west.

WESTERN POLYNESIA

Tonga: E.E. V. Collcott reported in 1923 that: "the dark patch of the sky near the left-hand end of the Southern Cross [Coal Sack] is called *'Humu'*, the name of a fish. The [nearby] Samoan word *'Sumu'* is the name of fishes of the genus Ballistes and also the name of a cluster of stars. Samoan legend states that the *sumu* (fish) and *toloa* (duck) were taken up to heaven and became signs... The Milky Way is called *Kaniva* (compare Samoan, *Aniva*)."[16] No meaning for *Kaniva* nor *Aniva* is given other than Milky Way.

MELANESIA

Solomon Islands: From his monograph and personal communication with Edvard Hviding from the University of Bergen, Norway we have the following description of the Milky Way from Morovo Lagoon in the New Georgia Group in the Western Province of the Solomon Islands. The people call the Milky Way *"Saghauru"* which means "coral reef." It refers specifically to the similar appearance of a reef at shallow to medium depths from a canoe where dark and light shapes are distinctly identifiable and vary from clear to fuzzy. The people explicitly think of the night sky as looking like the deeper waters of their lagoon and coral reef.[17]

Muyuw (Woodlark Island) Trobriands: In his book, *"From Muyuw to the Trobriands,"* Frederick H. Damon has compiled a table on the "Divisions and Activities of the Annual Cycle."[18] In the table, the Coal Sack Nebula is listed as *Tabwakum* but there is not a meaning given to that word.

Papua New Guinea: In *"The Folk-tales of the Kiwai Papuans"* the celestial words seem very unlike those of Polynesia. In particular, the shark, *baidamu*, is pictured in the stars of Ursa Major. The calendar identifications with the sky are of sons or brothers who were speared and thrown up into the sky. One is identified with Crux, the Southern Cross and another and his three-pronged spear in the constellation of Scorpious.[19]

MICRONESIA

Pukapuka Te Mango: Dark rift which divides the Milky Way from Scorpious to Cygnus; the monster which *Maui* speared and hurled high into the sky; small triangular dark nebulous patch near Scorpious as spear *(te tao)*.[20]

Gilbert Islands: Milky Way as belly of eel *Ruki*, heavens *(karawa)*, Rock-of-heaven *(Ba-ni karaw)*.[21]

Marshall Islands: Milky Way (*ial*; rainbow is other *ial*) in the yearly cycle of constellations across the sky, this is the pathway the star dieties follow, led by the Pleiades (brother *Jebro*) and followed half-way across by Antares (brother *Tumur*).[22]

Caroline Islands: On the island of Truk, the Milky Way is called the "Breadfruit Road," (*jaan or jaanenimej*) reflecting the belief that breadfruit comes from a mythical southland; Crux is the "trigger Fish."[23] On the island of Palau the Milky Way is called *"mesikt"* which means abundantly endowed or clustered as in grapes, coconuts and other fruit-bearing plants [breadfruit].[24]

PHILIPPINES

Several tribes tell the tale of lifting the sky. Sometimes there is a woman in the story wearing a necklace. The necklace chain becomes the Milky Way, the beads become the stars and the ornaments become the Sun and Moon.[25]

DISCUSSION AND CONCLUSION

For purposes of analysis, descriptions of the Milky Way will usually fall into one of four categories: path, river, animal, and/or dark-spots. The most *frequently reported* category in a *continent-wide region* can be summarized as follows:

Around the Mediterranean: straw path

Southwestern Europe: saint's path

Northern Eurasia: migrating-birds' path

North America: path of the souls

Asia: river and/or serpent (dragon, white elephant)

South America: river with animals, birds and fish in dark regions

Australia: river with dark lagoons, an emu

Africa: no one category stands out as most common

Regarding Oceania, a preliminary summary for this work-in-progress is that the ubiquitous identification across Polynesia of the Milky Way is with water and dark-spot fish, sharks(s) and lizard. This same concept extends to the island of Pukapuka Te Mango in southeastern Melanesia. The Gilbert islanders' identification of the Milky Way with an eel is similar to the idea of a shark. The Solomon islanders' identification of the sky as like a vast ocean and the Milky Way as a cosmic coral reef is similar to the Polynesian waters with dark caverns of mist where fish are lurking.

Farther westward in both Melanesia and Micronesia, the identification of the Milky Way with the chase of brothers, breadfruit, and a celestial necklace do not agree with the Polynesian conception of the Milky Way. Further information needs to be gathered from the intervening island groups to fill in crucial information just west of Tonga and Samoa, the last outposts of the Lapita Culture.

NOTES AND REFERENCES

1. P. BAHN, Archaeology - *A Very Short Introduction* (Oxford, 1996), 39.

2. R. ALLEN, *Star Names, Their Lore and Meaning* (Dover Publications Inc., New York, 1963), 476-477.

3. E. C. KRUPP, *Beyond the Blue Horizon* (Harper Collins), 257-273.

4. A. LEBEUF, «The Milky Way, a path of the souls,» in *Astronomical Traditions in Past Cultures*, eds. by V. Koleva and D. Kolev (Institute of Astronomy BAS, National Astronomical Observatory Rozhen, 1996)148-161.

5. J. Terrell, *Prehistory in the Pacific islands* (Cambridge, 1986) 1-270.

6. G. Irwin, *The Prehistoric Exploration and Colonisation of the Pacific* (Cambridge, 1992) 1-30.

7 P. Bellwood, *The Polynesians, Prehistory of an island people* (Thames and Hudson, 1987).

8. W. GOODENOUGH, *Prehistoric Settlement of the Pacific* (American Philosophical Society, 1996) 1-9.

9. G. IRWIN, «The Colonisation of the Pacific Plate: chronological, navigational and social issues» Journal of the Polynesian Society, Vol 107, No 2 (June 1998), 111-143.

10. B.V. ROLETT, *Hanamiai, Prehistoric Colonization and Cultural Change in the Marquesas Islands (East Polynesia)* (Yale, 1998) 1-7, 58.

11. M. W. MAKEMSON, *The Morning Star Rises, an account of Polynesian astronomy* (Yale, 1941) 183-188.

12. M. BECKWITH, *Hawaiian Mythology* (Honolulu, 1970) 438-439.

13. R. K. JOHNSON and J. K. MAHELONA, *«Na Inoa Hoku: A Catalogue of Hawaiian and Pacific Star Names»* (Topgallant Honolulu, 1975) 133-134.

14. B. FINNEY, *Voyage of Discovery* (Berkeley, 1994) 55-63, 75-88.

15. D. LEWIS, *We The Navigators* (Honolulu, 1972) 82-136, 277-294.

16. E. E. V. COLLOCOTT, «Tongan Astronomy and Calendar», Occasional papers of the Bernice Pauahi Bishop Museum, Vol VIII (1923) 159-160, 171.

17. E. HVIDING, «Guardians of Morovo Lagoon, practice, place, and politics in Maritime Melanesia,» Pacific Islands Monograph Series 14 University of Hawaii (1996) 402.

18. F. H. DAMON, *From Muyuw to the Trobriands* (Tucson, 1990) 29. Email personal communications.

19. G. LANDTMAN, «Folk-tales of the Kiwai Papuans,» ACTA Societatis Scientiarum Fennicae, Tom XLVII (1917) 483-484.

20. M. MAKEMSON, op. cit. (ref. 11) 185.

21. A. GRIMBLE, «Gilbertese Astronomy and Astronomical Observances,» Journal of the Polynesian Society, Vol 40 (1931) 197-207.

22. Personal email from Larry Carucci and phone call and letter from Gerald Knight accompanying his book Man This Reef, (Micronitor, Marshall Is, 1986) 1-7.

23. W. GOODENOUGH, *Native Astronomy in the Central Carolines*, (Philodelphia, 1953) 41, 43 and email.

24. Email from Pete in Palau.

25. Email from Pam Eastlick, Director of the planetarium in Guam.

ASTRONOMICAL REFERENCE AND SPIRITUALITIES IN EMPIRICAL ABORIGINAL NIGHT SKY

Hugh Cairns
Sydney, Australia

INTRODUCTION

Indigenous people know the night skies of their normal lives in great detail, and by massive linguistic, focussed imagination make sure that it is well remembered by young and old within the many-year long initiation educations which give them individual and community identity. By metaphoric interpolation their curiosity and care for experienced world includes concepts of transforming and transformative Spiritual Presence; and the night sky story-world in its personal knowledge of the empirical enhances the 24-hour reality of full human life while making all of life ceremonially ordered and personally valuable. This is a human spirituality of considerable cultural benefit and beauty — it refuses moral superiority to grasping forces of western cultures — and the ever-present night sky is full of proper Law.

This paper has both methodological content and new data. The methodological matters are to be noted immediately. 'Work-in-progress' tags emphasize that the most recent photographic and audio material of the writer and his co-researcher J.J. Drew is under continuing investigation. Digital videos — a small portion of 1998 Moon Dreaming was shown at Oxford 5 — give out direct, undoctored data: but two problems normal to such data-collection are present.

First, the exact astronomical reference in Bill Harney's stories is not always clear. Interpretation of the location of night sky phenomena is at times experimental, even if confirmed at the time. In some instances, there needs to be reappraisal and confirmation, with relocation, rejection or some other adjustment in accordance with new or examined data. This means that a qualitative theory approach is necessary: present sky maps are not in final form. Often the problem is simply language ambiguity: Bill Harney's six languages may be mixing together; for he is Bilarney in Pidgin, Yudumduma in family Wardaman; but the totemic story being recounted may be emerging from childhood with mother, or the initiating extended family; and in English emerging from the stockman's bush idiom, or the office know-how gained in successful Land Rights actions fought over 30 years in Courts.

Second, this means that the sky-maps prepared in 1998 have been re-made in 1999. Re-examination of the digital videos in the light of new ethnography reaffirms the tentative nature of some of the evidence: the present set is a third revision. When Yudumduma points to the map-set up along the wall in a discussion room, saying that a certain Spiritual Ancestor-Presence 'must be' in a particular area, this may be compounding an error made out in the bush.

The 1999 season has nevertheless confirmed, corrected, adjusted and at times added to the 1998 data; and oral traditions within Aboriginal cultures often amaze the western researcher with their firm memory for detail. Certainly the present data developing under qualitative theory produces working models to which the informant responds positively. Details in his data come from mother's father's, mother's mother's or mother's brothers' traditions; and in these families the story-telling basis of culture meant that under many, many clear night skies there was abundant talk over many years; and the emotion in these relationships in regard to oft-repeated intellectual contents of this cultural world will have worked for sometimes astonishing memory.

There are other reasons why the unveiling of deep childhood memories is not surprising. Yudumduma was hidden in the bush, not missionized. Quite often his own initiating Elders' story-set and concept-clusters are clearly involved. Perhaps fortunately for present research, he was unschooled, and written anthropological material has not been known to him. No researchers until the present writer (so Bill Harney says) have been interested in — or interested in him telling — his stories of the northern Australian night sky. So the way he expresses his Wardaman astronomy is fresh, unforced, convincing.

The videos show this informant bringing material into the maps being modelled with no prompting. Often it is the intra-story relationships and the way he cross-checks with the locations noted at an earlier session which suggest he is remembering his known story-and-night-sky details (not making them up). He sees them all through the very traditional Aboriginal world of Dream-time song-line within ancestral landscapes; and these include the night-sky total environment, part of the cosmic landscape of the 24-hour world, empirically experienced (Clarke 1997; Johnson 1998; Cairns 1999).

The night sky in fact has been almost the one thing which the european invaders and white occupants of the land have not been able to take away from the original indigenous people. Young Bill remembers hearing the stories of celestial happenings. It probably reflects his years of initiation-education after the age of 8 when he recently remarked:-

> "The (2 Falcons, Southern Cross Pointers) brought all the Law business, stopping people getting out of hand, making sure they behaved. They are the Watchmen: and if (people misbehave), they spear them with the Jinjin boning-tool. You sort of work me up, talking all about this! **We used to sit down and talk a lot after they taught us.** I forgot: but **when we were kids, we were all laying up, looking, talking about the stars".**
>
> *(Writer's emphases.* Source: Transcript Tape C: J. J. Drew. 1998*).*

Today, Bill Harney maintains that he is telling us the night sky story-realities because his grandchildren need to know the ancient Dream-time world for their survival, and their parents have lost interest. Thus, while he is a great story-teller in the Aboriginal genre — no doubt at times answering peacefully the anthropologists' questions as they wish, making things interesting in the normal community way (and the present researchers are well aware of this) — the material in these Wardaman sky-maps is a valid contemporary Aboriginal thought-world and lived-in order. It comes from mother and her kin. This Senior Elder in this land has not spiritually moved outside Tradition: it interiorizes its intellectual force in him, producing the spiritual freedom to fight in the courts, to win the Tradition back for grandchildren and people.

NEW DATA

With the above provisos, it is reasonable to put forward the tape- and video- data and conversations at major rock-painting and engraved art sites; and to reflect much of the whole Aboriginal Tradition in the mapping of night skies. Ancestral stories relate rock art to the night sky within a spiritual tradition where Cosmic Presences relate to ceremonial calendar, ritual details, seasons and natural environments, practical survival information and skills like night navigation — spiritual-intellectual pathways of life in which song, art, music, dance, medicine, story and social relationship express our true humanity.

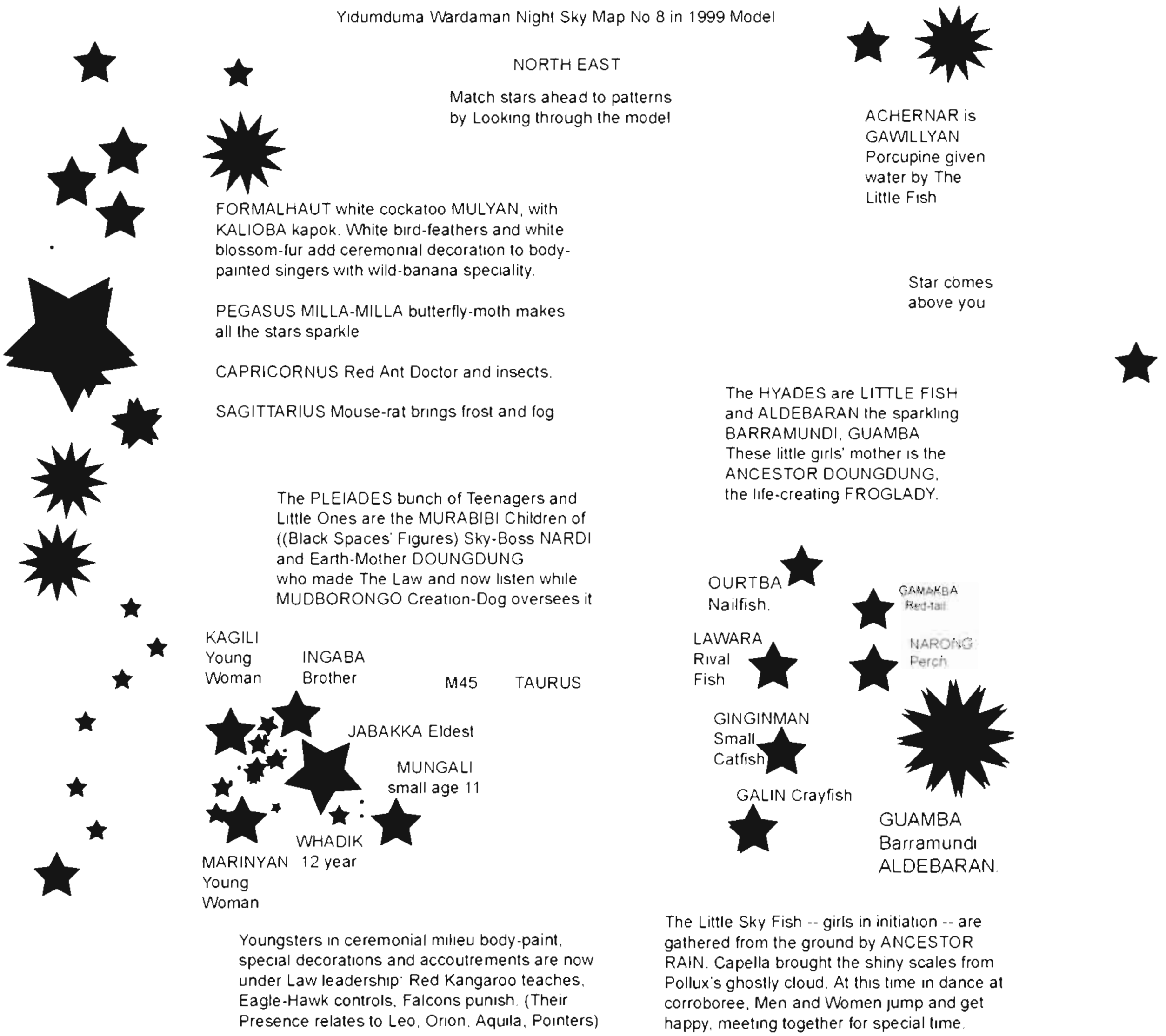
The Kadawaji, Kong-Kong-Meia and Nardaya sites have present in them Kandawa the Moon and the Sun Mooningari; and in the great Black Spaces (as dust-nebulae figures) the overall Sky-Boss Nardi, his Life-mother wife Doundung, the Cosmic Emu Gumerinji, and Rainbow Serpent Gorrondolmi who as Doungdung's first husband fathered earth-and under-earth life and being.

The Nardaya site with its interpretations are data new to formal research in the area. (The site will be reported on by J. Flood who visited it first earlier this year). Cosmic ramifications here (including astronomical relations of the Black Spaces Personages) are not in the literature. Gumerinji the Emu is Dreaming from a neighbouring people, so the story is not Bill Harney's to pass on (making it negative evidence). But Nardi, Doungdung and Rainbow are massive Spiritual Presences to him, and work in with other totemic ancestors integral to the Song-lines and present at these sites viz. Wedge-tail Eagle Bullian, Mudborongo the Creation Dog, and the Grasshoppers, Dendenman especially. The Black Spaces crocodile Wariga is mainly a neighbouring Dreaming: but others like Catfish, Yam, Ground Oven, and Hair-Belt are of considerable importance, but not specific to all major sites. As for the sun, moon and planets, their stories in these songlines are strong, and noted below: but the spiritual-intellectual world involves surprising detail.

The ecliptic is Yorndorim, a Dreaming Track in the Sky (just as Eagle's, Creation Dog's and Butterfly's). The pathway, route, direction along the ecliptic shows a traveller how to cross unknown country for trading, or a ceremony, or a camp. "It's a calendar, gives 'em direction". You put your eye there, "the route's over your shoulder ... and that little star ... you go straight there. You know the stars, planets and judge distance in your mind. Going across? Emu-foot tells you. South-east? Set course between Yorndorim and Emu's Foot ... it's a compass to us with the Southern Cross, the Moon, Bullian ..."

There are a number of 'morning' stars: Arcturus, Achernar, Canopus (with their stories). But it was the Ancestral Grasshopper, Neeri, who is called the Morning Star: travelling first (bright as Venus but in this Aboriginal world without any deifying 'worship' of a star or planet) she shows the straight regularities of direction, in proper and educational songs. Making the very big wind and underground water, she returns after dying — "the very large one coming last up in the east with that early morning breeze". Together with Lightning Neeri makes wind, rain and tornadoes; and with these surprisingly observed relationships, this Morning Star nevertheless shows the planetary ecliptic as a very practical pathway for travelling and navigation — an unusual but very reasonable method in a land of clear skies day and night.

As for the Milky Way, this is Wandarim. It divides the night sky into 4 pieces by spreading it into 2 areas followed by intersections by the sun and moon as they cross on their ecliptic routes. It shows the seasonal changes as it twists round during the year; and the time of night too. (Even westerners get to realize this, outside their northern clouds). As for spiritual song, the Milky Way is the children of Nardi sprayed across the heavens: but the cardinal points were produced by Blue-tongue Lizard, Barariman, who threw the (ceremonially special) Hair-belt, calling out the directions as the belt swung round when he did this. Beyond that metaphor and into concept-clusters galore, the Milky Way is a totemic pathway of stories for life. We should learn, our children must learn: the Ancestors have been this way before.



METAPHORICAL DESCRIPTION

The Murabidi children of Frog-lady Doungdung, the bunch of teenagers and little ones, controlled by Red Kangaroo (in Orion) and disciplined by the Falcons (Pointers).

CEREMONIAL FOCUS

Doungdung Earth-Mother lay back listening to these Children of the Sky-Boss Nardi and herself after making The Law. They let Mudborongo Creation Dog take the lead, leaving Red Kangaroo to be the Law with the children, and Bullian Eagle-Hawk to control, and punish them.

PRACTICAL IMPORTANCE

Youngsters in ceremonial milieux of body-paint, special decorations and accoutrements are under Law leadership. Also re. a special location: Wanibarung, the Women's Sacred Place where children are not allowed lest rocks are broken and spirit children let out to be born, is a dangerous area with paperbarks but no paintings.

A MODELLING OF THE CALENDAR INVOLVED

The Aboriginal Year to this group of Wardaman people begins with the constellation Leo, after the Wet (around May). Looking north and swinging round the horizon east and then south to Crux, the observer can see the autumn-winter songlines at a glance. Regulus in Leo (the Thylecine-striped and Dingo-related Creation Dog Mudborongo) starts the Songs with Coma Berenices and Ursa Major Bird-Ancestors as messengers. The watchful Sky-Boss Nardi, round by the Southern Cross and always observable in the southern hemisphere, is a looming Black Space observable figure; and he is checking that the world is going the way he plans, according to The Law.

The Mudborongo songs-with-ceremonies travel through the Corona Borealis major sacred place right round to Crux, where the massive ceremonial is focussed in initiation reality. En passant, this song-line set has functional relations with Hercules, Lyra, Cygnus, Delphinus, Ophiuchus, Capricornus, Serpens, Serpens Caput, Altair, Scutum, Sagittarius, Scorpius, Corona Australis, Pavo, Ara, Musca, Norma, Lupus, Triangulum, Avior, Carina, Puppis, Vela and Centaurus — and songs also relate to star-groups not in the exact central star-stream, viz. Corvus, Arcturus, Spica, Achernar, Formalhaut, Vela and Magellan Clouds.

These stars and star-groups carry information on eg. stone-knives needed for cutting rituals, boomerangs, messages; the trading necessary to get eg. the special stone; and other normal-life necessities such as fire, personnel for gatherings, food and water needs, locations of Law Places. Dance-steps are there with Brolga and Pee-wee, musical beat and noise with Bush Turkey and others; and details of instruments with all the accoutrements of ceremonial ritual and decoration — for instance what plants the feather-parachutes come from, what specific noise is to be made when, what smell or action is dangerous to someone who should not be there.

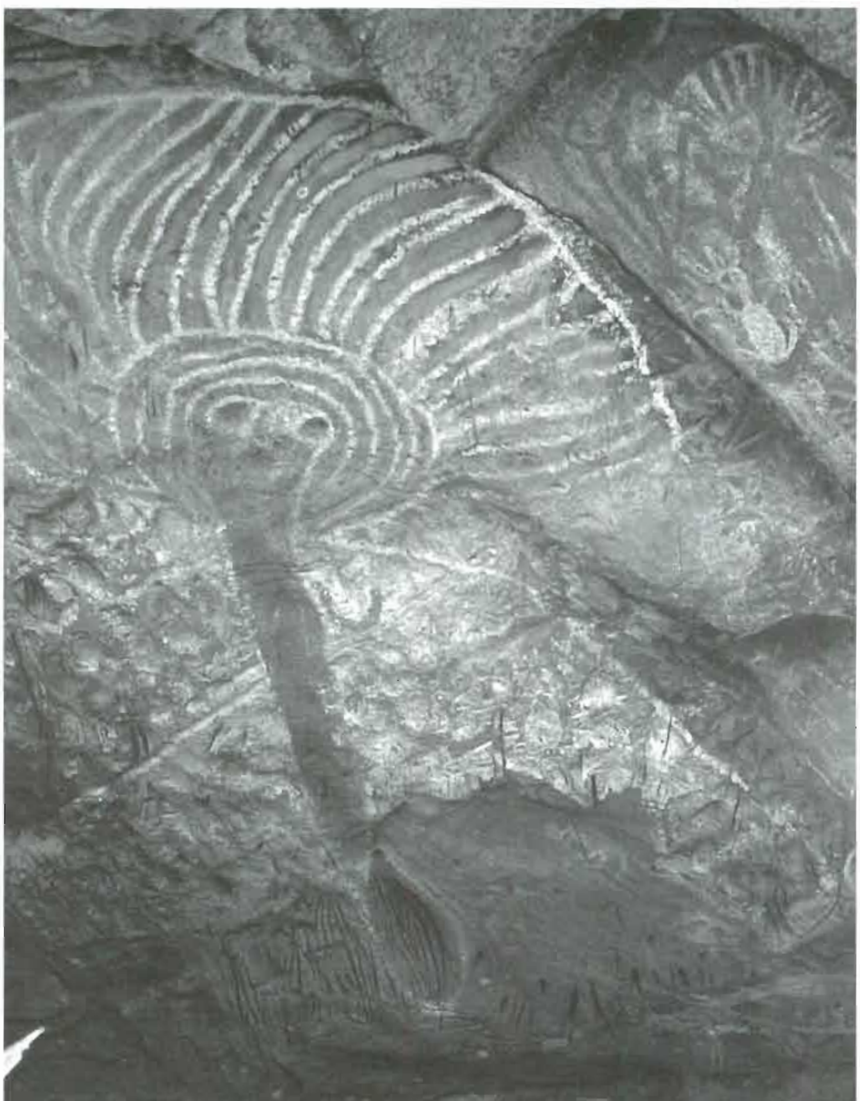
All through the night sky the pathways are the Ancestors themselves. Eagle (Altair) runs the preparations, Red Kangaroo (Orion) sorts the details, the Falcon security-men (The Pointers) check and control the disciplines involved in the communities and their ceremonies. All the while the Sky-Boss and his wife continue to listen, watch and make sure it is all going properly. All the world is meant to be happy and harmonious. For that The Law is to be kept.

Of course, by the October initiation-ceremonial season the people involved in the ceremonies have been appearing along the night sky. The Teenagers (Pleiades) and the Little Fish with their Barramundi keeper (Aldebaran in Hyades) have since July been organized by their manager Red Kangaroo. This set of songlines relates to Pegasus, Capella, Castor and Pollux, Canis Minor, Canopus, Canis Major with Sirius, Monoceros, Hydra, Canopus ... as well as the other star-group Ancestors (mainly noted above) who have come across from the winter songline to meet the Milky Way at Aquila with Bullian Altair.

Clearly, observation of this northern Australian night sky has developed (over the more than 60,000 years) into this ceremonial season in concert with Regulus becoming its brightest and most outstanding after the Wet; and with the reappearance of the Pleiades as the Milky Way comes up from the East, just after this. After Mudborongo-Regulus glitters, the Aboriginal group have 6 months education-time before the October gatherings for ceremony. Under the stars, every astronomically-informing story can be part of the preparation for both young people to become adults, and all people to gain a cosmic-perceptive Gestalt-impetus towards spiritually awareness and intellectual transformation, through the presence of the wonder of the night sky.

The input over these months is of all types of information. Old people note the reincarnation concepts involved in the July star-stories; clever-doctoring people see the Capricornus stars bringing out the dangers in the cutting operations and the informed methods of wound-cleaning; Pegasus-Butterfly shows the beauty and sparkle of the stars so that special clays are searched for, to make sure that the body paint glows like the Ancestral Presences in the cultic reality of Making a Man, and in the women's ceremonial world.

Thus, many areas of the sky inform other areas, as the stories move through and intersect the sky. Amongst the actually-observed astronomical presences of autumn-winter the massive Spiritual Presence (post-Wet) of the enflamed dust-nebulae shape of the Rainbow Serpent (with its head in Scorpius but body stretching to Aquila) is so awe-inspiring above at midnight in the Southern Hemisphere, such Big Cosmic Law and major local Creation-Law (when Black-headed Python, Water-snake, King Brown, Yellow Black-head and Taipan form Country and make Law within Rainbow's transformed reality) that cosmic wonder becomes intellectual Gestalt so powerful that Tradition rules, and makes sure that The Law is carried out absolutely right.



Photograph 1

Then, when Rainbow wanes in spring and summer, this one world of heaven-earth becomes over-seen by Nardi emerging in full visage, the vibrant Black Space figure in July (just after sundown) with his wife Dungdung (both to the west of the Southern Cross). With Dungdung's first husband Rainbow not now clearly seen, but surely known to be there both astronomically and as father of the water-wombed children in sea and river and lake, and on the land, Nardi keeps observing all his children spawned with Doungdung in the heavens, as well as their Lightning children's children on earth.

PHOTOGRAPHIC DATA AND THE VISUAL MODELLING OF A NIGHT SKY

These massively-lit Blace Space personages dominate Bill Harney's sky. Once we see them, we can understand the Law which moves through it all, as it dows on land. The following examples are examples of night sky concept-clusters in the metaphored symbols, the intellectual expressions within the art. They are details in Bill Harney's night sky world, but they show that art and archaeological sites in his country have major astronomical relations in many forms, in the many song-line metaphors of his totemic world.

PHOTOGRAPH 1. KADAWAJI: MOON DREAMING

Direct observation of moon phases was suggested at this site by the earlier custodian's description of an engraved series of grooves as "them's counting" (cf. Cairns in Ruggles ed. 1993). The nearby concentric-circles' rays number 28 (firmly suggesting the moon's observed monthly cycle); and various stories concerning the moon's monthly death are told here, with the glow of the unlit moon noted, and connections with water and its movement.

The ritually important site relates to circumscision (including sub-incision: the oval-shape being Special Law made by Kandawa for Initiations); to special "women's business" at the sacred Bandalan place (including the Corona's kneaded bowl of hair which is very special Big Hair Belt for Big Moon); and to Dungdung, Rainbow, Bat and Cheeky Yam Dreaming (a poisoning at the nearby spring-water site where Kandawa dies,"his spiritual going into the rocks there"). These songs are in the rock art, brought along by Grey and Brown Falcon (Nardi's man Bullian's enforcers); and the place makes the totemic descendant emotional, for it produces "a cloud, a spiritual in your brain".

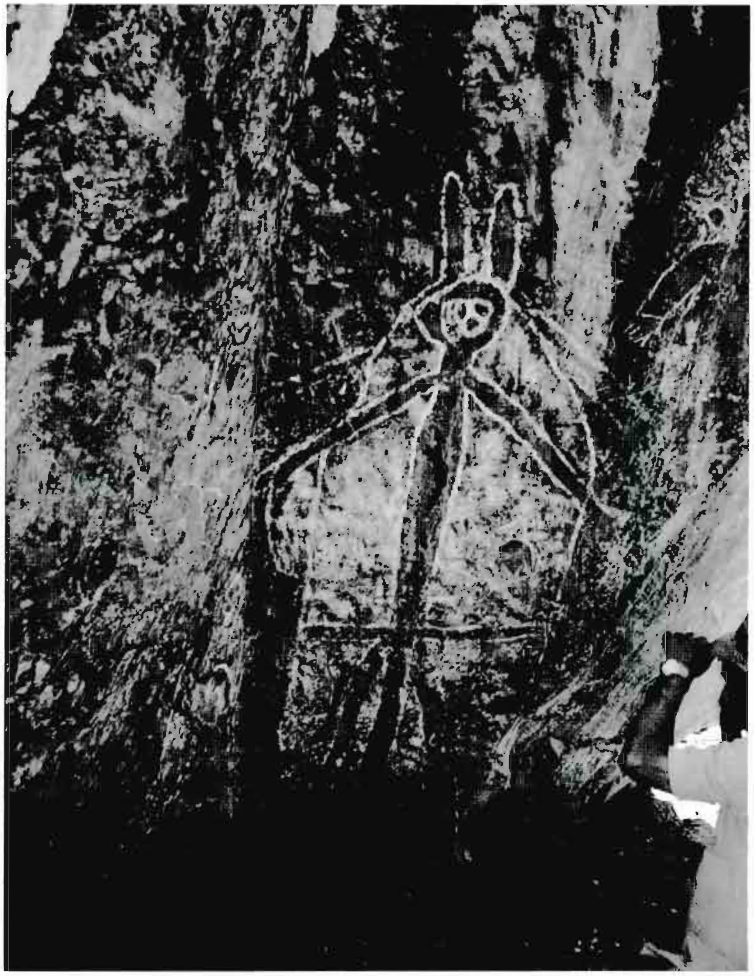
Photograph 2

PHOTOGRAPH 2. THE LARGE RAYED SUN (WITH THE COSMIC EMU) AT KONG-KONG-MEIA

This painting reflects direct observation-experience of the heat of the sun. The story concerns the sun's movements in the 'dungeon-weed' which drags it down, cooling it; and the rings pictured symbolize the progress deeper into the cooling world through funnel or tunnel (Lyra) and back again. It is therefore is about telling the time.

The sun is full before the Wet, at ceremony time when cuts need healing before the rain comes with flies, maggots and sickness. The outside line is the Big Sun Mooninganni who makes warm days and cool nights; and other rings are the dangerous sun and the heatwave season when rain is at last brought by the Grasshopper's whirly dancing with the Lightning Man. This Wardaman land is Grasshopper country.

The sun's different temperatures are recognized in (at least four) Grasshoppers' relationships with Rainbow/ Black-headed Python, the Djerjerman Bat, Wood-pigeon, the Falcons and the major Law-man Bullian who controls the



Photograph 3

careful burning of country. At the sacred places, small natural cups in the rock are grasshoppers' jumping-imprints during November's big fires, when the falcons and lizards eat them as they make the gum-weed in response to (lizard) Gagagula's Song.

PHOTOGRAPH 3. THE NARDEYA SKY-BOSS SITE

This site includes the cosmic-figure paintings of Nardi and his Earth-Wife, their Lightning Children, and the Cosmic Emu. The central Sky-Boss figure (with the Moymoi strings with which he transforms people up and down) has his wife on his right, a Lightning son higher up on his right (with headress); and Gumerinji the Cosmic Emu well to the right of Lightning. Gumerinji Emu is Dreaming from farther north, but it is still a Big Song in Yudumduma Bill Harney's family (not his story, and so, not told).

Nardi's engraved and painted footprint shows him moving up the middle of the Milky Way (symbolized by the engraved lines). To their left (out of the picture) are the footprints of himself, Red Kangaroo and Cosmic Emu. They are all travelling 'up top' as normal; and they are transforming 'in the spiritual way' — which all the time connects the night sky with the realities of earth.

In the song-set, Nardi sings his family as they travel across the sky, pushing them all along, saying 'you all be good!' as they are "all lined up right across with himself in the middle". To Bill Harney, Nardi was a "Big Gong Man" in those Creation days before things changed; and now he listens and watches to keep control of his mob down below also. Thus, while there are no songs about stars (and no stars painted as stars: they are Nardi's children), the songlines criss-crossing the country are to do with the 'on-top' creators "... Big Red travelling across top and bottom leaving formations and paintings; Rainbow on bottom, then top, then bottom; Mudborongo travelling up top, then down" ... all the while to do with Nardi, Doungdung and Rainbow. These are Living Presences, visible in the night sky ... and symbolized in the art.

SUMMARY AND CODA

Observation of the Milky Way, together with the northern and southern pole-areas, gave these Aboriginal people the cognitive signposts necessary for an ordered, reflexive and basically ceremonial year-season. In the autumn-winter skies the Creation Dog Mudborongo makes and carries Law (with his bag of songs) from outstanding Leo-Regulus; and major Law-maker/carriers move from Ursa Major and Coma Berenices along to the Southern Cross. Nardi's Law is taken via

Mudborongo, Bullian and others, with all their specializing legal-practical details, across from Leo to the Milky Way at Aquila, and thence to the centre of our galaxy (as it were) in Scorpius-Crux.

This Law-movement then continues from Pleiades-rising again over to the Southern Cross at the specific time, with its focal aim the teenager-initiations in October. With the latter Law being carried by Red Kangaroo from Orion, the movement has help from many others, especially stone-axe trader and song-carrier Willy-Wagtail. With the Grasshoppers and Flying Foxes closely involved, this ceremonial calendar brings practical real-life details into the educational world of the community; and its' basic relation to the heavens permeates the stories and the art found in Bill Harney's Wardaman world.

In all this art, the non-linguistic art-expressions are symbolizing what is cognitively expressed in story, to engage human understanding of the complex 24-hour multi-space and multi-dimensional world, and create awe.

The practices and spiritual realities, which burgeon out of humanity's exponentially-zooming mind in linguistic and artistic forms, include the conceptual and practical-ceremonial transformations and identities — and manipulations of these — which allow and encourage human cognitive exploration of the whole inner and outer environment. Metaphor is the focal channel in this language: but in drama-enhanced practice the actions enstoried in the night sky run the gamut from dance-step and decoration to fire-making and symbolic cuttings of the skin, to the demands and firm administrations of The Law through Ancestral Presences seen, observed, listened to and known today ... in the spiritual way ... in The Law Tradition.

This world includes solar-cycle musings and what may be seen as real curiosity. The spiritual worlds invoked gather totemic relationships to particular parts of the local natural world, and particular behaviours needed in relation to natural kin and seasonal regularities. In its linguistic beauty, its' cognitive resilience and its' flexible life-completeness the Aboriginal spiritual openness within creative story-telling shows a healthy and socio-biologically successful way of living life within a mutually-selective natural environment. This cognitive mapping needs no urban or even agricultural force. Modern conceptual scientific constriction with mathematical control is hardly needed when symbiosis within the natural world is contained within the spirituality of observed Spiritual Presences. Ceremonial songlines permeate heavens and earth; art in its various guises elucidates the world; life is danced with steps coming from eternity.

The Aboriginal night sky of the Black Space Presences and their lines of Song nourish a spiritual world. As Bill Harney's grandchildren meet such a Tradition alive with Good Dreaming, the Sparkling Presences too will light their way; and an astronomical world noted in Ionia and changed by theory and math into the chaos of today should aim to be at least as Good as this.

ACKNOWLEDGEMENTS

This continuing research into a particular Aboriginal astronomy is made through the good concerns of Bill Harney — Yudumduma — Chairman, Wardaman Aboriginal Corporation, Northern Territory, Australia. This people own all intellectual copyright of their material, including story and rock art. The field-work has been done cooperatively with J. J. Drew, M.Phil.(pending), University of Sydney; and indeed would not have been undertaken without her tenacious work. The sky-modelling is all the present writer's, and the concept of working observation and subjective perception involved stems from his Ph.D. work for the University of Edinburgh, 1971. Its' uniqueness and the interpretations both accurate and rather more uncertain (even wrong) are my own, but still in test.

REFERENCES

H. C. CAIRNS, 1993. Aboriginal Sky-mapping? In C.LN.Ruggles (ed.) **Archaeoastronomy in the 1990s,** pp.136-152. Gp D. Publications: Loughborough , U.K.

H. C. CAIRNS, 1997-9. Audio- and video-tapes of Field Work in Wardaman country.

H. C. CAIRNS, 1999. *RAR* Review. *Rock Art Research* 1999 — Volume 16, No.1. pp.57-60. Extended book review of **Night Skies of Aboriginal Australia — a noctuary** by Dianne Johnson 1998. Oceania Monograph, University of Sydney.

P. A. CLARKE, 1997. The Aboriginal Cosmic Landscape of Southern Australia. *Records of the South Australian Museum* 29(1):125-45.

J. J. DREW, 1997-9. Audio- and video-tapes of Field Work in Wardaman country.

D. JOHNSON, 1998. **Night Skies of Aboriginal Australia — a noctuary.** Oceania Monograph, University of Sydney.

C. L. N. RUGGLES (ed.) 1993. **Archaeoastronomy in the 1990s,** pp.136-152. Gp D. Publications: Loughborough , U.K.

YUDUMDUMA BILL HARNEY and J. WOZITSKY, 1996. **Under the paperbark Tree**. Sydney: Australian Broadcasting Commission.

Esteban & Belmonte Eds.

OXFORD VI and SEAC 99

CABILDO DE TENERIFE