

4.4 Appendices

4.4.1 Appendix 1 - Sub-Saharan Africa: Cultural Astronomy's Heart of Darkness

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Sub-Saharan Africa: Cultural Astronomy's Heart of Darkness

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There is no more deeply primeval experience than to gaze overhead at the Milky Way arching from horizon to horizon on a pitch-dark African night. And with good reason: our species originated in Africa; it was from there that our ancestors first looked up and pondered the mysteries of the cosmos. It should strike everyone as odd, then, that cultural astronomers have paid relatively little attention to Africa. The eve of a new millennium is an appropriate time to revisit, or for many of us to contemplate for the first time, the astronomical heritage of humanity's home continent before it is too late.

With the spectacular exception of ancient Egypt, Africa has not been well served by scholarship on cultural astronomy. The disruptive consequences of slavery, colonialism, and racism imposed upon Africans in modern history, and perpetuated in a real way by continuing discrimination, at times of a quasi-scientific "Bell Curve" variety, are inescapable. There are those who would say that cultural astronomy has precious little to do with race relations, but surely the African lacuna in our multidiscipline-which embraces so many societies and time periods within its global domain--is more telling than coincidental. On the other hand, it must be said that the Afrocentric backlash against academic discrimination and neglect has had, at best, mixed results. For instance, sensational claims of advanced astronomical knowledge for the Dogon people of Mali have given African cultural astronomy an "ancient astronaut" sort of reputation. New Age enthusiasts continue to be inspired (Andoh 1999). Not only is more responsible scholarship called for, more judicious if sympathetic presentation to wider audiences is sorely needed.

In terms of research, cultural astronomy's origins as a subdiscipline of archaeology have contributed to the neglect of Africa. Quite naturally archaeoastronomers have a strong predilection for material culture, especially monumental architecture. To be somewhat unfair one might say the more monumental the architecture, the better. The relatively unimposing nature of Sub-Saharan monuments has not attracted a great rush to document astronomical alignments, symbolic geometry's, and celestial iconography's. But perhaps the breakthrough study has just been made. In 1997 McKim Malville identified some very suggestive alignments at a megalithic complex in the southern Egyptian desert at Nabta, a site of seasonal habitation for nomadic pastoralists between 11,000 and 4,800 years ago (Malville et al. 1998). One stone circle exhibits a line-of-sight 'window' at an azimuth of 62 degrees; the rising mid-summer sun would have been visible in that direction circa 6,000

years BP. This is quite fittingly the oldest astronomically aligned structure yet discovered anywhere on the planet.

Another well-known megalithic site, Namoratunga II, near Lake Turkana in Kenya may well have aided calendrical observations around 300 B.C. (Lynch and Robbins 1978). Unfortunately, in recent years no other Sub-Saharan monuments have been surveyed for their archaeoastronomical potential. Numerous sites merit such investigation: the Senegambian stone circles, the Central African Republic's Bouar megaliths, and ruins in the Great Zimbabwe tradition. With the prospect of discovery we should no doubt expect many negative results. I am personally skeptical that any alignments could be found in the irregular architecture of the Zimbabwe sites. At all events, someone should look for them. If only there were more copy cats of Lynch, Robbins and Malville than of high-school shootists!

However, the lion's share of Africa's astronomical heritage is not locked in silent stones; it exists in still-living and exceedingly rich oral traditions. For among nonliterate peoples knowledge is passed from mouth to ear. Western scholars only began to appreciate the realm of African orality after Ruth Finnegan's *Oral Literature in Africa* (1970). (Ironically, Finnegan is best known for her erroneous claim that there was no such thing as African epic poetry—since the 1970s dozens of African epics have come to light.) Astronomy in the African oral record remains an undeveloped subject, although its potential can be gauged by the achievement of the only monograph to date on African cultural astronomy: Muusa Galaal's *Stars, Seasons, Weather in Somali Pastoral Tradition* (1992). Conducting his research in the 1960s Galaal relied entirely on oral texts as the Somali language did not have a standard written form before that time! Who knows what information could be had from the griot of West Africa or the isibongi of southern Africa? Or even from common folk who remember the stories their grandparents told them. Oral tradition, sadly, is an endangered resource; the indigenous societies that had created and sustained it have, in this passing century, been negatively transformed. On a recent visit to the University of the North-West in Mmabatho, South Africa, I heard from a professor that the local people had forgotten most of their sky lore but had a great appetite for cell phones and NBA t-shirts. It is hoped that a student research project in Setswana oral knowledge will be initiated within the next academic year.

There are other positive signs. Members of the United Nations Working Group on Space Sciences in Africa have expressed an interest in recovering indigenous astronomy's for purposes of promoting culturally relevant science education. Meanwhile, Thebe Medupe, one of the leading black astronomers in South Africa, is participating in a TV documentary "Cosmic Africa" on indigenous knowledge. Much more could be done. It goes without saying that others should join in the great enterprise of recovering Africa's astronomical heritage. After all, "Mistah Kurtz--he dead."

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Alignments and Orientations Again

Iwaniszewski, Syanislaw. 1995. *Alignments and Orientations Again*. *Essays from Archaeoastronomy & Ethnoastronomy News, The Quarterly Bulletin Of The Center For Archaeoastronomy*. Number 18 December Solstice 1995

Alignments and ancient observation places (ancient observatories?) are one of the main concerns of archaeoastronomy. In the last issue of A&E NEWS Dave Dearborn addressed a series of questions concerning the nature of observatories. His preoccupation with orientations and observatories mirrors a particular phase of the development of our discipline but our attitudes towards what we define as astronomical orientations and observatories are changing. This essay intends to form part of a larger dialogue concerned with multiple approaches to the study of orientations.

At the beginning of modern archaeoastronomy, the search for astronomical alignments and ancient observatories was a common methodological practice. Early archaeoastronomers (called astro-archaeologists in those times) were really obsessed with very precise astronomical orientations and the monuments and places where such alignments were detected, were naturally considered as ancient observatories. Where less precise alignments were discovered, early archaeoastronomers talked about different levels of astronomical competency and later separated scientific (and more precise) astronomy from ceremonial (less precise) astronomy. At that time alignments and not monuments were the goals of scientific activity.

In archaeoastronomical practice, alignments and orientations have been separated from material objects for a long time. In my view, alignments and orientations form one of the possible classes of attributes that characterize material objects. Archaeologists usually deal with a variety of material culture objects, be they pottery shards, lithic artifacts, iron implements, architectural remains or even human skeletons, and try to order them into a meaningful pattern. This can be achieved through the identification of resources, materials and technologies used for the object fabrication, description of their macroscopic (physical dimensions, color, shape, ornaments, etc.) and microscopic (chemical composition of raw sources, biological identification of organic remains, etc) attributes and the establishment of their spatial and temporal relationships. Therefore, alignments and orientations should be viewed as artifactual (macroscopic) attributes.

Alignments and orientations do not exist without artifacts. Similarly, the quality to be red, or redness when separated from a red jar becomes an abstract concept losing its sense.

Redness, particular diameter or an orientation are abstract concepts which manifest themselves in material objects. The visual line that links a particular monument or place with horizon features associated with certain astronomical events, exists through this artifact. So, when we speak of alignments, we cannot separate them from artifacts, ultimately those are the artifacts that have certain meaning and this meaning may be stressed or emphasized by particular alignments.

Traditional archaeology has dealt with orientations in a very narrow sense. Orientations of architectural features or human burials were treated as attributes used for typological purposes. Archaeological reports present summary statistics of how many structures (usually houses, temples or tombs) or skeletons are oriented in such and such direction to conclude that in particular archaeological cultures such were general orientation patterns. In case of human burials differences of gender in respect to certain orientations have been observed. However, it should be emphasized that orientation trends were used only for the establishing of typological criteria.

Processual or "new archaeology" has interpreted orientations in terms of society's adaptation to natural environment. Particular orientations have been analyzed to define their adaptive function (for example in terms of offering a better protection against prevailing winds, minimizing of temperature extremes, or improving air circulation inside structures). Contextual or post-processual archaeology has emphasized orientations' social and symbolic significance. Orientations towards celestial objects or other natural phenomena or objects have been interpreted as strategies that "could have produced a higher authority" of a certain class of monuments. It has been also postulated that where architectural structures or human skeletons were oriented in the same direction, it might have symbolized "social relations of identity between the social groups who erected them".

Landscape archaeology intends to reconstruct ancient cultural landscapes. Such investigation identifies basic landmarks around which cultural landscapes were created. Their location in space may be emphasized through particular orientations which project human attributes onto distant horizons, creating meaningful skylines. But there may be also a reverse situation: particular locations of oriented monuments may be explained in terms of visibility of prominent features on horizon with its astronomical associations attached. Each of the currents of modern archaeology treats orientations in a different form. Yet cultural and social anthropology reveal how people use space to mark social distinctions of gender, age, rank, religion, ethnicity, etc.

What I want to say exhibiting these examples is that material objects may possess a variety of meanings. Orientations, considered as an attribute may also carry multiple meanings. Orientations and alignments are polysemous in nature. A particular set of meanings may be attached to orientation patterns of different classes of artifacts. The orientation of the dead does not necessarily express the same patterns as do the tombs in which they are deposited. The (invisible) corpses of the dead may relate to different sets of meanings if compared to the (visible) elaborated funeral monuments. Less precise astronomical observations may appear where previously very precise ones were found. The meanings of locations are not fixed for ever and particular locations and monuments,

especially those of long duration, may change their meanings with the passage of time. As Dave observes, today's Intihuantana bears different meanings than some 500 years ago. What was an observational device! yesterday, may be converted into a token today. Another example is the evolution of the use of clocks in culture.

Last but not least, the meaning of alignments depend on our research purposes. Dave trained as a scientist is interested in types of observations performed, and how they were made technically. Trained as an archaeologist I would rather look for the social meaning of such observations, decode their meaning in order to reconstruct the cognitive models of the world, analyze their particular function in culture systems and finally try to associate particular patterns of orientations with other cultural features. Our approaches are different but complementary since both of us study astronomy in its cultural context. Only in this sense archaeoastronomy (as a part of cultural astronomy) involves a true cooperation between physical and social scientists.

4.4.2 Appendix 2 – General Overview of Archaeoastronomy Methods¹⁴¹

Artefactual analysis

- The Antikythera mechanism (main fragment)

In the case of artefacts such as the Sky Disc of Nebra, alleged to be a bronze age artefact depicting the cosmos, the analysis would be similar to typical post-excavation analysis as used in archaeology. An artefact is examined and attempts are made to draw analogies with historical or ethnographical records of other peoples. The more parallels that can be found, the more likely an explanation is to be accepted by other archaeologists.

Another well-known artefact with an astronomical use is the Antikythera mechanism. In this case analysis of the artefact, and reference to the description of similar devices described by Cicero, would indicate a plausible use for the device. The argument is bolstered by the presence of symbols on the mechanism, allowing the disc to be read ¹⁴².

Symbolic analysis

In some cases the use of an artefact may be known, but its meaning may not be fully understood. In such cases an examination of the symbolism on the artefact may be necessary.

¹⁴¹ The following Overview is drawn from the following reference dealing with Historical and Cultural Archaeoastronomy, which is an open-source development of the discipline Archaeoastronomy.
<http://en.wikipedia.org/w/index.php?title=Archaeoastronomy&action=edit§ion=32>

¹⁴² 2006. April. http://ecuip.lib.uchicago.edu/diglib/science/cultural_astronomy/

A mundane example is the presence of astrological symbols found on some shoes and sandals from the Roman Empire. The use of shoes and sandals is well known, but Carol van Driel-Murray has proposed that astrological symbols etched onto sandals gave the footwear spiritual or medicinal meanings.¹⁴³ This is supported through citation of other known uses of astrological symbols and their connection to medical practice and with the historical records of the time.



Figure 49 Diagram showing the location of the sun daggers on the petroglyph on various days 2001. August. http://en.wikipedia.org/wiki/History_of_astronomy

More problematic are some petroglyphs. Symbols on rock are one such class of symbol which are occasionally argued to possess astronomical meanings. An example is the Sun Dagger of Fajada Butte which is a glint of sunlight passing over a spiral petroglyph. The location of the dagger on the petroglyph varies throughout the year. At the solstices a dagger can be seen either through the heart of the spiral or to either side of it. It is proposed that this petroglyph was created to mark these events. If no ethnographic nor historical data are found which can support this assertion then acceptance of the idea relies upon the reader's

¹⁴³ van Driel-Murray, C. 2001. Regarding the Stars, TRAC 2001: Proceedings of the Eleventh Annual Theoretical Roman Archaeology Conference Glasgow 2001. eds. M Carruthers, C. van Driel-Murray, A Gardner, J. Lucas, L. Revell and E. Swift. Oxbow Books. 2002, 96-103, ISBN 1842170759

own belief as to whether or not there are enough petroglyph sites in North America that such a correlation could occur by chance. It is helpful when petroglyphs are associated with existing peoples. This allows ethnoastronomers to question informants as to the meaning of such symbols¹⁴⁴.

Alignment analysis



Figure 50 The Sun rising behind the Heel Stone at Stonehenge 2001. August.
http://en.wikipedia.org/wiki/History_of_astronomy

The most public image of archaeoastronomy is the practice of alignment analysis. This is the study of the orientation of structures and calculating the direction in which they face. In the case of Stonehenge it is well known to face the rising midsummer sun. In the case of the pyramids of Egypt they face north, probably to face the circumpolar stars.¹⁴⁵

The use of alignment analysis may vary depending upon the researcher. As a coarse stereotype archaeoastronomers from an historical background tend to have an idea which is then tested by examining structures for alignments. Astronomically-minded archaeoastronomers may analyze large numbers of sites and attempt to find statistical patterns. This approach was particularly employed in early papers by pioneers in the field such as Alexander Thom who conducted extensive fieldwork at megalithic sites and concluded many sites were situated to observe the moon.¹⁴⁶ In this instance the aim was to prove that there is an astronomical problem which requires an historical explanation. This

¹⁴⁴ Krupp, E. C., ed. 1978. *In Search of Ancient Astronomies*. Garden City, N.Y.: Doubleday & Company, 1978 (and New York: McGraw-Hill Book Company, 1979 paper back reprint).

¹⁴⁵ Spence, K. 2000. Ancient Egyptian Chronology and the astronomical orientation of the pyramids, *Nature*, Vol 406, 16 November 2000, 320-324.

¹⁴⁶ Michell, John. 2001. *A Little History of Astro-Archaeology*. Thames & Hudson

Krupp, E.C. 1988. *Light in the Temples, Records in Stone: Papers in Memory of Alexander Thom*. 473-499, ISBN 0521333814

latter approach continues to an extent in some modern research but it has comparatively little direct impact on mainstream archaeology¹⁴⁷.

One reason the statistically-led approach has proven unpopular with archaeologists and anthropologists was stated by the anthropologist Keith Kintigh:

"In light of the fact that archaeoastronomers bring considerable energy and expertise to their efforts, what accounts for archaeologists' indifference? I think the principal reason is that archaeologists see archaeoastronomers as answering questions that, from a social scientific standpoint, no one is asking. To put it bluntly, in many cases it doesn't matter much to the progress of anthropology whether a particular archaeoastronomical claim is right or wrong because the information doesn't inform the current interpretive questions."¹⁴⁸

Recent statistically led research has tended to be more discriminating, choosing archaeologically associated sites and where possible referring back to historical or ethnographic records to place the findings in a social context.

An alignment is calculated by measuring the azimuth, the angle from north, of the structure and the altitude of the horizon it faces. The azimuth is usually measured using a theodolite or a compass. A compass is easier to use, though the deviation of the Earth's magnetic field from true north, known as its magnetic declination must be taken into account. Compasses are also unreliable in areas prone to magnetic interference, such as sites being supported by scaffolding. Additionally a compass can only measure the azimuth to a precision of a half a degree.¹⁴⁹

A theodolite can be considerably more accurate if used correctly, but it is also considerably more difficult to use correctly. There is no inherent way to align a theodolite with North and so the scale has to be calibrated using astronomical observation, usually the position of the Sun. Because the position of celestial bodies changes with the time of day due to the Earth's rotation, the time of these calibration observations must be accurately known, else there will be a systematic error in the measurements. If one is measuring buildings which were unlikely to be orientated by their builders to within fractions of a degree then a

¹⁴⁷ Iwanizewski, Stanislaw. 1995. Alignments and Orientations Again. Essays from Archaeoastronomy & Ethnoastronomy News, The Quarterly Bulletin Of The Center For Archaeoastronomy. Number 18 December Solstice 1995 (Appendix 1 page 119)

Ruggles, Clive L.N. 1999. Astronomy in Prehistoric Britain and Ireland. Yale University Press.

¹⁴⁸ Kintigh, K. 1992. I wasn't going to say anything, but since you asked: Archaeoastronomy and Archaeology, Archaeoastronomy & Ethnoastronomy News 5, 1992

¹⁴⁹ 2006. October. [Brunton Pocket Transit Instruction Manual, p. 22](#)

theodolite can be more trouble than it is worth. Horizon altitudes can be measured with a theodolite or a clinometer¹⁵⁰.

Recreating the ancient sky

Once the researcher has data to test, it is often necessary to attempt to recreate ancient sky conditions to place the data in its historical environment.

- Declination



Figure 51

A time lapse photo showing the stars as they appear to rotate around the celestial pole, as a result of the earth's rotation about its axis. 2006. September. Wikipedia - <http://en.wikipedia.org/wiki/Archaeoastronomy>

To calculate what astronomical features a structure faced a coordinate system is needed. The stars provide such a system. If you were to go outside on a clear night you would observe the stars spinning around the celestial pole. This point is $+90^\circ$ if you are watching the North Celestial Pole or -90° if you are observing the Southern Celestial Pole. The concentric circles the stars trace out are lines of celestial latitude, known as declination. The point on the horizon due East, if the horizon is flat is the celestial equator which has a declination of 0° . The visible declinations vary depending where you are on the globe. Only an observer on the North Pole of Earth would be unable to see any stars from the Southern Celestial Hemisphere at night (see diagram below). Once a declination has been found for the point on the horizon that a building faces it is then possible to say if a specific body can be seen in that direction.

- Solar positioning

¹⁵⁰ 2006. October. [Brunton Pocket Transit Instruction Manual, p. 22](#)

While the stars are seemingly fixed to their declinations the Sun is not. The rising point of the Sun varies throughout the year. It swings between two limits marked by the solstices a bit like a pendulum, slowing as it reaches the extremes, but passing rapidly through the mid-point. If an archaeoastronomer can calculate from the azimuth and horizon height that a site was built to view a declination of $+23.5^\circ$ then he need not wait until June 21 to confirm the site does indeed face the summer solstice.

– Lunar positioning

The appearance of the moon is considerably more complex. Its motion, like the Sun, is between two limits - known as lunistics rather than solstices. However its travel between lunistics is considerably faster. It takes a sidereal month to complete its cycle rather than the year long trek of the Sun. This is further complicated as the lunistics marking the limits of the movement of the moon on an 18.6 year cycle. For slightly over nine years the extreme limits of the moon are outside the range of sunrise. For the remaining half of the cycle the Moon never exceeds the limits of the range of sunrise. However, much lunar observation was concerned with the phase of the Moon. The cycle from one New Moon to the next runs on an entirely different cycle, the Synodic month. Thus when examining sites for lunar significance the data can appear sparse due the extremely variable nature of the moon.

– Stellar positioning

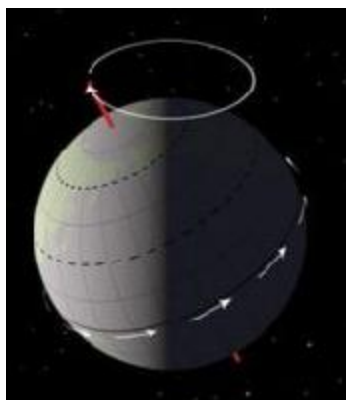


Figure 52 Precessional movement. 2006. September. Wikipedia - <http://en.wikipedia.org/wiki/Archaeoastronomy>

Finally there is often a need to correct for the apparent movement of the stars. On the timescale of human civilisation the stars have maintained the same position relative to each other. Each night they appear to rotate around the celestial poles due to the Earth's rotation about its axis. However the Earth spins rather like a spinning top. Not only does the Earth rotate, it wobbles. The Earth's axis takes around 25700 years to complete one full wobble. The effect to the archaeoastronomer is that stars did not rise over the horizon in the past in the

same places as they do today. Nor did the stars rotate around Polaris as they do now. In the case of the Egyptian pyramids, it has been shown they were aligned towards Thuban, a faint star in the constellation of Draco. The effect can be substantial over relatively short lengths of time, historically speaking. For instance a person born on December 25 in Roman times (roughly 2000 years ago) would have been born under the astrological sign of Capricorn. In the modern period a person born on the same date is now a Sagittarian¹⁵¹ due to the precession of the equinoxes.

- Transient phenomena



Figure 53 Halley's Comet depicted on the Bayeux tapestry 2006. September. Wikipedia - <http://en.wikipedia.org/wiki/Archaeoastronomy>

Additionally there are often transient phenomena, events which do not happen on an annual cycle. Most predictable are events like eclipses. In the case of solar eclipses these can be used to date events in the past. A solar eclipse mentioned by Herodotus enables us to date a battle between the Medes and the Lydians, which following the eclipse failed to happen, to May 28, 585 BC¹⁵². Other easily calculated events are supernovae whose remains are visible to astronomers and therefore their positions and magnitude can be accurately calculated.

Some comets are predictable, most famously Halley's Comet. Yet as a class of object they remain unpredictable and can appear at any time. Some have extremely lengthy orbital periods which means their past appearances and returns cannot be predicted. Others may have only ever passed through the solar system once and so are inherently unpredictable.

Meteor showers should be predictable, but the meteors are cometary debris and so require calculations of orbits which are currently impossible to complete. Other events noted by ancients include aurorae, Sun dogs and rainbows all of which are as

¹⁵¹ 2006. October. [Astrological Things What is Your Sign, Really?](#)

¹⁵² 2006. October. Herodotus, [The Histories](#), I.74

impossible to predict as the ancient weather, but nevertheless may have been considered important phenomena.

Some Major topics in archaeoastronomical research

- The use of calendars



Figure 54 Aztec Stone of the Sun replica in El Paso, Texas, cast from the original to be found in the National Museum of Anthropology and History. A religious artefact showing how the Mexico people thought about time. 2006. March 12th.

http://en.wikipedia.org/wiki/List_of_artefacts_of_archaeoastronomical_significance

A common justification for the need for astronomy is the need to develop an accurate calendar for agricultural reasons. Ancient texts like Hesiod's Works and Days, an ancient farming manual, would appear to contradict this. Instead astronomical observations are used in combination with ecological signs, such as bird migrations to determine the seasons. Ethnoastronomical work with the Mursi of Ethiopia shows that haphazard astronomy continued until recent times in some parts of the world.¹⁵³ All the same, calendars appear to be an almost universal phenomenon in societies as they provide tools for the regulation of communal activities.

An example of a non-agricultural calendar is the Mayan Tzolkin which is a cycle of 260 days. This count is based on an earlier calendar and is found throughout Mesoamerica. This formed part of a more comprehensive Maya Calendar which combined a series of astronomical observations and ritual cycles.¹⁵⁴

Other peculiar calendars include ancient Greek calendars. These were nominally lunar, starting with the New Moon. In reality the calendar could be paused or days

¹⁵³ Turton, D. and Ruggles, C.L.N. 1978. Agreeing to Disagree: The Measurement of Duration in a Southwestern Ethiopian Community, Current Anthropology Vol. 19.3, 1978, 585-600

¹⁵⁴ A.F. Aveni, A.F. 1989. Empires of Time, Basic Books, 1989, ISBN 0465019501

skipped which confused citizens to inscribe dates by both the civic calendar and ton theoi, by the moon.¹⁵⁵ The lack of any universal calendar for ancient Greece suggests that coordination of panhellenic events such as games or rituals could be difficult and that astronomical symbolism may have been used as a politically neutral form of timekeeping.¹⁵⁶

– Myth and cosmology



Figure 55 The constellation Argo Navis drawn by Johannes Hevelius in 1690. 2006. March 12th. http://en.wikipedia.org/wiki/List_of_artefacts_of_archaeoastronomical_significance

Another motive for studying the sky is to understand and explain the universe. In pre-scientific times myth was a tool for achieving this and the explanations, while not scientific, are cosmologies.

The Incas arranged their empire to demonstrate their cosmology. The capital, Cusco, was at the centre of the empire and connected to it by means of ceques, conceptually straight lines radiating out from the centre.¹⁵⁷ These ceques connected the centre of the empire to the four suyus, which were regions defined by their direction from Cusco. The notion of a quartered cosmos is common across the Andes. Gary Urton, who has conducted fieldwork in the Andean villagers of Misminay, has connected this quartering with the appearance of the Milky Way in

¹⁵⁵ McCluskey, S. 2000. The Inconstant Moon: Lunar Astronomies in Different Cultures, *Archaeoastronomy: The Journal of Astronomy in Culture* Vol 15. 2000, 14-31

¹⁵⁶ Salt, A. and Boutsikas, E. 2005. Knowing when to consult the oracle at Delphi. *Antiquity* Vol 79:305, 2005, 562-72

¹⁵⁷ Bauer, B and Dearborn, D. 1995. *Astronomy and empire in the ancient Andes: the cultural origins of Inca sky watching*, University of Texas, 1995, ISBN 0292708378

the night sky.¹⁵⁸ In one season it will bisect the sky and in another bisect it in a perpendicular fashion.

The importance of observing cosmological factors is also seen on the other side of the world. The Forbidden City in Beijing is laid out to follow cosmic order though rather than observing four directions the Chinese saw five, North, South, East, West and Centre. The Forbidden City occupied the centre of ancient Beijing.¹⁵⁹ One approaches the Emperor from the south, thus placing him in front of the circumpolar stars. This creates the situation of the heavens revolving around the person of the Emperor. The Chinese cosmology is now better known through its export as Feng Shui.

There is also much information about how the universe was thought to work stored in the mythology of the constellations. The Barasana of the Amazon plan part of their annual cycle based on observation of the stars. When their constellation of the Caterpillar-Jaguar falls they prepare to catch the pupating caterpillars of the forest as they fall from the trees.¹⁶⁰ This provides planning for food procurement at a time when hunger could otherwise be a problem.

A more well-known source of constellation myth are the texts of the Greeks and Romans. The origin of their constellations remains a matter of continuing and occasionally fractious debate.

- Displays of power

¹⁵⁸ G. Urton, *At the crossroads of the earth and the sky: an Andean cosmology*, University of Texas, 1981, ISBN 029270349X

¹⁵⁹ E.C. Krupp, *Skywatchers, Shamans and Kings*, John Wiley and Sons, 1997, 196-9, ISBN 0471329754

¹⁶⁰ M. Hoskin, *The Cambridge Concise History of Astronomy*, CUP, 1999, 15-6, ISBN 0521576008



Figure 56 The Intihuatana ("tie the sun") at Machu Picchu is believed to have been designed as an astronomic clock by the Incas, while some have speculated about the site's possible astrological role. 2006. March 12th.

http://en.wikipedia.org/wiki/List_of_artefacts_of_archaeoastronomical_significance

The most common popular image of archaeoastronomy is the expression of hidden knowledge and power. By using stellar symbolism one can make claims of heavenly power.

By including celestial motifs in clothing it becomes possible for the wearer to make claims the power on Earth is drawn from above. It has been said that the Shield of Achilles described by Homer is also a catalogue of constellations.¹⁶¹ In North America shields depicted in Comanche petroglyphs appear to include Venus symbolism.¹⁶²

Solstitial alignments also can be seen as displays of power. In Egypt the temple of Amun-Re at Karnak has been the subject of much study. Evaluation of the site, taking into account the change over time of the obliquity of the ecliptic show that the Great Temple was aligned on the rising of the midwinter sun.¹⁶³ The length of the corridor down which sunlight would travel would have limited illumination at other times of the year.

¹⁶¹ Hannah, R. 1994. [The Constellations on Achilles' Shield \(Iliad 18. 485-489\)](#). *Electronic Antiquity* 11.4, 1994, 15-6

¹⁶² E.C. Krupp, *Skywatchers, Shamans and Kings*, John Wiley and Sons, 1997, 252-3, ISBN 0471329754

¹⁶³ E.C. Krupp, *Light in the Temples, Records in Stone: Papers in Memory of Alexander Thom*, ed. C.L.N. Ruggles, 1988, 473-499, ISBN 0521333814

In a later period the Serapeum in Alexandria was also said to have contained a solar alignment so that, on a specific sunrise, a shaft of light would pass across the lips of the statue of Serapis thus symbolising the Sun saluting the god.¹⁶⁴

The use of astronomy at Stonehenge continues to be a matter of vigorous discussion.

Popular Sites and Artifacts regarded as Archaeoastronomical ¹⁶⁵

Some of the prominent so-called archaeoastronomical and world heritage sites as well as various known tourist and cultural landscapes throughout the world: -

- Bolivia - Tiwanaku, the Kalasasaya and its alignments
- Brazil - Calçoene
- Korea - Cheomseongdae
- Egypt - Great Pyramids of Egypt, Nabta Playa
- France - Carnac
- Germany - Goseck circle, Nebra skydisk. A bronze disc said to date from the Bronze Age which portrays the cosmos. From Nebra, Germany. Golden hats
- Indonesia - Borobudur
- Mediterranean - Antikythera mechanism A device for plotting positions of heavenly bodies. (Found off the island of Antikythera, Greece), Malta Megaliths, Sardinia Megaliths, Spain Megaliths and the host of sites researched by Michael Hoskin and Clive Ruggles
- Mexico - Chichen Itza, the caracol, Monte Alban, zenith tube, Teotihuacan :- the pecked-cross circles as survey-markers, Uxmal, Venus alignment of the "Governor's Palace", Xochicalco, zenith tube
- Peru - Cusco, Machu Picchu
- Republic of Ireland - Brú na Bóinne
- Romania - Sarmizegetusa Regia
- Russia - Arkaim and Megaliths throughout Black Sea Area
- Sweden - Ale's Stones
- United Kingdom - Ballochroy, Callanish stone circle, Kintraw, Minard/Brainport Bay, Stonehenge – see research areas of Michael Hoskin and Clive Ruggles
<http://www.amazon.co.uk/Cambridge-Illustrated-History-Astronomy-Histories/dp/toc/0521411580>
- United States - Cahokia, City of the Sun, Chaco Canyon

¹⁶⁴ 2006. November. [Rufinus, The destruction of the Serapeum](#)

¹⁶⁵ 2006. March 12th.

http://en.wikipedia.org/wiki/List_of_archaeoastronomical_sites_sorted_by_country
http://en.wikipedia.org/wiki/List_of_artefacts_of_archaeoastronomical_significance

- China - Han Dynasty silk comet atlas Drawings of comets unearthed from Han tomb number 3 at Mawangdui, Changsha, China. The Gan Shi Xing Jing (the first star catalog, produced during the 5th century BC)

Pretelescopic Astronomers

It is believed that the Chinese were the first pretelescopic astronomers due to evidence such as the Gan Shi Xing Jing (the first star catalog, produced during the 5th century BC). This primitive form of astronomy was once a crucial facet to science and technology in China. It was once claimed that if a Chinese astronomer were to inaccurately predict the occurrence of a comet or eclipse, he would be ordered to a beheading.

Even though the Chinese were among the first to document stellar activity, some of the oldest observatories on Earth are still speculated to exist today throughout regions of Korea, Egypt, Great Britain, Cambodia, et cetera.

China also bears a fair sum of pretelescopic observatories such as the Beijing Ancient Observatory—a facility built during the 13th century and equipped with a wide array of revolutionary instruments, including an armillary sphere, a quadrant, a theodolite and a sextant.¹⁶⁶

Introduction of the telescope

Even though telescopes existed during the age of some pretelescopic observatories, they were not used to fulfill astronomical endeavours until the introduction of Galileo Galilei's "perspicillum" in 1609. A creation that was later amended by Johannes Kepler in his book *Astronomiae Pars Optica*.¹⁶⁷

Examples of Archaeoastronomical Artifacts

- The Nebra sky disk

The Nebra sky disk is associatively dated to c. 1600 BC and attributed to a site at Nebra, Saxony-Anhalt in Germany. It is a bronze disk of around 30cm diameter, patinated blue-green and inlaid with gold symbols interpreted by some as a sun or full moon, stars (including a cluster interpreted as the Pleiades) and a crescent with

¹⁶⁶ Hetherington, Barry (1992) *A Chronicle of Pre-Telescopic Astronomy*, John Wiley & Sons, Inc. ISBN 0-471-95942-1

¹⁶⁷ 2001. January 18th. [Institute and Museum of the History of Science - Pretelescopic astronomy](#)

multiple strokes, interpreted as a sun boat with many oars. It has been associated with the Bronze Age Unetice culture.

The find sheds new light on the astronomical knowledge and abilities of the people of the European Bronze Age, such as the builders of Stonehenge. Judging from the angles set by gilded arcs along the sky disk's circumference, it may be that the Bronze Age cultures in Central Europe made far more sophisticated celestial measurements far earlier than has been suspected.

If the disk is authentic then it may be argued that quantitative astronomy in central Europe may possibly date back 3,600 years. Egyptian representations of the sky are purely schematic at this time. The lack of a secure archaeological context for the disk however, means that it is difficult to accurately date or even authenticate it. It is unlike any known artistic style from the period and has been described as a fake by some archaeologists. Possibly a scientific instrument as well as an item of religious significance, the disk is a beautiful object; the blue-green patina of the bronze may have been an intentional part of the original artifact.



Figure 57 Diagram of the disk in its current condition (a star and a part of the full moon was restored). 2006. November. http://en.wikipedia.org/wiki/Pretelescopic_astronomy

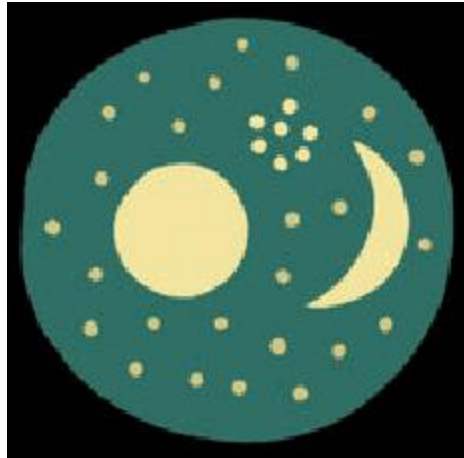


Figure 58 Initial state: On the left the full moon, on the right the waxing moon, and between and above, the Pleiades. 2006. November.

http://en.wikipedia.org/wiki/Pretelescopic_astronomy

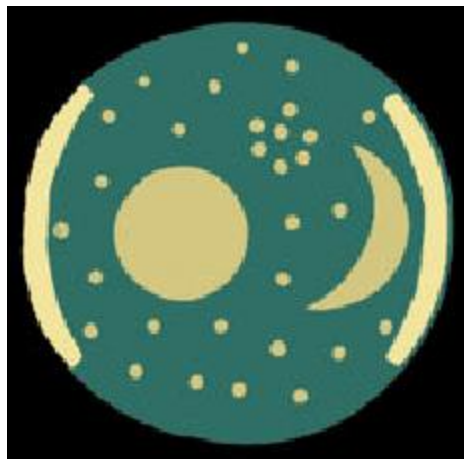


Figure 59 Second state: Arcs are added on the horizon for the zones of the rising and setting sun. Individual stars were shifted and/or covered. 2006. November.

http://en.wikipedia.org/wiki/Pretelescopic_astronomy



Figure 60 Third state: Addition of the "sun boat".2006. November.
http://en.wikipedia.org/wiki/Pretelescopic_astronomy

– Conical Golden Hats

Four tall conical golden hats dating to between 1400 BC and 800 BC, have been found in Central Europe: one find in 1835 near Schifferstadt near Speyer dated to 1400-1300, one fragmentary find in 1844 near Avanton near Poitiers, one at Ezelsdorf near Nürnberg in 1953, dated to 1000-900, and one find of unknown origin, probably from Switzerland or Swabia, bought in 1996 by the National Museum of Berlin, dated to 1000-800¹⁶⁸. The tallest of these is the Ezelsdorf one, measuring 90 cm. The 'hats' infer a relationship to the Moon's Metonic Cycle and it is as if a logarithmic table of the moon phases over 18 years was worn on the head. It is regarded that the similar use of (28 to 31) studs on each of the hats relates to the amount of times the moon is seen during lunation, over a period of a year and that each each circle can also represent a year as well.¹⁶⁹

The hats are associated with the pre-Proto-Celtic Bronze Age Urnfield culture. Their close similarities in symbolism and techniques of manufacture are testimony to a coherent Bronze Age culture over a wide-ranging territory in eastern France and western and southwestern Germany. A comparable golden pectoral was found at Mold, Flintshire, in northern Wales¹⁷⁰.

¹⁶⁸ 2006. March 17th. [Mysterious gold cones 'hats of ancient wizards'](#), Daily Telegraph 17 March 2002. Retrieved 15 May 2006.

¹⁶⁹2001. January 18th. [Institute and Museum of the History of Science - Pretelescopic astronomy](#)

2006.November.http://en.wikipedia.org/wiki/List_of_artefacts_of_archaeoastronomical_significance

2006. November. http://en.wikipedia.org/wiki/Pretelescopic_astronomy

¹⁷⁰ 2006. November. http://en.wikipedia.org/wiki/Pretelescopic_astronomy

The gold hats were first brought together for comparison and set in the broader context of the culture of Bronze Age Europe in a 1999 exhibition in Bonn, Gods and heroes of the Bronze Age: Europe in the time of Odysseus ¹⁷¹



Figure 61 Aventon gold cone from 1500-1250 BC. 2004. June 23rd. ["Mathias Schultz, "Der Kult der Sternmagier"](#)

– Antikythera Mechanism

¹⁷¹ 2004. June 23rd. ["Mathias Schultz, "Der Kult der Sternmagier"](#)

1999. [Götter und Helden in der Bronzezeit: Europa im Zeitalter des Odysseus](#), exhibition, Bonn. 1999. Catalogue introduction, wall panel information

Antikythera () is a Greek island with a land area of approximately 20 square kilometers, 38 kilometers south-east of Kythira. It is notable for being the location of the discovery of the Antikythera mechanism and for the historical Antikythera wreck.

The origins of the mechanism are unclear, as are the circumstances in which it came to be on the Antikythera ship. The ship was a Roman one, though there is no doubt that the mechanism itself was made in Greece ¹⁷².

One hypothesis¹⁷³ is that the device was constructed at an academy founded by the ancient Stoic philosopher Posidonios on the Greek island of Rhodes, which at the time was known as a centre of astronomy and mechanical engineering. Investigators have suggested that the ship could have been carrying it to Rome, together with other treasure looted from the island to support a triumphal parade being staged by Julius Caesar.

Another hypothesis is that the mathematician Archimedes constructed the mechanism. The advanced geometry needed for the Antikythera mechanism's construction was developed by Archimedes and is unlikely to have pre-dated his discoveries. However, there is little to directly link Archimedes with the machine.

The device appears to have been constructed as a calendrical device using planetary movements ¹⁷⁴.

¹⁷² Price, Derek J. de Solla. 1959. "An Ancient Greek Computer". *Scientific American*, June 1959. p. 60-67.

¹⁷³ Price, Derek J. de Solla. 1959. "An Ancient Greek Computer". *Scientific American*, June 1959. p. 60-67.

¹⁷⁴ Price, Derek J. de Solla. 1959. "An Ancient Greek Computer". *Scientific American*, June 1959. p. 60-67.



Figure 62 The Antikythera mechanism (main fragment) 2006. November.
http://en.wikipedia.org/wiki/Antikythera_mechanism

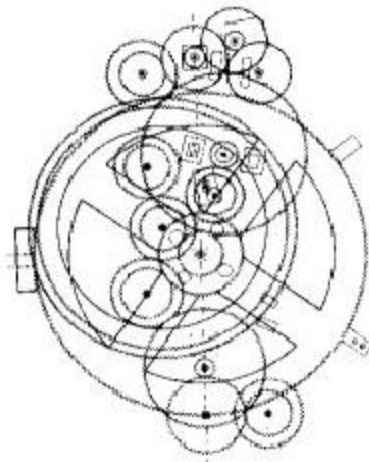


Figure 63 Schematic of the artifact's mechanism 2006. November.
http://en.wikipedia.org/wiki/Antikythera_mechanism



Figure 64 The Antikythera mechanism as reconstructed by Paolo Amoroso side 1
14th May 2007 <http://www.mogi-vice.com/Antikythera/Antikythera-it.html>



Figure 65 The Antikythera mechanism as reconstructed by Paolo Amoroso side 2
14th May 2007 <http://www.mogi-vice.com/Antikythera/Antikythera-it.html>

4.4.3 Appendix 3 - Wheeler Seminar Research Compilation

Wheeler Seminar Research Compilation

1998. December 2nd <http://hej3.as.utexas.edu/~www/wheel/africa/namoratunga.htm>

1998. December 2nd <http://hej3.as.utexas.edu/~www/wheel/africa/nabta.htm>

SUMMARY - Like ancient people everywhere, Africans wondered at the sky and struggled to make sense of it. Evidence that they did so with creativity and intelligence has been slow to permeate academic studies of archeoastronomy and wider public understanding. This evidence is not just in myths and calendars, but in ancient megalithic observatories. Two are known, Nabta in southern Egypt that predates the famous site at Stonehenge and other European megaliths, and Ng'amoritung'a on the shores of Lake Turkana in Kenya where the logic of a 2000 year old calendar predates any European influence. Other such artifacts undoubtedly await discovery. This site is an introduction to the astronomy of ancient Africa

1998. December 2nd <http://hej3.as.utexas.edu/~www/wheel/africa/index.htm>

Namoratunga

The cultural background of Namoratunga (sometimes rendered "Ng'amoritung'a," a spelling perhaps closer to the original language) lies shrouded in much mystery, as does its purpose. Evidence for the Namoratungans' cultural heritage is found in the rock art found at Namoratunga I. These [petroglyphs](#) closely resemble brands on livestock that the Turkana use. These cattle brands could have come from a common past as Lynch points out in his response to Robert Soper's challenging paper. The cattle brands seem to point to the fact that the Namoratungans probably were ancestors to the present-day Cushitic and Nilotic-speaking peoples.

The cattle burials at Namoratunga I are very interesting though because of the lack of explanation. Were these burials ritual sacrifices or did they see these cows as gods? There seems to be a cattle burial connection between Namoratunga and the Nabta area because Wendorf, a noted expert on Nabta, wrote a paper on cattle burials in the Sahara.

The most striking connection between Namoratunga II and the present day peoples is the connection with the [Borana calendar](#) of the modern-day Cushites. If Mark Lynch's astronomical alignments were right, then this would provide much evidence towards the Namoratungans being the ancestors of the present-day Cushites. The other interesting tie here is that the Borana calendar only works if precessed back to [300 BC](#). This date is very near the radiocarbon date for Namoratunga I. An unanswered question in all of this is why a calendar which does not work anymore is still being passed down. All of this seems to provide much evidence for the Namoratungans being the ancestors of the current day Cushites still living near Lake Turkana.

(L. Bowman)

Namoratunga

Robert Soper: A Realistic Reevaluation of Namoratung'a

In a startling yet vital article in *Azania*, a publication of the United Kingdom in Eastern Africa (vol. 17, 1982), Robert Soper refreshingly addresses many important questions concerning various aspects of preceding research done in a special area of the Turkana District of North-Western Kenya. This area, called Namoratung'a II or Namoratung'a-Kalokol after a nearby village, is a site boasting 20 peculiar polygonal basalt columns and has been surrounded with mystery and predictions of possible ancient astronomical significance officially since Dr. Mark Lynch and Dr. L. H. Robbins independently and jointly surveyed the area in the 1970's. In his article, Mr. Soper accounts for his own survey of the disputed area and, in reference to the initial surveying, addresses much questionable data as well as some debatable techniques of taking original measurements. He then, after addressing additional issues not even raised by the original surveyors, draws his own conclusions concerning the possible astronomical site however emphasizing a need for further investigation.

To set up arguments later in the article, Soper introduces the reader to two additional sites located approximately 160 km south of the primary Kalokol site, one containing eleven presumed gravestones and another made up of one hundred and sixty two gravestones, together labeled, because of their close proximity, Namoratung'a-Lokori or, in some references, Namoratung'a I. Here, in reference to Dr. Lynch's assertion that the three sites are "approximately contemporaneous and culturally related," (Soper, 145) Soper relates his doubts, stating the sites are of rather different character and not associated with any local settlement sites. Expanding later in the article, he addresses the issues Lynch used to construct a relationship between the two sites. The first, as Soper concedes, is difficult to argue either way and is whether there is a direct relationship between gravestones at each site (as the Kalokol site, Lynch suggests, contains gravestones in addition to those with possible astronomical significance alone). The second concerns possibly related petroglyphs on stones from each site. As Soper argues, while there is a similarity between some of these ancient pieces of art, there is much to be questioned as to whether the builders of the site produced all or even any of them.

The third major issue raised by Soper concerning the supposed connection of the sites rests on Lynch's description that the Namoratung'a II site was, in fact, dedicated to calendrical makeup and use. As the Eastern Cushites made up the Borana Calendar, Lynch's thought that the stone sites in question were influenced if not completely designed and built by them as well implies that at least the Kalokol site was used for some kind of astronomical observations with the goal of calendar making in mind. Soper's response, self-affirmed later in the article, suggests the site in fact has no astronomical significance, thus implying the resourceful Eastern Cushitic speakers simply erected stones with no direct or presently sensible reason for doing so, which, he states, is highly unlikely. Adding to his doubt that the Eastern Cushites were the connection between the sites, Soper points out that in the making of the Borana calendar, a very Eastern Cushitic creation, there is no mention of stone pillars being used for assistance.

Much of Mr. Soper's argument and contention concerning Namoratung'a's astronomical significance as stated by Dr. Lynch is based on his own resurveying and the many discrepancies that were found between his and the initial data collected on Dr. Lynch's own expedition. The data in question was that collected concerning possible alignments of nineteen of the twenty stones (one is flat and displaced) with seven stars and constellations popularly used for astronomical purposes; Triangulum, the Pleiades, Aldebaran, Bellatrix, Central Orion, Saiph, and Sirius (see [African stars](#) and the [Borana calendar](#) in [300 BC](#)). Using the same reference points as Lynch (the highest points of the stones), Soper found error in angle measurement ranging from 1 to 17 degrees, gross errors he attributes to likely magnetic anomalies or instrumental error. From this error he concludes that Lynch's astronomical hypothesis cannot be maintained.

Another pervasive issue Soper raises in his article is that of dating the sites. As he reports, radiocarbon dates of two bone samples from the larger Lokori sites have been taken from, as he states, bone apatite (330+-165 BC) and bone collagen (AD 750+-100), bone outsides and bone insides, respectively. Soper addresses Lynch's claim that the first is likely correct because, from his knowledge, apatite is more reliable and it fits the linguistic dating more reliably. What Soper takes issue with is the lack of foundation for Lynch's claim of linguistic dating. As his own research found, in fact no linguistic reconstruction places Eastern Cushites as far south as Lokori at any time on this side of Lake Turkana (existing between and not far east of the sites) and that, while this is not "significant negative evidence," linguistic reconstruction can provide no evidence of absolute dating anyway. Further, Soper asserts that when the unlikelihood that the site was used for astronomical purposes is coupled with this fact, the chance of a Eastern Cushitic connection becomes that much more unlikely.

Concluding his many remarks and arguments of the previous accounts of the Namoratunga sites, Soper offers an alternate hypothesis. In forming his hypothesis, he introduces very interesting aspects not addressed by Lynch or in any other report. He attempts to use the presence of different types of pottery found around Lake Turkana, south down the Rift Valley, and as far north as northern Tanzania to help account for some kind of cultural presence. For, as it was found by Lynch, nowhere within a 190 km radius around the Lokori site is there sign of some kind of ancient settlement site. The types of pottery identified in the article and their likely makers were Nderit ware by Southern Cushites and Turkwel ware and its possible Eastern Nilotes or, maybe, Western or Southern Nilotes. Soper asks if, perhaps, Namoratunga could be a further mystical remnant left by one of these cultures; however, acknowledging its shortcomings in research, Soper recognizes that it is nothing more than another possible hypothesis. (J. Greenbaum)

Citations

Soper, Robert: "Archaeo-astronomical Cushites: Some Comments with further Comment by B. Mark Lynch;" *Azania: The Journal of the British institute in Eastern Africa*, vol. 17, 1982. pp. 145-162

Lynch, B.M. and L. Robbins: "Animal Brands and the interpretation of rock art in East Africa;" *Current Anthropology*, vol. 18, 1977. pp. 3, 538-539

Namoratunga

Summary of Doyle and Wilcox Article

The article "Statistical Analysis of Namoratunga: An Archaeoastronomical Site in Sub-Saharan Africa?" written by Laurence R. Doyle and Thomas J. Wilcox examines the probability of randomly obtaining 25 or more stone alignments with seven random positions in the sky as a test of the possible astronomical alignments of the stones at Namoratunga II.

The article begins with a synopsis of previous work conducted at Namoratunga II by Lynch and Robbins in 1978-1979. Their research introduces the first evidence for possible archaeoastronomical stone alignments at Namoratunga II. Later analysis conducted by Soper in 1982 suggested possible deviations in the calculations of alignments, conducted by Lynch and Robbins, due to the stone's magnetic properties. Soper also raises the issue of the utility of the pillars with respect to the Borana calendar. He is skeptical that the Borana calendar even dates back to 300 BC, the age of the site proposed by Lynch and Robbins. These issues are taken head-on in the Doyle and Wilcox article.

Doyle apparently revisited the site and took his own measurements of the alignments. He found 25 two-pillar alignments with the [300 BC](#) horizon rising positions of the seven [Borana calendar](#) stars. He also reports 25 two-pillar alignments with the 300 BC setting positions of the seven Borana stars and suggests that alignments on the eastern horizon only may underestimate the number of alignments.

Measurements taken by Soper at Namoratunga II used the highest point of the stone as the line of sight. Doyle and Wilcox contest this assumption and use the geometric center of the stones, as seen from above, for their reference points. Testing of the alignments in 300 BC was performed by a program run on a NASA supercomputer to determine the probability of the alignments occurring at random. The numerical experiment was run 10,000 times and the likelihood of having 25 or more alignments arise by chance is 0.0041. The most feasible number of stone alignments occurring at the site is 13.

The authors do a good job of critiquing their work. They discuss possible sources of error in their research. These include: overestimating the accuracy of alignments, too broad a definition of alignment, stone shifting, and location of pillar measurement. Evidence is then presented to support the validity of their claims.

I feel this article handles the questions raised about Namoratunga II in a very practical and comprehensive manner. Though there is still research to be performed, as the authors admit, I believe that the evidence does point to Namoratunga II being a significant archaeoastronomical site. (N. Griffin)

Nabta and Ng'amoritung'a

Nabta and Namoratunga II are both megalithic sites in Africa, and are thought to be astronomically related. Both could also be ceremonial sites. At both sites the rocks are tilted unlike many megaliths such as Stonehenge, where the rocks are perpendicular to the

ground. This information suggests that the people who built Namoratunga II could somehow be connected to the people who built Nabta thousands of years earlier.

Many differences between Nabta and Namoratunga II weaken the suggestion that the two could be connected. Nabta has been excavated and studied thoroughly, and radiocarbon dated to have been built around 6000 B.C. Namoratunga II was not excavated. It was assumed to have been built around 300 B.C. because that was the radiocarbon date on a related site. Nabta is reasonably well established to be astronomically related, with orientations north/south and with the summer solstice. There has been much discussion about whether Namoratunga II's astronomical alignments are correct or not, although the preponderance of evidence seems to be that it is. Nabta and Namoratunga II are also different because the Nabta calendar deals with alignments with the Sun, and Namoratunga II aligns with the stars. Nabta was a burial site. The bones of cows were found there. Namoratunga I was a burial site, but bones have not been found at Namoratunga II.

Many differences also exist in the way the two megaliths were built. Nabta consists of several sites spread out over approximately one square mile. Namoratunga has three sites spread out over a greater area. Nabta sites are circular, but Namoratunga II is more linear. The rocks themselves are also different. The rocks at Nabta are much bigger than the rocks at Namoratunga II, which are only about one meter high, or less. Nabta's rocks are unshaped, but the rocks at Namoratunga II have been shaped to have four flat sides and a slanted top. The rocks at Namoratunga II also have [petroglyphs](#) on them and the rocks at Nabta do not. Many pieces of pottery that had symbols on them were found at Nabta, but no pottery was found at Namoratunga II.

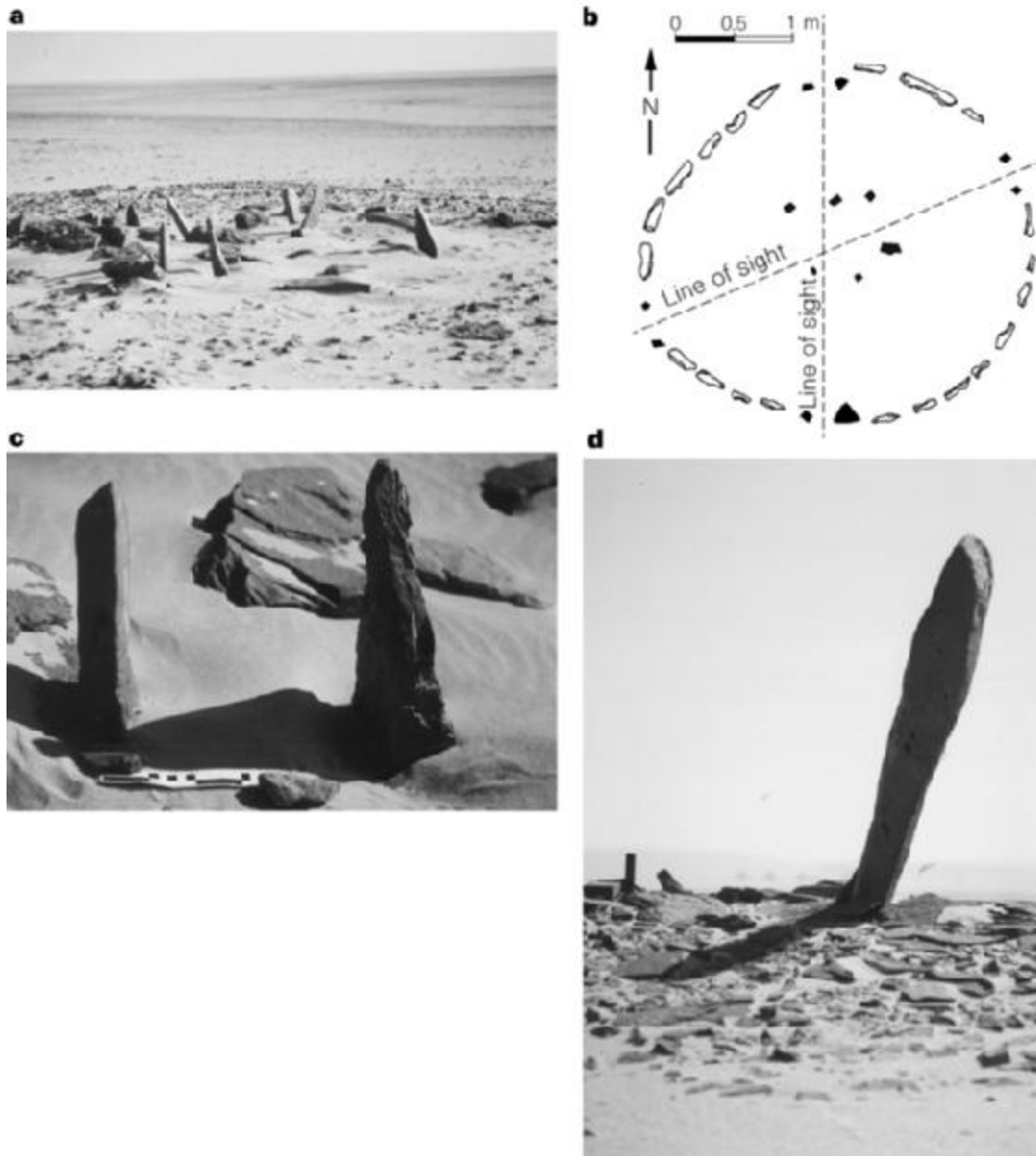
It can be theorized that the same line of people who built Nabta could have migrated south over the thousands of years that passed between the construction of the two megaliths, and built Namoratunga II. Cultural changes over the large time span could account for the differences between the two megaliths. Not enough evidence exists to come to a conclusion.
(H. Price)



Namoratunga - Photograph by Jens Finke and Maria Helena Barreira



Nabta Monolith
John (Kim) Malville and Fred Wendorf



5a - d Monoliths at Nabta. Malville, J. M., Wendorf, F., Mazar, A. A., & Schild, R. 1998. Megaliths and Neolithic astronomy in southern Egypt. *Nature* 392, 488 (1998) (Letters to Nature).

Nabta

There exists a site in southern Egypt that is the oldest astronomical site in the world. This site, called Nabta, was created some 6500 years ago by a Neolithic people who were concerned with the progress of the year. The circle of standing stones allowed the people to determine when the solstices occurred as well as rainy seasons. This sub-Saharan culture is likely to be the predecessor of the Egyptians. The site was excavated by [Fred Wendorf](#) and John (Kim) Malville.

Stones, some more than 9 feet tall, were set in a circle to predict the coming solstices. The people had to drag these monstrous stones for more than a mile, thus showing a great dedication to their task. Scientists have discovered that there is an east-west sighting among the megaliths, as well as a north-south lining.

During the first three weeks before and after a solstice, the standing stones would cast no shadow in the noonday sun, due to their proximity to the equator. Seasons were thus followed, including the rainy season, very important to a cattle-raising, agricultural society. There have been several other alignments found, but their significance is yet to be determined.

It also seems that the Nabtians were worshipers of [cattle](#), much like the Egyptians who come later. Several [cattle burial sites](#) are located at Nabta, at least one of which has a clay housing with a roof. This care to the burial site of cattle shows the importance of cattle in the Nabtian society.

There were several pieces of pottery found at Nabta. Most of which comes from the Neolithic people who built the site. The pottery is completely covered with designs, thus making it easily identifiable. The lips of the pottery jars, however, were not decorated.

Human remains were also found at Nabta, but only the jawbone was left available to Wendorf to examine, the rest being confiscated by the Egyptian museum in Cairo. The study of this jawbone led Wendorf to an interesting conclusion: the Nabtians were of sub-Saharan descent, not of middle eastern. He deduced this based on the size and structure of the teeth and jaw compared to different ethnic groups. The conclusion undercuts the mainstream theory that Egyptian society was founded by Mesopotamians and Syrians. The idea that the Egyptian society was truly of African descent is revolutionary indeed. Yet it is backed with good evidence from the Nabta site, such as the jawbone and knowledge of the cycle of aridity in the region.

The Nabta region goes through an aridity cycle. That is to say that the area fluctuates between being fertile and arid due to weather patterns. Currently the area is extremely arid, yet at the time of the Nabtians, the area was fertile indeed. There is much evidence of agriculture in the region, along with evidence of a flourishing culture. There were found numerous deposits of charcoal (which comes from organic sources) and many deposits of floral fossils, including grass roots, palm, wood fragments, fruit, and barley grains. This cycle would cause people to migrate into and out of Nabta, making it feasible that the Nabtians migrated north to found the Egyptian culture after Nabta itself became arid.

The 6500 year old astronomical site at Nabta is evidence of a developed culture. They had knowledge of astronomy, the calendar year, and the science needed to construct the stone circle to keep track of their knowledge. Nabta was once home to a flourishing people, but the change in the weather forced the people to migrate (possibly to Egypt). The Nabtian culture is preserved only in the stones and pottery they left behind. Thus, all we know is from the work of Wendorf and Malville, and what we can extrapolate from that.

(J. Clendenon)

Nabta

Symbols in the Sand

Roughly one hundred kilometers to the west of the Nile River in southern Egypt lies a basin with myriad stones placed in various alignments. Five arrangements seem to be somewhat linear, branching off in several different directions. Another stone formation is circular, with small openings at four opposite sides of the circle. This region is known as Nabta, and has recently been investigated by archaeologists and astronomers exploring its historical function.

Perhaps the most important note to make about Nabta revolves around the radiocarbon dating that was used extensively on the site. The dates determined by carbon samples shows that Nabta could not be younger than 4,800 years old. Some of the alignments, if not all of them, are probably much older than this. This means that the megaliths at Nabta predate most other similar sites, such as Stonehenge. The region of southern Egypt where Nabta is located became inhabitable as early as 11,000 years ago. There is evidence of people living in the vicinity about 10,000 years ago. There seem to be three eras of occupation of the basin, divided by periods of drought. Early in the Neolithic age, the inhabitants constructed villages, one of which had walk-in wells. While it is thought by the excavation crew that the ancient nomads only lived in the region during the rainy summers, these wells may have allowed for year-round occupation.

The megaliths in the alignments are generally about 2 m by 3 m, and are made from sandstone. After they were carried for 0.5 km or more, each stone was partially buried in the ground. The stone circle is believed to be astronomically related. There are two lines of sight: one north-south, the other a seemingly obscure angle at first glance. When researched in greater detail, the second line of sight matches up with what astronomers calculate the azimuth of the summer solstice Sun was 6,000 years ago. The north-south line of sight, as well as the direction of the bases of the megaliths may have been important for the navigation through the Sahara Desert. There is also a possibility that the spatial arrangement of the megaliths suggest a connection between the Sun, water, death, and the fertile Earth.

Such a complex accomplishment this early on in history has many of Nabta's investigators questioning the importance of this ancient culture. It is possible that after the final exodus of these early inhabitants, the foundation of a stronger cultural base was laid out. This would have lasted until the more advanced Egyptian society we are familiar with today developed. (J. M. Britt)

Nabta and Ng'amoritung'a

Nabta and Namoratunga II are both megalithic sites in Africa, and are thought to be astronomically related. Both could also be ceremonial sites. At both sites the rocks are tilted unlike many megaliths such as Stonehenge, where the rocks are perpendicular to the ground. This information suggests that the people who built Namoratunga II could somehow be connected to the people who built Nabta thousands of years earlier.

Many differences between Nabta and Namoratunga II weaken the suggestion that the two could be connected. Nabta has been excavated and studied thoroughly, and radio carbon dated to have been built around 6000 B.C. Namoratunga II was not excavated. It was assumed to have been built around 300 B.C. because that was the radio carbon date on a related site. Nabta is reasonably well established to be astronomically related, with orientations north/south and with the summer solstice. There has been much discussion about whether Namoratunga II's astronomical alignments are correct or not, although the preponderance of evidence seems to be that it is. Nabta and Namoratunga II are also different because the Nabta calendar deals with alignments with the Sun, and Namoratunga II aligns with the stars. Nabta was a burial site. The bones of cows were found there. Namoratunga I was a burial site, but bones have not been found at Namoratunga II.

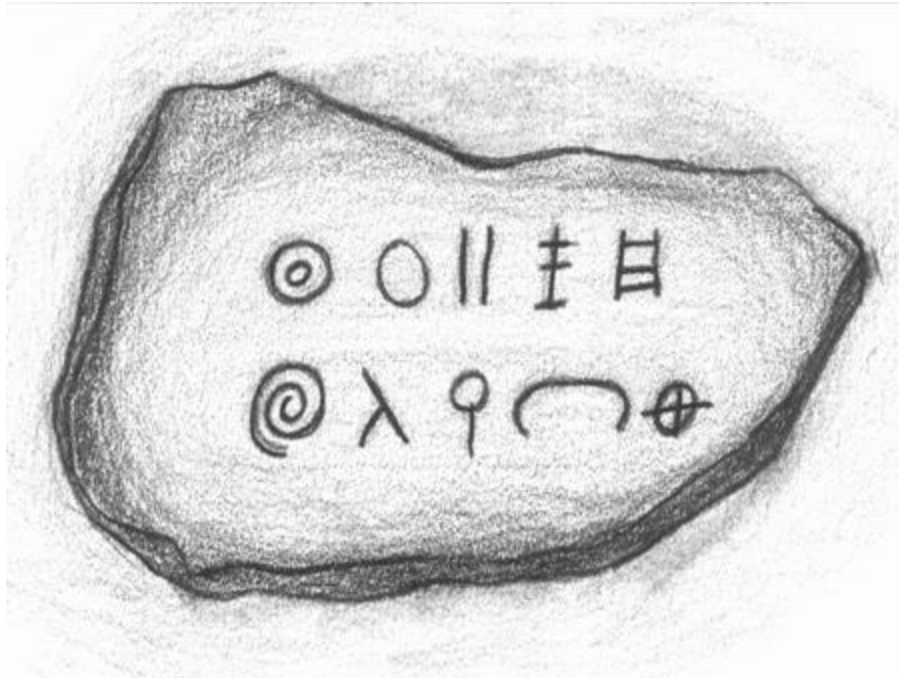
Many differences also exist in the way the two megaliths were built. Nabta consists of several sites spread out over approximately one square mile. Namoratunga has three sites spread out over a greater area. Nabta sites are circular, but Namoratunga II is more linear. The rocks themselves are also different. The rocks at Nabta are much bigger than the rocks at Namoratunga II, which are only about one meter high, or less. Nabta's rocks are unshaped, but the rocks at Namoratunga II have been shaped to have four flat sides and a slanted top. The rocks at Namoratunga II also have [petroglyphs](#) on them and the rocks at Nabta do not. Many pieces of pottery that had symbols on them were found at Nabta, but no pottery was found at Namoratunga II.

It can be theorized that the same line of people who built Nabta could have migrated south over the thousands of years that passed between the construction of the two megaliths, and built Namoratunga II. Cultural changes over the large time span could account for the differences between the two megaliths. Not enough evidence exists to come to a conclusion. (H. Price)

Petroglyphs and Ancient Arts

There are petroglyphs at Namoratunga I and Namoratunga II that share aspects of modern cattle brands and help to link the cultures of then and now. Mark Lynch (Azania, Vol XVI I, 160, 1982) identifies at least ten of the Namoratunga designs on contemporary Turkana livestock.

At the Lokori and the Kalokol Namoratunga sites, rock art was found on several of the pillars. Lynch listed twenty- three symbols that he found in his survey of Namoratunga II. Many of these symbols are the same symbols used by the Turkana people as [brands for their livestock](#). It could be possible that these Turkana symbols are from the same ancestral pool of animal brands as Cushitic and Nilotic speakers in the past, but this would mean that many other peoples would recognize the symbols. Recent inquiries have found that the Masai, Pokot, and Samburu tribes do recognize the symbols, although less of them than the Turkana.



The Turkana elders consistently recognized the symbols when about twenty of them (taken in groups of two and three), were asked to identify them when drawn in the sand. They could also draw them in the sand when given the name of the symbol.

It is a fact that all rock art can not be directly dated through patination processes, and Namoratunga is no exception. The patination at the Lokori site ranges from the symbols being completely patinated, in the same state as the rest of the rock that they are on, to being completely fresh. This means that the art could have been executed at any time after the pillars were erected. The conflict with the idea of the art being made after the pillars were erected is that art is only found on the male graves and only the builders of the graves would know who is buried where and what gender they are.

An explanation for the different levels of patination could be that people recopied the designs on top of the original designs at a time after the graves were erected, or people could have added symbols on the same pillars that had original designs. The latter could be an explanation of the Turkana not recognizing all of the symbols.

The art at the Kalokol and Lokori Namoratunga sites is very similar. The art at the Kalokol site is all completely patinated and that rocks used are a harder, different type of rock. Elsewhere in Africa, there is rock art that has astronomical undertones. For instance, in the San Rock paintings of South Africa, there are incisions in the rocks that depict [comets or fireballs](#), and stars. After much analyses though, they are believed to be symbols that represent streaks of light or meteors seen when entering a trance.

Other forms of art were found at several sites. For instance, the ancient Egyptian site, Nabta, contained art all over the pottery that was excavated. In wooden bowls and walking

sticks, astronomical representations were obvious such as star formations, and crescent shaped moons.

Body decorations are found to this day in Africa that represent celestial objects. The women of the Chopi tribe and other tribes in Mozambique incise circles on their foreheads to represent the full moon. Men of the Muyanga clan in Namibia, whose name derives from "the heat of the sun", tattoo their backs with pictures of sun-rays to depict the rising sun, and with lines on their forearms to represent meteors. Women from other tribes in Namibia decorate their lower lips with jewelry such as polished quartz pieces, which they believe to be fallen stars.

(M. Hymen)



Brian Warner (in *Astronomy Before the Telescope*, British Museum Press, 1996, page 314)]

- This image clearly represents a comet or meteor with a long tail

African Stars

The modern culture of the Borana have a calendar based on the rising of the new Moon or the setting of the full Moon. This calendar has ancient roots and the question of how the calendar works and whether the people who constructed Namora tunga II used the same calendar is central to the possibility that Namora tunga II is an ancient astronomical site. Here is a summary of some of the [key stars and constellations](#) of African lore and the stories that go with them.

The Borana Calendar

The Borana Calendar plays a large role in the analysis of Namoratunga II, The Borana calendar is based on the rising of the new Moon with various asterisms. The question for Namoratunga II is where these key stars were in 300 BC.

Sky of Kenya in 300 BC

Brian Warner (in Astronomy Before the Telescope, British Museum Press, 1996, page 315) gives a photo of a bone tally stick (a baboon fibula) with 29 notches giving 28 spaces that could represent the days of the lunar cycle.

Photograph of Bone Tally Stick



Sky Of Kenya in 300 B.C.

One of the key features of many [African astronomical events](#) is the first rising of Canopus. Canopus rises in June, marking the onset of the dry winter season South of the Equator. Traditionally, the first man to spot it rising after its transition behind the Sun would be awarded a cow.

Here is how Canopus appeared in **300 BC** rising with the Sun
 (These images were produced by the "Starry Night" planetarium program)

June 18th
(Still Undetectable)



June 21st
(Morning Cow Was Won)



June 24th
(Clearly visible to all)



Here is how Canopus appeared in **1998** rising with the Sun

June 24th
(Still Undetectable)



June 27th
(Morning Cow Was Won)



June 30th
(Clearly visible to all)



Things were not much different 2300 years ago than the rising of Canopus now, so this tradition could be very ancient.

For half the year, the [Borana Calendar](#) is based on the sequential rising of the new moon with various asterisms. [Namoratunga II](#) is supposed to be [pointing at the key asterisms](#) as they were in 300 BC. The next series of images shows the sequential rising of the new Moon in 300 BC.

March Sky of Kenya



April Sky of Kenya



May Sky Of Kenya



June Sky Of Kenya



4.4.4 Appendix 4 - Star Lore Of South Africa

Wade, R.P. 2001. Star Lore Of South Africa. MWeb Online Encyclopedia. NASPERS

<http://www.mweb.co.za>

STAR LORE OF SOUTH AFRICA

Richard Wade

Beliefs about star lore in general includes that it is possible to touch the sky at the horizon but some share the medieval European view of the danger of falling down a bottomless precipice. The earth is thought to be a large flat disk floating in water, roofed by the dome of the sky, which meets the circumference of the disk at the horizon, where one would need to pound maize in a kneeling position because there is no room to stand upright, with the pestles resting against the sky- known as 'the place where the stampers are leaned'.

Stars are suspended from the sky and meteors are falling stars that have broken away. Another view is that they are doors into the sky or the eyes of departed husbands who wish to see their wives and children.

Compared with the inhabitants of Asia and Europe, the African peoples of the southern end of the continent appear to have shown a limited but specialized interest in the sky. They sought the intervention of their ancestor spirits when plagued by illness, drought or crop pests, and the future was foretold by mediums, who interpreted the wishes of the spirits. In Asia and Europe astrologers divined the future using the position and pattern of the stars.

The notion of stars as torches or fires is common, for example, they are believed to be candles or torches carried by the ancestor spirits, and that a shooting or falling star, is an arrow shot from the bow of a spirit against an evil wanderer. There are various other interpretations of falling stars such as heralding a death; a sorcerer, on his, or usually her, travels; your future wife is to be found where the star falls: or simply that you will be lucky.

If the southern African tribes have shown relatively little interest in the stars this cannot be said of the San or 'Bushmen'. They were more familiar with the appearance of the night sky and relied on the light of the stars to find their way back to camp after a hunt. Just as the evening star lights the path of the for a bachelor, so the bright stars Sirius and Canopus shine for the San. Believing that a star's brilliance was due to the sun's heat, it was the custom to point a burning brand from the fire to these stars as soon as they appeared, an example of imitative magic. One of their myths tells how a certain girl of their tribe, wanting more light from the sky, threw up the white ash from an old fire to form the Milky Way. She is also reputed to have torn up the red and white roots of a plant and to have thrown the pieces towards the sky where they formed the red and white stars. Like other cultures they believe that a falling star announces a death, and when the 'hammerkop' bird, sees the star, it flies to the bereaved relatives to break the news.

An eclipse of the sun is an evil omen, either foretelling the death of a leader or a famine or a pest. It is believed that where the sun rises, a bird fancier guards some large and peculiar birds, and that one of these escapes and swallows the sun for a short time, causing the eclipse. An eclipse of the moon signals the death of a prominent person such as a Chief or spiritual leader.

Two months after an army (impi) had left for the Zambezi valley there was a lunar eclipse which to those left behind was taken as a sign that not only had the raid been successful but that a Chief had been slain in battle, conclusions which were subsequently confirmed. A less fortunate raiding party in 1885, whilst crossing the Kalahari en route to lake Ngami, were worried by the non-appearance of the expected full moon. Anxiety turned to terror when the eclipsed moon at last showed its horns of light, and the impi, thinking itself bewitched, turned for home. A march in which many died of thirst in the desert. Perhaps the most famous and well-known solar eclipse in Africa occurred on 25th November 1835 whilst the migrating Ngoni under Zwangendaba, were crossing a drift on the Zambezi River near Zumbo.

The moon is supposed to be racing with the sun across the sky, being always left behind, and finally beaten in the race when the new moon appears. The new moon is called the 'little moon' and the waning moon is said to be 'dying' or 'going dark'. The waxing moon with points of the crescent turned upwards is said to be a basin holding all the coughs and colds and a waning moon with the tips pointing downwards is the basin inverted and upsetting all the colds over the earth.

Hailstones are connected vaguely with the stars and it is considered unlucky to count the stars, and a child is forbidden to do so, as if he does he will wet the hut during the night, only a rain-maker astronomer-priest may count and name the stars, in total secrecy.

Sirius is the most observed star. When it appears as an evening star it is 'asking for supper'. When it is the morning star, rising early in the morning during the winter months, it is called 'the horn'. The first appearance of Sirius each year used to be the signal for the beginning of the harvesting. The first man to spot it climbed up a high hill and blew a horn to spread the glad news, and was afterwards rewarded by the chief with the present of a cow. That day the young boys drove all the chief's cattle half a day's journey from the village and then left them unattended. The first animal to reach home safely was greeted with the trilling of the women and there was great rejoicing at the chief's village.

Canopus is the second brightest star in the night sky and is known simply as 'brilliant star' or 'The Harbinger', as it was a morning star that rose during harvest time. Achernar, when appearing as the morning star, is a sign that the cold weather is about to set in. It is called the 'little horn'. Aldebaran is identified as a morning star in winter and is the first star seen on opening the door, telling the women that it is time to begin the stamping. The 'Pulling out the dawn' star appears in the winter as a morning star and is seen high in the sky in the evening. There was much diversity of opinion about this star, some informants having noted that it did not appear regularly. It is the planet Venus.

When Spica rises before the sun it is known as the 'Wildebeest star' as this is usually also the time when herds are highly synchronized in their reproduction corresponding roughly with November/December as the 'Wildebeest Month'.

Two constellations are of particular importance as they are used to reckon the time to begin ploughing, and so mark the beginning of each year's activities. The 'Giraffe' contains the two brightest stars of the Southern Cross (α and β Crucis), called the 'female', with the two pointers to the Southern Cross (α and β Centauri), called the 'male'. The !Xu San people knew the Giraffe stars as 'the lions'. The 'Rhinoceros' is the only other constellation. It contains the belt and 'sword of Orion' (δ , ζ , θ Orionis), the 'sword' being the rhinoceros' horn. The three stars are also known as the 'three wild pigs' or the 'For God I Cut You' stars.

The 'ploughing stars' or Pleiades star cluster, shows that the time for ploughing has arrived and there is a proverb that goes "If the Digging Stars set in sunny weather, they rise in rain; if they set in rain, they rise in sunny weather", and exactly at the first appearance of the new moon when the 'female' (Giraffe) is not visible, and 'male' (Giraffe) is just visible over the horizon soon after sunset with the Pleiades low on the horizon around the end of October, then it is the time to call for rain and is the start of the 'Wet month' and a very special time begins.

It appears that the three stars of Orion called 'Rhinoceros', 'three wild pigs' and the 'For God I Cut You' stars are amongst those chosen for a most sinister event, for at this exact time when The 'Giraffe', Pleiades and moon form a conjunction marking the 'New Year's Day', the three stars of Orion will ascend on the eastern horizon and are hailed with fires. The rainmaking ceremonies then commence with the words, "For God I Cut You!" or "Mademba-Ndikuteme!" and a sacrificial victim was chosen at this stage to be cut at the throat and then thrown on a fire to coax the rain - and 'the rain would always fall when the entrails burst forth'.

This "Mademba-Ndikuteme" conjunction with the new moon marks the New Year's Day in Southern Africa and usually occurs on the same day as 'Rosh Hashana'h'.

The method of charming rain by star asterisms is well known in the records of medieval Yemen (Anwā system) and may have been introduced by the ancestors of the Balemba (people of Sayuna), who purportedly built Great Zimbabwe.

Through Archaeoastronomical research, it was found that the Great Enclosure at Great Zimbabwe may have functioned as an observatory, which gives credence to the myths and legends of their descendents, now also living in South Africa, who say that they were led to the site where they state they built Great Zimbabwe by a "star which stood on top of the hills" - a star which "never came back". Preliminary research has produced evidence that the ruins of Great Zimbabwe are the remains of an astronomical instrument, designed as a general calendar and used to predict the New Year and the correct time to start ploughing and sowing. The star turns out was most likely to be the supernova - RX J0852.0-4622, the

nearest, most brilliant and recent supernova to have occurred during history, in the constellation of Vela in the early 14th century.

“They were guided by a star which came every evening and showed the direction. They followed the star until the star stood on top of the little hills of Zvishavane. Here the community settled under the Kingship of Mhani...In Zvishavane King Shabi of the Mhani tribe ruled for a long time but all the time the star came in the evening reminding them that God was not satisfied with the place where they should settle permanently. One evening they set out and followed the star in a Southern direction until the star reached the mountain where it stood on the mountain...the fifth clan was good in the observation of the stars and other heavenly bodies. Members of this clan could foretell what the stars meant by certain positions. They led the other suburbs in the observation of the phases of the moon and to determine the seasons...During the evening on the hills the star shone showing that they had not arrived at the place where God of heaven had directed them to go... They crossed the river and established a city on the mountain and in the valley...The settlement was named Zimbabwe after the founder... This lineage is sometimes called the star lineage of the Basena. It is spread over many areas in South Africa as well as in Zimbabwe... After the establishment of this village the star never came back since then.”

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4.4.5 Appendix 5 - Astronomy and World Heritage Initiative

Astronomy and World Heritage Initiative

2006 October 26th. <http://whc.unesco.org/en/initiatives/32/>

The cosmos has captivated the imagination of civilizations throughout the ages. The efforts of those cultures to understand or interpret what they see in the sky are often reflected in their architecture, petroglyphs, and other cultural representations.

The objective of the Astronomy and World Heritage thematic initiative is to establish a link between science and culture on the basis of research aimed at acknowledging the cultural and scientific values of properties connected with astronomy. The identification, safeguarding and promotion of these properties are the three lines of actions for the implementation of this programme. Its goals are:

to offer a methodological framework for associated actions to open the pathway for cooperation between States Parties and academic communities and to share knowledge.

Background

The sky, our common and universal heritage, forms an integral part of the total environment that is perceived by mankind. Including the interpretation of the sky as a theme in World Heritage is a logical step towards taking into consideration the relationship between mankind and its environment. This step is necessary for the recognition and safeguarding of cultural properties and of cultural or natural landscapes that transcribe the relationship between mankind and the sky.

Properties relating to astronomy stand as a tribute to the complexity and diversity of ways in which people rationalised the cosmos and framed their actions in accordance with that understanding. This includes, but is by no means restricted to, the development of modern scientific astronomy. This close and perpetual interaction between astronomical knowledge and its role within human culture is a vital element of the outstanding universal value of these properties. These material testimonies of astronomy, found in all geographical regions, span all periods from prehistory to today.

Why "Astronomy" and "World Heritage"

As there are few properties related to science on the World Heritage List, and the scientific value of cultural properties related to astronomy is not always recognized, the World Heritage Centre, in close collaboration with the State Parties and ICOMOS, have developed the thematic initiative "Astronomy and World Heritage" in response to the ever-growing concept of World Heritage, and the Global Strategy for a Balanced, Representative and Credible World Heritage List adopted by the World Heritage Committee in 1994.

This Initiative provides us with an opportunity to identify properties related to astronomy located around the world, to preserve their memory and save them from progressive deterioration. Support from the international community is needed to develop this activity which will allow us to help preserve this sometimes very fragile heritage.

Projects

[Cyber forum http://whc.unesco.org/en/projects/74/](http://whc.unesco.org/en/projects/74/)

Focal Points - Sidorenko-Dulom Anna

Jan 1, 2005 - Jun 1, 2005

Practically, it is materialised as a web-based information management system accessible on the web-site of the World Heritage Centre (WHC). It will build on the existing framework of the WHC web-site.

Objective - the objective of our contribution is to develop internet tools allowing the preparation of a database of sites related to the theme of the project and to improve communication between the partners.

Strategic objectives: -

credibility of the world heritage list

conservation

capacity building

communication

Initiatives

[Astronomy and World Heritage Initiative](http://whc.unesco.org/en/initiatives/32/)

<http://whc.unesco.org/en/initiatives/32/>

This travel through time and continents presents the development of architectural forms and landscapes related to the observation of the sky from the appearance of the first sacred places up to the present time.

Information presented (in gathering phase) is the result of the collaboration between experts working in the framework of the initiative 'Astronomy & World Heritage'.

The aim of the initiative is to establish a link between science and culture on the basis of research aiming at the acknowledgement of the cultural and scientific values of properties connected with astronomy. The identification, safeguarding and promotion of these properties are its three lines of actions.

4.4.6 Appendix 6 - African Astronomical History Symposium

African Astronomical History Symposium

2005 September 1st. <http://www.saa0.ac.za/assa/aahs>

Held in Cape Town, 2005 November 8 & 9

The first African Astronomical History Symposium took place under the auspices of Astronomical Society of South Africa (ASSA) and its Historical Section on 8 and 9 November 2005 in the new auditorium on the former Royal Observatory site in Cape Town. It was one of several meetings taking place around the opening of the Southern African Large Telescope (SALT) on 10 November. The occasion was an opportunity to talk about the increased interest in the traditional beliefs of the indigenous peoples of southern Africa as well as an opportunity to reflect on the contribution of the (mainly foreign-founded) observatories to main-line scientific astronomy.

Chris de Coning, Director of the ASSA Historical Section, called it a "ground-breaking event as it was the first-ever symposium covering the whole of Africa's astronomical history. Prior to this event, the only other truly historical astronomical symposium in South Africa was the John Herschel Bicentennial Symposium held on 6 March 1992 under the auspices of the Royal Society of South Africa."

About 62 delegates attended, from all parts of South Africa as well as several from other continents. Four of the invited guests came from distant places; namely Prof Jarita C. Holbrook (University of Arizona, Tucson), Prof J. McKim Malville (University of Colorado), Dr W. Orchiston, James Cook University, Townsville, Australia, and Prof Keith Snedegar (Utah Valley State College).

The proceedings of the Symposium will be published in African Skies during 2006. This publication will be available free on the Web, but to give a flavour of the meeting, brief summaries are given here.

8 November - Indigenous African Astronomical Ideas and Beliefs

The first day was devoted primarily to indigenous African astronomical ideas and beliefs, while the second dealt with contributions to modern astronomy.

The first talk, by Prof McKim Malville, was on the subject of "Astronomy and Stelae at Nabta Playa". Nabta Playa is in southern Egypt and was at one time (11000 to 5000 years ago) a valley that received rains and was fertile. The region contains cattle burials, complex stone structures with astronomical alignments and stelae (standing stones).

The following three talks dealt with the beliefs of a more recent African people, the /Xam bushmen. Firstly, Dr Jeremy C Hollmann of the Natal Museum in Pietermaritzburg spoke on "The Sky's things: /Xam Bushman cosmology". This group lived in the Northern Cape

Province. He presented /Xam narratives in which the nature and origins of 'the sky's things' are explained.

W.P. Koorts and A. Slotegraaf (ASSA) (talk presented by Slotegraaf) spoke on "/Xam astronomical references in GR von Wielligh's Boesman-Stories". Von Wielligh was the Surveyor-General of the Transvaal Republic and collected bushman tales in the NW Cape at about the same time as the more famous Bleek and Lloyd pair. In "Comets in bushman paintings", Brian Fraser (ASSA, Johannesburg) showed a selection of slides of bushman drawings said to represent comets from the collection by Bert Woodhouse and asked the audience to draw their own conclusions on the matter.

The following two talks dealt with the astronomical beliefs of present-day indigenous peoples. Tembo Matomela (Iziko Planetarium, Cape Town) discussed Xhosa beliefs and celestial nomenclature. The reappearance of the Pleiades (Isilimela) was used to set the date of initiation ceremonies. Lerothodi Leeuw (University of Chicago) discussed the astronomical beliefs prevalent in the Setswana linguistic area (parts of South Africa and Botswana), with special reference to the Moon and Venus.

Thebe Medupe (SAAO) and colleagues from UCT presented a paper on "The Timbuktu Science Project". In Timbuktu there are many manuscripts written in Arabic characters, but sometimes in the local language, on a variety of subjects, including astronomy. The manuscripts date from the middle ages and are contained in a number of libraries, most of them private. The project aims to study them, including an investigation of their originality, and will produce translations of the more important ones.

Anne Rogers presented an account of the research that went into the film "Cosmic Africa", a documentary. Extensive interviews were conducted through interviewing village elders, sky experts, shamans, historians and various other experts from seven countries. The final film concentrated on the early Egyptian site of Nabta Playa, on the Dogon people of Mali and the Ju/'hoan culture of NE Namibia. A special showing of "Cosmic Africa" took place at 6pm.

The first part of the afternoon contained talks of a more organisational nature about the future of Cultural history studies. Dr Jarita Holbrook talked on "The cultural astronomy of Africa - recent studies", in which she summarised the gradually expanding numbers of presentations and articles on the subject, including the conferences of the recent past and intended for the near future.

Prof Keith Snedegar (Utah Valley State College) talked on "Problems and prospects in the cultural history of South African astronomy". He reflected on the manner in which South African astronomical history was presented in the past. Studies or regional ethno-astronomies has value in advancing relevant science education. Snedegar's interests uniquely cover both the areas of traditional and of scientific astronomy and he discussed the historiography concerning both amateur and professional groups.

The second part of the afternoon was intended to be a discussion of "Social and historical aspects of the proposed NRF Astronomy Frontiers Programme", facilitated by Ms Candice

Levieux (NRF). The AFP is a comprehensive plan for the structure and funding of astronomy in the future and the discussion was intended to cover what might be called the humanistic aspects of the programme – for example studies of the place and meaning of the night skies in African society past and present

Prof Keith Gottschalk (University of the Western Cape and current Chairman of the Cape Centre of ASSA) gave an interesting and provocative talk on the promotion of astronomical studies from a political point of view. He commented on the value of the subject as seen by the post-apartheid government and its support of projects such as SALT, the proposed SKA and a National Space Agency.

Dr Otsile Ntsoane of the Department of Science and Technology spoke on indigenous knowledge systems.

The last paper of the afternoon, by Drs K.J. de Beer and M.J. Hoffman (University of the Free State), was about the value of astronomical history, traditional and scientific, as an aspect of tourism in, for example, the Northern Cape.

Poster papers

I.S. Glass: "Royal Observatory, Cape of Good Hope: the vanished past" This poster showed an index map of the site and photographs of many vanished or changed buildings.

Graham Rodgers: "San scientific astronomy" The San used an astronomical instrument, a modified form of digging stick and bored stone, to site and orientate observing shrines.

W.P. Koorts: "The nature of the Dawn's Heart Star" One of the most developed San narratives is the story of the Dawn's Heart Star, which is here interpreted in detail, with critical remarks on Bleek's account

Group photograph of African Astronomical History Symposium attendees



Photograph by Maciej Soltynski

Alphabetical list of attendees: Prof M. E. Bailey, Miss P. Booth, Mrs G. Borchers, Mrs C. Botha, Ms E. Brits, Dr K. de Beer, Mr C. de Coning, Prof D. Dravins, Mr M. Dyszel, Prof A. P. Fairall, Mr E. Foster, Mr B. Fraser, Dr M. Gaylard, Dr I. S. Glass, Mr K. Gottschalk, Mr M. Hannibal, Mr B. A. Hendry, Mr A. W. Herder, Mr J. Hers, Dr J. C. Holbrook, Mr J. C. Hollmann, Mrs J. Houston, Mr R. Hurly, Mr P. Hurly, Mr & Mrs E. & S. Ingamells, Mrs M. Joubert, Dr E. Knox-Davies, Mr M. Koitswe, Mr W. P. Koorts, Ms L. X. Labuschagne, Ms E. Lastovica, Dr L. Leeuw, Ms C. Levieux, Mev M. M. Louw, Prof J. McKim Malville, Mr S. Manxoyi, Mrs M. R. Masekoameng, Dr M. Masoga, Mr T. Matomela, Dr T. Medupe, Mr K. Meiring, Mr C. Middleton, Mrs A. Naudé, Dr O. Ntsoane, Dr H. M. Oluseyi, Dr W. Orchiston, Mr G. B. Rodgers, Ms A. Rogers, Dr P. Seitzer, Prof J. Shochot, Mr A. Slotegraaf, Prof D. Smit, Prof K. Snedegar, Mr M. G. Soltynski, Dr & Mrs P. D. & E. Toens, Mr B. S. Togoe, Mr C. R. G. Turk, Dr J. O. Urama, Prof B. Warner, Prof J. Zaaiman.

4.4.7 Appendix 7 - The First Workshop on Theories, Methods, and Future Collaborations in African Cultural Astronomy

The First Workshop on Theories, Methods, and Future Collaborations in African Cultural Astronomy

[2006. January 6th. http://www.ceao.arizona.edu/eclipse/](http://www.ceao.arizona.edu/eclipse/)

The First Workshop on Theories, Methods, and Future Collaborations in African Cultural Astronomy - March 27- April1, 2006 Cape Coast, Ghana

"Cultural Astronomy is an interdisciplinary research area that encompasses the many relationships between humans and the sky including archaeoastronomy, ethnoastronomy, history of astronomy, and how astronomy has inspired humanistic expressions. The Edward Bouchet Abdus Salaam Institute, the National Society of Black Physicist, the University of Nigeria, and the University of Cape Coast announce the first workshop on the cultural astronomy of Africa.

The organizers are seeking abstracts for presentations on the latest research results and reports of projects in progress. Abstracts should be less than 500 words and should clearly state your research hypothesis, method of data collection, and major results. We are interested in literary studies, artistic analysis, oral histories, archaeological, and anthropological research."

See conference proceedings in In Holbrook, J. Urama, Johnson O. & Medupe, Thebe R. (eds.), African Cultural Astronomy - Current Archaeoastronomy and Ethnoastronomy Research in Africa. Springer Science+Business Media B.V. 2008.

Paper submitted, received and reviewed February 2006: -

Wade, R.P. 2005. "Preliminary Research Into Archaeoastronomical Aspects Sub-Saharan Africa" in proceedings of The First Workshop on Theories, Methods, and Future Collaborations in African Cultural Astronomy. March 27- April1, 2006 Cape Coast, Ghana.

4.4.8 Appendix 8

Government Memorandum - Returning Identity Of Capital Formation To Actors: Matatielesega/Mesp Study to Director-General DEAT

06 October 2006 02:56 PM

BUILDING RESILIENCE TO IMPACTS OF GLOBAL CLIMATE CHANGE ON THE STATE OF THE ENVIRONMENT: CAPITAL FORMATION TO BUFFER SEISMIC SHIFTS IN ENERGY AND MATERIALS TRANSFER SYSTEMS IN THE CAPITAL BASE OF THE GLOBAL ECONOMY

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AIM

To bring dead capital into production to buffer climate-induced changes in consumption dependent on materials and energy transfer systems contributing to Gross National Product (GNP), the macroeconomic indicator used in a System of National Accounts (SNA) to measure wealth of nations.

SUMMARY

Thermodynamics of the industrial revolution depend on applications of the kinetic theory of mass (energy as a property of mass), whereas thermodynamics of living processes in the biosphere depends on applications of quantum theory and exchange of massless particles known as gauge bosons (energy as a property of space). Integrating the two by bringing dead capital in the biosphere into production can shift the social equilibrium towards the Pareto optimum by liberalizing capital formation under neo-liberal macroeconomic policies. The concept of capital as a materials and energy transfer system provides a base on which to build the knowledge to increase employment and equity in the process of delivering goods and services with laws of primary science. Conformance with the laws, applying them practically and ensuring that the identity belongs to the actors has the logical consequence that the social constructs of good custom, command-and-control legislation, incentives and taxes that follow, will satisfy human wants and improve human welfare in environmentally sustainable growth and social development.

Thermodynamics of the industrial revolution are characterized by Import Substitution Industrialisation (ISI) to increase GNP of developing economies. Reviving dead capital utilizing energy as a property of space in economies using materials and energy transfer systems dependent on energy as a property of mass, liberalises capital formation. It changes urban and rural sprawl into clustered human scale settlement patterns whose agrarian character provides a comparative economic advantage for trading with industrialized nations in natural goods and real estate services. The associated lifestyles, under climate change regimes, can cause seismic shifts in global markets.

Driving biodiversity conservation of Protected Areas with liberalization of capital formation in human settlement patterns around them provides Corporate Social Responsibility Programmes with a "*sal biodiversity conservation buffer zone*" vehicle to create better lifestyles for an industrial working class bearing the brunt of rural land degradation and urban waste/pollution in the migrant labour systems characterizing ISI in developing countries. Declaring more protected areas with this *science of liberation* can accelerate the implementation of the social plan of *political liberation*.

At the same time, it neutralises the *class struggle* with improved performance in the *economic struggle* to increase employment and equity, supported by neo-liberal macroeconomic policies driven by a *circulating elite* created by increasingly basing politics on *primary science*

Thermodynamics, ecology, economics, accounting, and management of economic activities can all be understood in one head when the constructivist method of teaching primary science is used to familiarize thinking patterns with the concepts on which the knowledge of these disciplines is built.

The practical application of laws of primary science in the constructivist method of teaching is illustrated in Al Gore's latest movie on climate change "An Inconvenient Truth". Al used good digital still and video cameras and Apple computer multimedia presentations to do the teaching. He has appointed Steve Jobs, CEO of Apple, to do the marketing and advertising for the movie.

Our educational system teaches thermodynamics, ecology, economics, accounting and management to produce engineers, ecologists, economists, accountants and managers who don't understand each other. The words in the text of this submission that are taken from these "big five" disciplines are like subtitles in a movie, and the familiarity with the concepts on which these disciplines are built is like the multimedia context to the subtitles. The copywriter and graphic design to match sub-titles with multimedia context is all that is required to turn this submission into a 3-minute TV news documentary that everybody can understand. Global climate change to create a common global identity with a common concern. Role-players like Richard Branson, George Soros and Steve Jobs have assumed this identity in their responses to Al Gore's movie, but they need help from the bottom.

The aim of this submission is to serve the need that entrepreneurs, financiers, marketing and advertising people at the top have to think globally and act locally to start the ball rolling in building resilience to climate change with a layering of this common identity from global-African-uMzimvubu catchment, rather than Global, South African, to Johannesburg WSSD event. Natural identity bypasses SNA's accounting that interferes with the pricing mechanism. SNA's externalise the cost of land degradation in developing countries in the sums done in industrialized countries whose foreign economic policies run the global neo-liberal economic regime.

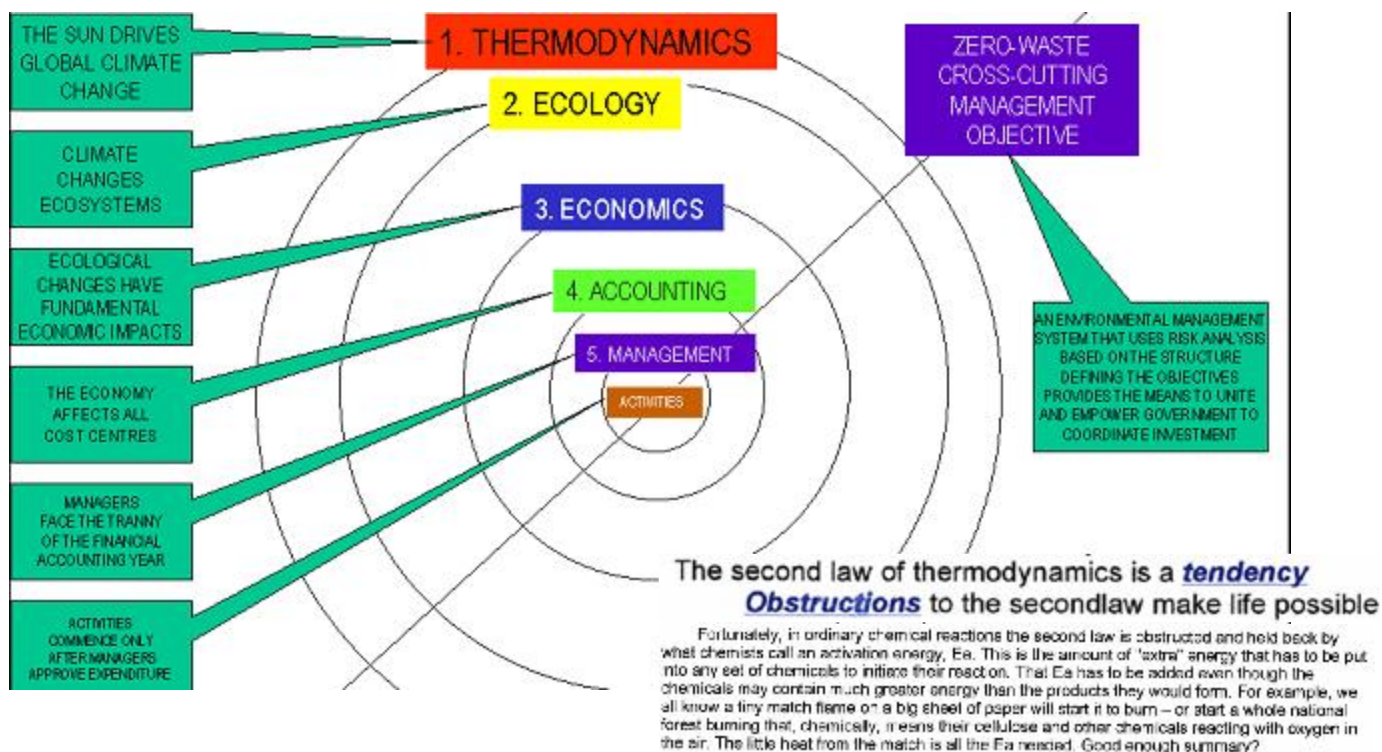
BACKGROUND AND DISCUSSION

The wealth of nations based on energy and materials transfer systems

The wealth of nations depends on the science of using capital invested in materials and energy transfer systems for the business of exchanging goods and services. It is driven by the incentive of satisfying human wants and improving human welfare in sustaining consumption in the economy.

Money provides a trusted medium of exchange for anonymous transactions, which allows effort to be focused on the incentives of doing business without having to waste time on social deadweight losses like mechanics of barter transactions or client finding customer.

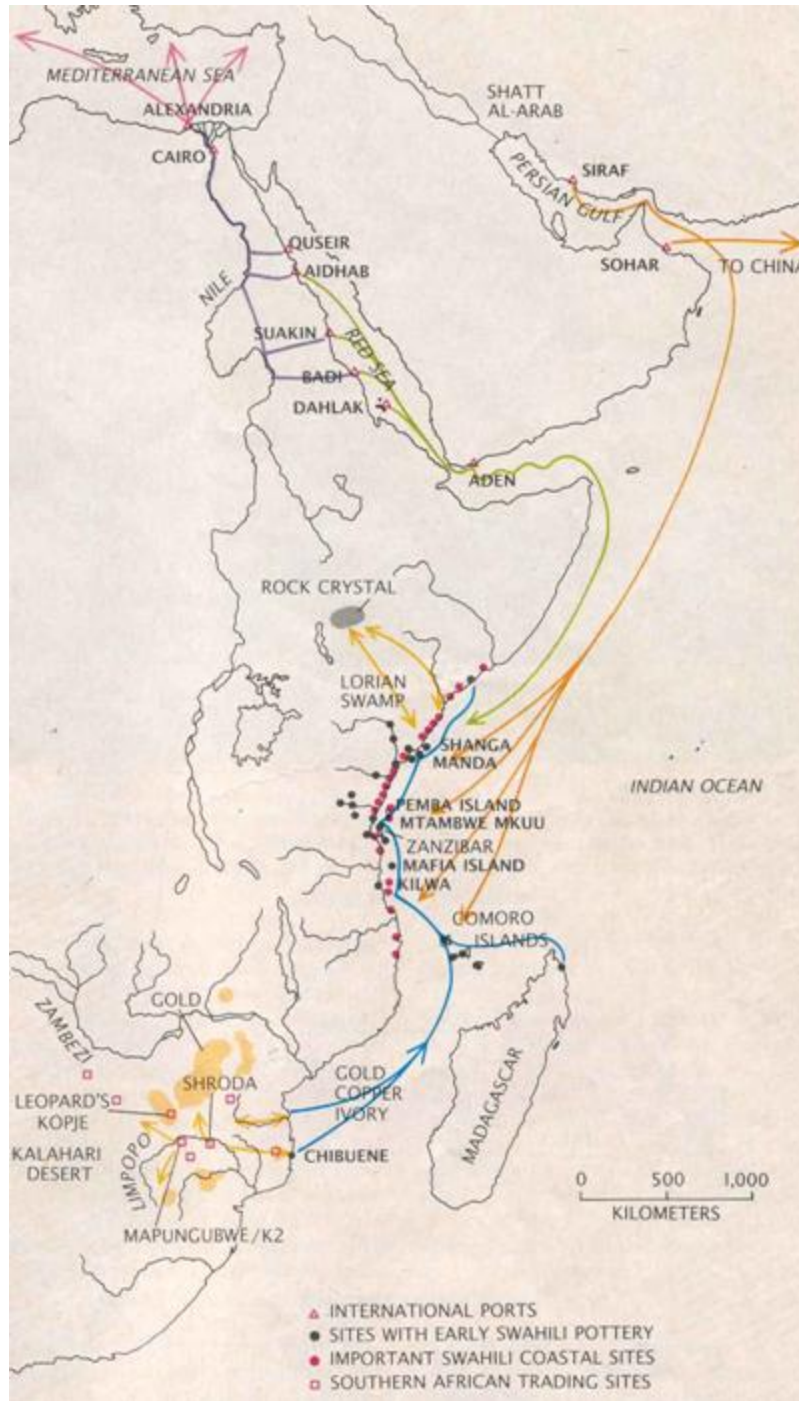
Adam Smith came into the picture with his treatise on "The wealth of nations" after the European Renaissance, when knowledge of thermodynamics fulfilled the narrowly conceived purpose of building more efficient machines to support the industrial revolution. Capital investment in materials and energy transfer systems based on the science of the kinetic theory of mass got a big kick-start from trade chains starting with *low entropy* thermodynamics of coal, oil and natural gas based industries, bypassing ecological capital running on quantum theory-based *higher entropy* growth.



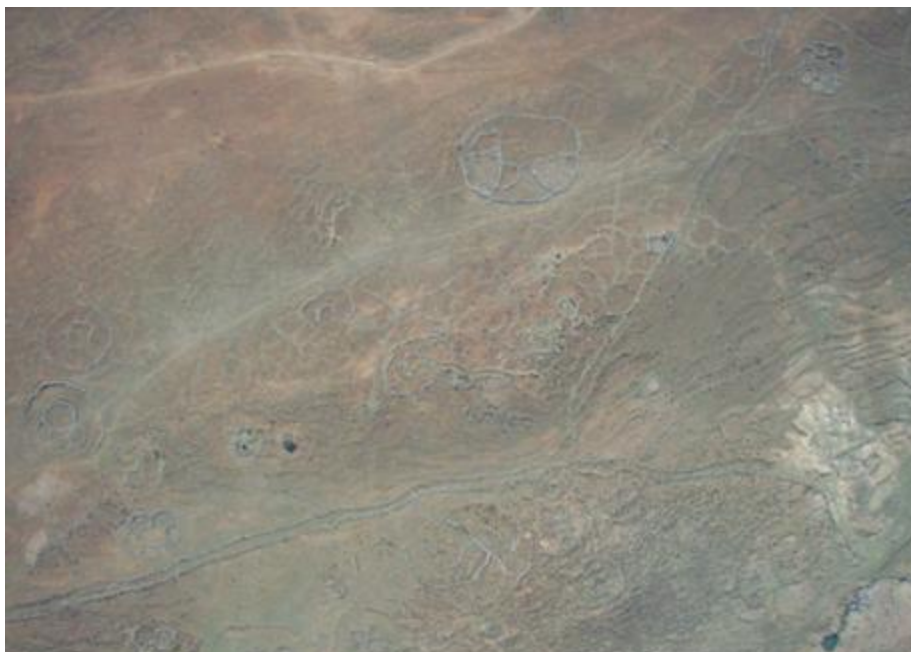
Whilst thermodynamics was successfully applied to liberalise capital formation in plant and machinery through the kinetic theory of mass (lower entropy production processes), it simultaneously failed to increase capital in trade-chains starting with quantum theory energy flows through ecological systems to the economy (higher entropy production processes). A modern industrial approach thus optimizes by adding E_a in changing energy properties of *mass*. Reducing E_a to ambient in changing energy properties of *space* instead, is the way of ecosystems. Switching benefit stream optimisation from *quantum theory energy flows*, to *kinetic theory of mass energy stocks*, changed clustered human settlement patterns to urban and rural sprawl. This has converted much of the biodiversity of terrestrial, freshwater, estuarine and marine habitats into dead capital with resource use pricing that has optimized only low entropy energy transfer systems.

The dual capital formation that built the platform for Adam Smith's capitalism

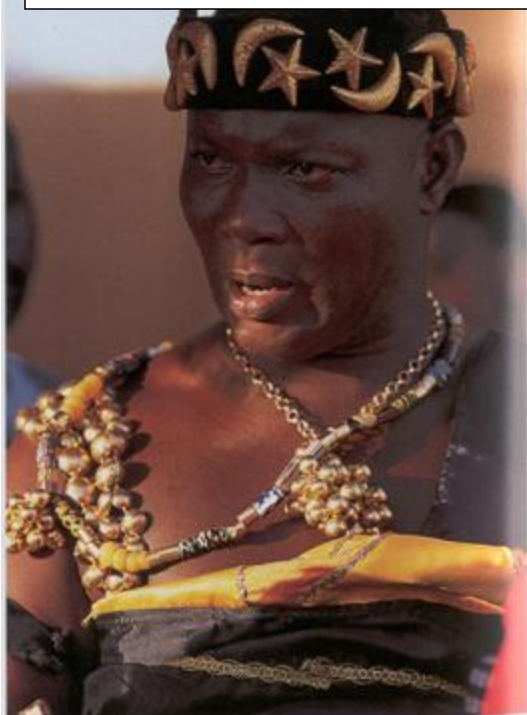
Sustainable trade routes of the Swahili corridor are partly responsible for growth in capital formation that sustained Europe after the "Dark Ages". This platform gave people time to create knowledge for thermodynamic applications of the kinetic theory of mass in machinery as capital for the neo-liberal economic regime of Adam Smith's economics. Sustainability was, however built from *integration* of quantum theory and kinetic theory of mass-based capital in the trade routes.



The dual energy transfer systems that built Adam Smith's platform for capitalism



THE SCIENCE OF AFRICAN LIBERATION –
ENVIRONMENTALLY SUSTAINABLE INTEGRATION OF
AGRARIAN AND INDUSTRIAL ECONOMIES



Terracing over thousands of kilometres of the veld in Southern Africa, stretching from the uMzimvubu catchment draining from the Drakensberg escarpment, up to Inyanga in the Chimanimani Mountains in Zimbabwe, provide evidence of extensive quantum theory-based capital formation in soil biodiversity for dryland cropping. This capital in soil biodiversity is associated with an abundance of stone structures that demonstrate unmistakable astronomical alignments useful for weather forecasting essential for increasing agricultural production in the Southern African climate.

The staggering level of effort required to do this would be absolutely pointless in the absence of an economic incentive to engage in surplus cropping trading with the miners. It speaks of *dual* energy and materials transfer systems based on quantum theory in ecosystems and kinetic theory of mass in metal refiners' fires.

The value of biodiversity in the science of African liberation

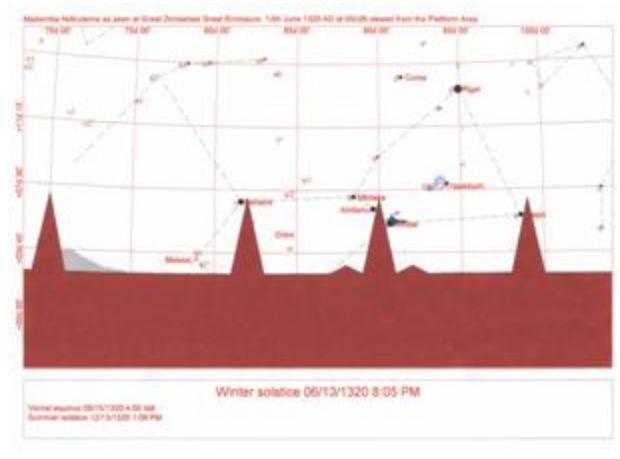
Role players in Adam Smith's wealth of nations only occupy half the stage in a neo-liberal economic regime that drives capital formation with the kinetic theory of mass. The opportunity to use the whole stage can be utilized by satisfying human wants and improving human welfare by reducing activation energy levels in quantum theory-based energy and materials transfer systems. These allow *biodiversity based production* to take place at higher entropy levels. This method of increasing benefit streams liberalises capital formation by bringing the dead *capital* of terrestrial, freshwater, estuarine and marine systems into *production to create new wealth* from biodiversity.

Plate 5 Nationalist leaders Joshua Nkomo (left) and Robert Mugabe (second from left) being greeted at Salisbury airport in 1962 by a veteran of the 1896 uprising. The ceremonial axe with which they are being presented is identical to those used by spirit mediums and symbolises the legitimate ownership of the land (See Plate 3.)



REINTEGRATION OF AGRARIAN
 AND INDUSTRIAL ECONOMIES

African liberation is capital formation on the whole platform African science created for Adam Smith



Funding archaeology for sustainable capital formation in the West Indian Ocean Region

Integration of high and low entropy thermodynamics in capital formation with a sustainable energy and materials transfer system in the Karanga Empire was in part responsible for building the platform for Adam Smith's capitalism. Mercantilism exploiting raw materials from colonies made it possible for the pugnacious, insensitive and practical approach of the islanders of Britain to use the half-truth of low entropy thermodynamics (and the trust in monetary exchange inspired by the Bank of England), for bankrolling national debt. This served to eclipse the European empire and eventually led to domination of colonial expansion in establishment of the British Empire. The 1896 uprising in Zimbabwe and the Bambata (hut tax) rebellion at the same time in Zululand, were both against income skewness abuses of money's property as a trusted medium of exchange. This subjugated equity holders in a higher entropy agrarian economy to labour, in the working class of a capital formation process the British controlled with low entropy industrial production.

The traditional elite was not deceived by the mantle of the capitalist economic elite (disguising thermodynamic underpinnings), to engage in a class struggle instead of an economic struggle. In 1962, to liberalise capital formation by reintegrating agrarian and industrial economies, they hit the scientific principles underpinning the neo-liberal economic regime dead centre when the ceremonial axe symbolizing legitimate ownership of the *land* was handed over to the appointed African liberation leaders at Harare airport. Their mixed traditional and modern attire signifies that *science* of African liberation is rooted in integration of agrarian and industrial energy and materials transfer systems to liberalise *capital formation* with dual high and low entropy strategies for exceeding activation energy thresholds.

The energy dependence of the wealth of nations on the kinetic theory of mass was not perceived by other price-takers. To these role-players, the primary science underpinning both Adam Smith's and Karl Marx's concept of capital remained hidden in the shadows of money it produced and money's ability to finance long drawn-out wars abroad, a foreign economic policy game in which the USA superseded British dominance when it succeeded in pegging the value of the dollar to gold at Bretton-Woods after World War II. When this all came unstuck in 1973, the petrodollar crisis again exposed the energy science of a neo-liberal economic regime determining the wealth of nations. Running on a "half-baked" philosophy of energy and materials transfer systems, impressive GNP could be traced mainly to low entropy production under the kinetic theory of mass. This controlled exchange rates, which aided and abetted G7 nation economic expansion into developing economies through strictures imposed by the Bretton-Woods Institutions on lending.

In the West Indian Ocean region of the Trade Routes in particular, the above lending conditions permitted a neo-liberal regime of foreign investment to openly increase corruption in, and thereby control over, capital formation in exploited developing African economies in a manner insensitive to overarching societal objectives that the environmentally sustainable integration of agrarian and industrial economies achieved in the Karanga Empire golden era. An *identity of capital formation* nevertheless remains rooted in the cultural heritage of the trade routes. This identity with capital formation determines *value* of archaeology and archaeoastronomy of these sites in applied science of African liberation. Identity defines where our best interests lie and in so doing reinforces property rights in these areas in providing the cornerstone for *sustainable capital formation*. This provides a framework for quantitative methods for valuing heritage sites in extended cost-benefit analysis in EIA processes. It establishes the economic reasons for funding archaeology.

Scientific rationale for introducing macroeconomic reforms to resolve the land question

As the 1970's wore on, a floating gold price associated with cyclical price volatility of commodity markets played havoc with the second leg of South Africa's twin macroeconomic growth strategy for Import

Substitution Industrialisation (ISI) and expansion of mineral exports, notably gold. Sanctions blocking access to capital markets which South Africa's competitors had access to, both exacerbated the deprivations of an economically marginalised majority and sapped resources to finance wars funded by the apartheid regime foreign economic policy to combat the African liberation movement in the South. In the ensuing political change, the energy and materials transfer system of a neo-liberal economy generating GNP largely from coal energy remained unchanged, hidden under the mantle of political liberation. The economic RDP never got into GEAR, and despite laudable fiscal frugality imposed to escape the strictures of the Bretton-Woods lending agencies, liberation leaders carried on doing the same thing while expecting a different outcome.

Industrial revolution thermodynamics, disguised in the euphoria of subsuming the economically marginalized majority from the working class to *bourgeoise* society, relentlessly opened up South Africa's economy to the socially insensitive overtures of an internationally based economic elite. This took the form of continued investment in capital formation in one-sided low entropy macroeconomic growth. An *open mind* on thermodynamics can enable African society to resist the pursuit of a neo-liberal economic orthodoxy that has been so well branded by the international economic elite that it has become an end in itself. The identity of capital formation associated with trading centres like Great Zimbabwe and Mapungubwe provides a marketing tool in that prides free the identity of Africans from a global economic elite and allows them to take possession of it to break the shackles of a Western education on African minds in *applied science* of liberation.

The integration of the "big five" disciplines of thermodynamics, ecology, economics and management in primary science education has the potential to create societal objectives that conform to the criteria of equity, efficiency and sustainability. Such objectives unite and empower government to coordinate investment. Economic cluster group cooperation between institutional structures that have been formed by Western education can in this way remove the imposition of a Western identity on the everyday life of individuals in developing country economies. In so doing this can induce African society as a whole to invest where the best interests of African society lie in a twin macroeconomic growth strategy of *integrating* low entropy industrial with high entropy agrarian capital formation under a regime underpinned by *good science* for improving delivery.

The identity of capital formation during the Trade Routes era, in Southern Africa at least, succeeded in integrating industrial and agrarian economies. This is closer to interests of African society than modernisation is. Related industrialization of agriculture needs to take second place to production from capital formation in soil biodiversity-generated energy and materials transfer systems.

The VAT zero rating on fertilizers and pesticides needs to be addressed. A tax-shifting exercise to instead impose a VAT zero rating on composting will strengthen the quantum theory capital base in soil biodiversity. This should be amplified by adjusting agricultural lending agency policies to enable traditional leadership to optimize *land rehabilitation* for building economic resilience (to climate change), replacing the current lending policy of optimizing for production accounting (tyranny of the financial accounting year). The tax-shifting and lending policy adjustments form a self-contained package for introducing land and agrarian reform with a neo-liberal economic policy.

Intervention to renew the identity of capital formation in an African heritage project

The site of the Holy City of Moria, a tabernacle erected in the Limpopo Province, South Africa, is marked by the crater of a nearby meteorite strike whose advent was interpreted as a sign of the times in a resonance that struck a chord in the political economy of natural resource wealth. It mobilized organization for social change in the political struggle, class struggle and economic struggle towards a Just South Africa.

In African heritage, it re-awakened the awareness of an ancient people and capital formation associated with the Trade Routes up the Swahili Corridor in the West Indian Ocean Region. The business people in the economic struggle and trade union leaders in the class struggle owe the human spirit with which they were imbued to their economic origins in the Karanga Empire era of capital formation in an integrated

industrial and agrarian economy whose archaeological remains in metallurgical melting ovens and terraces for surplus cropping surround Morija City.

The closest economic link from mining in the present day industrial economy to traditional agriculture in the economically marginalized agrarian society under traditional leadership governance is the trading in indigenous soil biodiversity taken from rehabilitated mining areas. This accelerates soilification in and around mine tailings to increase cost-effectiveness of surface rehabilitation of mining areas required by law. An innovation in mining rehabilitation in Venezuela provides another linkage to agrarian economies in circular metre-diameter holes bored into mined surfaces to provide pockets for soil biodiversity in composted material. This provides a social plan for subsistence for remnant mine labour communities left behind. After the capital depletion associated with mining construction has run into the diminishing marginal returns prompting mine closure, workers are left destitute. A South African innovation introduced a perforated waste 2l plastic beverage container buried to the neck in the soil in the middle of the 1m circular hole to provide a water-efficient means of root irrigation that is five times more efficient than drip-irrigation.

The heritage project this suggests to rebuild the ancient link between industrial economies driving agrarian economies in using the mining-related soil biodiversity trading to form capital on the ancient terraces. Through export-oriented surplus cropping of natural products and medicines the collateral in land can be created to secure loans to finance capital formation in mining of the gold and platinum group of metals.

A capital requirement for establishing this identity is the funding of the archaeological work needed to do the interpretation necessary to show the descendants of the ancient people who did this agriculture-based mining, firstly the authenticity of the rich African heritage around Morija City. Secondly the business people of the African liberation movement linked with Morija City need to build an understanding of how to use their original identity with an integrated industrial and agrarian society to reconstruct the capital formation process by collectivizing effort in the context of present-day markets and cosmopolitan society under an export-oriented neo-liberal macroeconomic policy.

In particular, the archaeo-astronomy linkages to weather forecasting from astronomical alignments in monolithic structures needs to be linked to providing authenticity of the sign of the times that started the reawakening in the cosmic event that occurred when the meteorite hit the earth. In the great political theories, symbolism, myth and legend are the base from which charismatic leaders deliver goods and services based on good science that can create Pareto's "circulating elite".

Extending the renewal of the identity of capital formation to the social plan for mining

Gold mines around Johannesburg are nearing closure after a century of mining that has constructed the deepest mines in the world. These mines represent part of South Africa's twin macroeconomic growth strategy, which in the apartheid era, traditionally recruited mine-workers from captive labour markets in former "homeland areas" like the "Transkei". This area has the most surplus water and a hydro-electric scheme on the uMzimvubu river is being planned. It borders on the Drakensberg/Maloti Trans-frontier Conservation Area shared with Lesotho to the north. In terms of the social plan of political liberation, mines are required by law to have a social plan for mining to internalize the social costs of insecure tenure of migrant workers associated with cyclic price volatility of commodity markets and diminishing marginal returns of mines nearing closure.

The Matatiele Nature Reserve, including a mountain lake, in the uMzimvubu catchment watering the Transkei is soon to receive Protected Area status as part of the scientific plan to conserve biodiversity in the mountain catchment area. A socially sensitive implementation of the scientific plan opens the door to capital formation in the buffer area on the Transkei side of the nature reserve through the social plan for mining. The mountain catchment area provides good winter grazing with palatable perennials like *Themeda triandra*. An arrangement with Chief Magadla's people at the bottom of the mountain to create a carbon sink from grass land rehabilitation with a high-intensity short duration grazing scheme using the nature reserve as a "cushion" to assist the recovery of degraded grassland in the traditional authority area would

dovetail with the need to produce a mosaic-type habitat essential for the breeding of the rare Rudd's Lark, which keen "birders" all over the world come to see. At the same time, the removal of dead top hamper by an appropriate grazing regime would assist in fire management in the nature reserve.

The area is known for its "natural red meat" and bull replacement with valuable indigenous Nguni stock can add the value of bilateral symmetry in hide patterns sought after in up-market interior design. This indigenous breed is tick-resistant due to the fact that it has oil glands, which secrete a tick-repellant substance on the hide, and this would cut costs associated with dipping. The value of indigenous biodiversity in Nguni cattle can be augmented by mining rehabilitation soil biodiversity trading for compost acceleration in the mining-related circle cultivation micro-irrigation in e-Village and e-commerce development at the bottom of the mountain. Collateral in the form of land could be converted into capital in zero-waste to landfill technology to make durable intrusion and extrusion moulding construction material from organic fibre and waste plastic, as well as compost from garden waste, while retrieving 2l used plastic beverage containers for circle cultivation.

A no-fence agreement would allow access of game animals from the nature reserve to the surplus cropping area as part of the carbon sink grassland rehabilitation deal. This would allow the game animals access to micronutrients, which are deficient in the leached mountain soils. Soil design in the circles using the indigenous soil biodiversity method of soilification could enhance this. Extending the social plan for mining capital formation programme to the adjacent trans-frontier conservation area with Lesotho would be a logical roll-out. Building on success with the Matatiele Nature Reserve Protected Area in a large-scale programme to create carbon sink capital formation zones will assist biodiversity management in both Lesotho and South Africa's heritage in the Drakensberg escarpment as a provider of natural products and real estate lifestyle services. From there, the social plan for mining could serve to anchor an African identity of capital formation in integrating industrial and agrarian economies right up the coast of the West Indian Ocean Region.

RECOMMENDATIONS

It is recommended that in principle, resources be allocated to:-

- The archaeology and archaeo-astronomy necessary to establish the authenticity of an African identity of capital formation based on integration of industrial and agrarian economies.
- The capitalization of a heritage project including marketing and advertising to show how land and agrarian reform can provide the collateral for securing loans for sustainable mining under an African identity of capital formation.
- The capitalization of human resource training required to form capital under the social plan for mining to build resilience to climate change on land degraded under the influence of the migrant labour system associated with mining/ISI in developing economies associated with the heritage of the ancient Trade Routes up the Swahili corridor.
- Macroeconomic reforms for sustainable development that provide incentives for traditional society associated with an African identity of capital formation to secure greater access to natural resource wealth from energy and water through capital formation based on collateral created by land and agrarian reform. These incentives should be amplified by wealth taxation on economic sectors built on unequal access to natural resource wealth from energy and water. The incidence of taxation should be designed to divert capital and entrepreneurship to surplus labour and land to support liberalization of capital formation.
- Specific investigations to replace the VAT zero-rating on fertilizers and pesticides with a VAT zero-rating on composting goods and services in a tax-shifting exercise. This should integrate quantum theory – based energy and materials transfer systems with those based on the kinetic theory of mass, in order to create a capital base for a more eco-efficient macroeconomic trajectory for building resilience to climate change.

4.4.9 Appendix 9 - African Astronomy

Holbrook, Jarita. 1998. **African Astronomy**. Essays from Archaeoastronomy & Ethnoastronomy News, The Quarterly Bulletin Of The Center For Archaeoastronomy and ISAAC. Number 28 June Solstice
1998. Essays from.

<http://www.wamumd.edu/~tlaloc/archastro/ae28.html>

African Astronomy

by Jarita Holbrook, History Dept. UCLA

The title of this paper "African Astronomy" tends to cause readers to scratch their heads in confusion and ask for more details as to what exactly it means. Does it mean academic or European astronomy conducted on African soil? Not in this case. Instead, "African Astronomy" refers to the astronomical beliefs, artifacts, and practices of indigenous African peoples. Why study African Astronomy? The night sky is the heritage of all peoples and each took countless generations to watch, justify and map the heavens in addition to defining their relationship with it. Indigenous European, Arabic, American, and Polynesian astronomies have been the focus of many scholars over the last century. These works have revealed a surprisingly intimate knowledge and understanding of the night sky and its phenomena. There is a decided lack of scholarship on African astronomy.

However, two African sites of astronomy have been studied in great detail: Egypt and the Dogon region of Mali, West Africa. My research goes beyond these two sites to sites all over Africa where various forms of astronomy have been and in some cases are still being practiced today, thus I leave it to the reader to review the extensive literature on those two sites. A brief overview of the types of astronomy and the locations in Africa where they are practiced are presented. Several sites exist but detailed astronomical analysis has not been conducted. Thus, in addition to describing established sites of astronomy, I present many sites where research still needs to be done. I hope this article serves as a starting point for individual projects on African Astronomy.

Star Lore: Star Lore refers to the myths and legends surrounding celestial bodies. Examples of star lore include the names of the planets, stars, and constellations along with the stories created about them. Star lore often incorporates origin and creation myths of people as well as insightful tales that reflect important aspects of their culture. For example, in Greek/Indo-European culture, the constellation Canis Major is the faithful dog of the hunter, the constellation Orion, reflecting an idealized and permanent relationship between man and dog. While in Egyptian star lore Orion becomes Osiris, the Lord of everything, while Sirius, the brightest star in Canis Major, becomes Isis his female companion, enough said. Africa extends from 35 degrees north to 35 degrees south covering an area of 11.6 square miles (Europe is 3.8 million square miles).

The star lore of Africans spanning the continent focus on the constellations visible in their sky. As one travels from North Africa to South Africa Polaris, the Big Dipper and the

Pleiades give way to Orion, Sirius, Canopus, the Magellanic Clouds, and the Southern Cross. Thus the star lore of North Africa differs from the star lore of southern Africa. Instead of telling the star lore of the various African peoples, I summarize a few of the regions/peoples and those celestial bodies that are important to them. The Pleiades and Sirius figure largely in the star lore of the peoples of Mali (Bass 1990) and Ethiopia (Lynch & Robbins 1983, Aveni 1993), and Sirius, and Canopus appear in the star lore of South Africa and Botswana (Snedegar 1997, Cuff 1997). Physically Sirius, Canopus, the constellation Orion, and the star cluster the Pleiades are bright distinctive objects in the night sky, this is most likely the reason for their distinction in African star lore. The Milky Way which spans the sky and Venus which is bright and remains close to the Sun are focused on all over Africa (Senkintu 1956, Aveni 1993, Doyle 1997). While the Southern Cross is important to the Zulu, Sotho, and Tswana of southern Africa and is recognized as a navigation constellation (Cuff 1997, Snedegar 1997). For a treatment of the legends and myth behind the stars and constellations see the bibliography that follows.

Equinoxes and Solstices: Due to the 23.5 degree tilt of the polar axis of the earth, the apparent motion of the Sun, in addition to traveling east to west over the course of a day, travels south, to north, to south over the course of a year. The north and south extremes of the Sun's path are called the solstices, and the equinoxes mark the half-way points in between the two. For the northern hemisphere, winter solstice is when the Sun is the furthest south, and the summer solstice is when the Sun reaches its northernmost position. For the southern hemisphere, the seasons are reversed. The equinoxes are when the sun rises due east and sets due west at the Earth's equator. Africans in Zimbabwe, Togo, and Benin built physical structures aligned to the positions of the solstices and equinoxes.

In the Great Zimbabwe stone city, a chevron pattern is bisected by the solstice Sun (Doyle 1997). Great Zimbabwe was built around 400 AD and a finished city around 1350 AD. It is credited to the Karanga people. In Togo and Benin, the Batamalimba people have designed their houses such that their crossbeams are aligned to the equinox sunrise and sunset (Aveni 1993). Finally, there are over 1600 stone circles in Senegal, the Gambia, and Togo which have yet to be astronomically analyzed in great detail (Posnansky 1982), however in East Africa, the stone circle, Namorotunga II, has been shown to be an astronomical calendar (Lynch 1983, Doyle 1997).

Calendrical Systems: Agricultural calendars, migration calendars, and rain schedules are all important to African people. Possibly the oldest lunar calendar is the Ishango bone dated at 6500 b.c. (Van Sertima 1983, Aveni 1993). The Ishango bone was found at the site of a fishing village on the shores of Lake Edward which border the Congo (Zaire) and Uganda. The lunar cycles regulate the tides and marine activity, thus it's not unexpected to find a lunar calendar along the shores of a lake (Aveni 1993).

The problem of following a lunar calendar is that it doesn't accurately measure the solar and seasonal year. Twelve months only adds up to 254 days about 11 and a quarter days short of the 265 and one quarter days of the solar year. The Borana of Ethiopia follow a lunar calendar but add an extra month to compensate for this difference (Aveni 1993, Ruggles 1987). But as a result, telling time among the Borana is not a simple matter but

debated because of this. In the Congo (Zaire) the Milky Way is called "God's clock" and is orientated east-west during the wet season and oriented north-south during the middle of the dry season (Aveni 1993). In Mali, the Bozo people migrate along the delta of the Niger river when the Pleiades transit overhead and begin their fishing season when the Pleiades leave the night sky (Bass 1993). The equinoxes, solstices, and stars all follow the solar cycle, thus observing these phenomena establishes a more exact year than following a lunar calendar.

Stellar Navigation: Stellar navigation is a method of using the stars to determine directions when traveling at night. During my field work in Tunisia, North Africa, I discovered that the fishermen of the Kerkennah Islands still used stellar navigation to reach their fisheries at night (Holbrook 1998). Since then I've unveiled several sites of stellar navigation all over Africa. A second site which I am researching is the Afar people in Eritrea (Holbrook 1998). During the struggle for independence which ended in 1993, the Afar were consulted to navigate troops at night. Other potential stellar navigation sites are in Senegal, Ghana, Nigeria, and Madagascar. Most but not all of the sites are associated with ocean travel.

Summary: My preliminary findings on African Astronomy reveals a continent rich in astronomical traditions. I have presented four of these traditions as separate from each other, but in fact they overlap in interesting and unexpected ways. Such as stars being named for their use in navigation or being named for the season which begins with their appearance. In addition to the four topics mentioned here there are several more focusing on the moon, the sun, the major planets, and the relationship between the stars and man. I continue to search the literature for mention of African astronomical traditions as well as taking trips to Africa to interview people about their astronomy.

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4.4.10 Appendix 10 – Sacrificial Practices Amongst the Lovedu People and Ritual Deaths in Southern Africa

Sacrificial Practices Amongst the Lovedu People and Ritual Deaths in Southern Africa

The Kingdom of Modjadji is situated in the Limpopo Province and comprises of a rural community of over 150 villages. The Balobedu or Lovedu Kingdom has a population of more than a million people. Apart from her ruling duties, the Queen of Modjadji has the duty of providing her nation with rain and the fertility of the land.

In the many legends that are told about the origins of Queen Modjadji the most acceptable version is that an old Karanga chief from the Kingdom of Monomotapa (south-eastern Zimbabwe), was told by his ancestors that he must impregnate his daughter, Dzugundini. This would bestow on the princess rainmaking powers, which would expand the wealth of his kingdom. This princess was called Modjadji or "the person of the sun". Each queen trained her successor in the rainmaking rituals, and then disappeared by drinking poison.

Early In the 19th century Modjadji's tribe, now known as the lovedu, moved further south into the fertile Molototsi Valley, where they founded present day Ga-Modjadji.

The reigns are as follows: -

Rain Queen Maselekwane Modjadji I (1800-1854)

Rain Queen Masalanabo Mankhatene Modjadji II (1854-1895)

Rain Queen Khetwane Modjadji III (1896-1959)

Rain Queen Makoma Modjadji IV (1959-1980)

Rain Queen Mokoape Modjadji V (1981-2001)

Rain Queen Makobo Constance Modjadji VI (2003-2005)

The present rule is now with the brother of the late queen, Mokgomana (Prince) Mpapatla Modjadji together with the Modjadji Royal Council.

In May 1998, Michael Modjadji, brother of Queen Mokoape Modjadji V, died. He was the queen's closest relative and proxy.

The destined successor to Modjadji V and mother to Makobo Constance Modjadji VI, Princess Maria Makhaele Modjadji, died on the 25th June 2001 two days before the death of Queen Mokoape Modjadji the V on 28th June 2001. Both died during the time of the Winter Solstice 21st June 2001 and a Solar Eclipse marked the event.

Mokgomana (Prince) Masopha Edwin Modjadji died on 12th August 2005, two months after his sister Queen Makobo Constance Modjadji VI died, at the time of the Winter Solstice in June 2005.

“CONDOLENCES BY PREMIER OF THE NORTHERN PROVINCE, ADV. NGOAKO RAMATLHODI, AT THE BURIAL OF HER MAJESTY QUEEN MODJADJI THE V, 1 July 2001

We have come to bury Modjadji, the Queen of Balobedu of the Northern Province. We are bidding farewell to the grand daughter of Monomotapa and a distance cousin to the Masingo who rule the Venda people today.

We are here to celebrate the life of a remarkable woman, and an incredible man, for she was a mother and father in one. In a dual role she married wives and fathered children as well as giving birth to her own offspring, one of whom is being buried with her today.

Modjadji, the Queen's fame was and remains legendary. As the Queen of Kings, her giant shadow was cast over the length and breadth of our country, continent and indeed beyond the wide seas. Her mythical powers as the rain Queen went far beyond the realm of doubt. For this we are most grateful, as she singularly validated our being as Africans with tremendous force. She epitomised our past, our present and our future with unsurpassed eloquence.

Our Queen added in no small measure to the dignity of her throne. Most of the time, she did this at a great personal sacrifice. She followed the rules of her throne, and reigned with calm, dignity and tremendous fortitude. She leaves a giant footprint on the sands of time. We salute her. She kneeled on her knees in returning the salutations of us, the commoners. She honoured our feasts without breaking the rule to always be separate and thus archiving the miracle of being present and absent at the same time. She was a great human being who gave laughter when circumstances so permitted.

Wise men and women must still tell us the relationship between the recent eclipse and the demise of our Queen. Could it be that the heavens chose to mourn her death in the most spectacular show? Last weekend, we buried her ancestral cousin, Kgoshi Molepo. It was at that funeral where her other cousin, Vhamusanda Vho Khosi Kutama lamented the death of several Magoshi in our Province, this very year. The initiated would know that a Queen or King always sleeps on a pillow. If indeed the royalty we have been burying in recent months was meant to accompany our great Queen, today we summon her great Spirit to put an end to the deaths and usher in tranquillity to Bogoshi in our province and elsewhere in our amiable land.

The Queen is dead. Long live the Queen.

Issued by: Office of the Premier, Northern Province, 1 July 2001 " ¹⁷⁵

Ritualized deaths, sacrifices and cannibalism are a prevalent throughout Africa and various activist movements have issued a protest specifically for southern Africa in the light of the rampant extent of the practice. In the 2004 December issue of Five Minutes To Midnight Griffin, Keshish and Perrella presented the following article: -

"Muti Medicine" ¹⁷⁶

By Mark Griffin, Sasoun Keshish and Eric Perrella

Muti medicine is a system of African holistic healthcare that involves the use of human body parts and vital organs to produce medicine. The word "Muti" derives from the Zulu word for medicine. Certain beliefs state that this medicine can increase the luck and health of a person who consumes it. Muti medicine is prepared by traditional healers known as Sangomas, who resort to barbaric means in acquiring their medical specimens.

The preparation of these medicines requires that Sangomas dismember their victims while they are still alive in the belief that by doing so, they will be more powerful. The Sangomas operate mainly through a business-based perspective, where they conduct their practices to obtain money. They collect money from customers who wish to have Muti murders carried out, customers who purchase Muti medicine from them, and by selling their concoctions in black markets.

The leading cause of death from acute poisoning in South Africa is from traditional medicines such as Muti, causing 51.7% of mortality rates. These deaths occurred from medicine acquired directly from the Sangomas or the black market shops that deal with them.

Most Muti victims are innocent children who are lured, murdered and dismembered. Children are primary targets as they are susceptible to attacks due to their being weaker and defenseless. Young children are also targeted as it is believed that due to their young age, they have used up very little of their good luck and health. Screams of these young children are also believed to make Muti medicine more powerful by waking the spirits and empowering them. According to Muti traditions and beliefs, the power of

¹⁷⁵ 1st July 2001. <http://www.info.gov.za/speeches/2001/010914145p1001.htm>
SouthAfrican Government Information www.gov.za

¹⁷⁶ Griffin, M. Keshish, S & Perrella, E. December 1st 2004. Muti Medicine. In Five Minutes to Midnight. Volume 2, Issue 12. <http://i2r.org/fmm/issues/december2004/article3.html>

a virgin is greater than one who is sexually active.

The many body parts and organs of a person are believed to have different significant effects. The hand of a victim that is buried in front of a store is believed to drive in customers. The genitals of the victims are believed to bring luck and health to the consumer. The brain may provide knowledge and intelligence, while consuming the eyes would grant far-sightedness.

Muti victim remnants are usually discarded in flowing bodies of waters such as lakes and rivers, hindering any identification processes the police and investigators undertake.

These murders occur to enhance personal power, health and bring good fortune to a person. This good fortune can come in terms of having a thriving business or to win the lottery. Ingesting Muti medicine produced with another's healthy heart or kidney is believed to cure heart and kidney ailments.

Conservative estimates say that there have been at least 300 Muti murders in South Africa over the past decade. These numbers do not allot the numerous people that have perished as a result of HIV from Muti practices.

However, instances of Muti murders are increasing. Although most Muti murders occur in South Africa, there are an increasing number of cases in European nations. There have been barbaric cases in England, Italy, Belgium and Germany. Muti practices have been increasing in South Africa, as well, where children are going missing every week from townships. These missing children are assumed to be forced into prostitution and muti murder.

Numbers are difficult to collect as the investigation of Muti murders is complex and difficult to undertake in the current South African police institutions. Many witnesses do not come forward as they are afraid that the Muti murderers will seek revenge upon them.

Something must be done to improve conditions in South Africa. The people must be provided with alternatives to Muti medicine as many Muti murders are a result of lack of access to professional medicines and healthcare - Sangomas provide basic healthcare to an estimated 80% of South Africa's 45 million people, most of whom cannot afford Western-style healthcare.

Local governments must commit themselves to providing alternative means of medical care for their citizens. Education is key, and citizens must be taught about the criminal aspects of Muti medicine, as well as their ineffectiveness. With an informed public, action can be taken to prevent further Muti killings and provide alternative means to healthcare. Innocent lives are being lost for beliefs that eating, drinking or anointing oneself with

another person's organs and body parts will provide power, health and luck. United and educated communities can help put an end to Muti murders and killings.

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Muti murders

March 18, 2005 - [Man to Hang for Muti Murder](#)
February 07, 2005 - [The Witchcraft Murder](#)
26 Jan 2005 - [Couple appear for 'muti killing'](#)
January 6, 2005 - [Little progress made in 'muti murder' probe](#)
27 Sep 2004 - [Reward offered in suspected muti murder](#)
2003-08-14 - [Grisly killings supply S. African body parts demand](#)
15/04/2003 - [Muti murder claims 6-yr-old](#)
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¹⁷⁷ F.A.C.T. Net - Fight Against Coercive Tactics Network. April 22nd 2007.
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[Muti Murders](#) - South African Police Services

[Muti Medicine](#) (by Mark Griffin, Sasoun Keshish and Eric Perrella)