MEASUREMENTS OF THE GODS

Updated edition February 2018

This edition includes additional confirmatory material regarding the veracity of the measures employed in the narrative.

HARRY SIVERTSEN with STEPHEN REDMAN

For Gillie

Companion and support every step of the way.

Thanks to Steve's sister Ann for comments on early drafts of both works.

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Graham Hancock

Megalith, Masonry, Myth and Measure.

Volume II.

Measurements of the Gods

Revealing the source of measure and math in the ancient world…the 11000 year old foundations of our modern world.

Preface

In every disputation, we must look more to the weight of reason than to the weight of authorities.

Cicero

It is a thousand times better to have common sense without education than to have education without common sense.

Robert Green Ingersoll

This book is Volume II of a two part investigation by Harry Sivertsen who has been ably assisted by his wife Gill, a constant and utterly reliable support since the investigation began and who has contributed much more than she realises. Invaluable assistance in the writing and presentation of Megalith, Masonry, Myth and Measure has been provided by Steve Redman who added some essential historical background and technical info regarding astronomy.

Measurements of the Gods with its 19 chapters and over 200 illustrations could have been shortened a little as some material from Volume I, *Deluge: from Genesis to Atlantis* has been included for clarification purposes but then, we could say the same for *Deluge*, it has some borrowings from this book. If either work were to be shortened and were read without at least some explanatory inclusions from its companion book much would not be understood. While *Deluge* primarily deals with the myth of the flood story, *Measurements of the Gods* reveals the units of measure that applied to that and other Biblical myths…their uses in more recent times and their history. However, as with the flood studies we move far beyond Biblical regions and times to ancient India…and even beyond India. Here we reveal the ultimate source of Greek and indeed our own metrological knowledge. In fact we reveal the source of the foundations of

modern society, the origins of mathematics upon which virtually all our developments are based.

Seen in this work is the ultimate home of what can logically be termed a 'lost civilisation' but the only civilisation that can rightly be claimed to be that which laid the foundations of our much later mathematical world. Many groups have been seen to have worked extremely skilfully with stone and equally many have developed methodologies for moving heavy stone…but only one developed mathematics and measure, the very entities that enabled the furtherance of human development.

While measurement may sound a rather mundane subject for an historical study, this is not the case…at least not in as far as this work is concerned because here we reveal much that has never been seen before in any work prior to this study. In a similar vein to *Deluge* we reveal commonalities that most would not have thought existed. We show connections between Biblical myth and standing stones in Britain, links that extend to Egypt and mediaeval cathedrals…only revealed via the use of the same astronomy and / or units of measure and frequently the same counts of those measures. The unit counts, in fact, often tell a story, a tale of astronomy and calendars…precisely the source of the counts involved with the measures. An example of astronomy and calendars is seen in that a description in the flood tale of Genesis [one version, Genesis in fact has two different accounts of this occurrence] is replicated in South Gwent [UK] across miles of landscape while other numerical elements associated with the same myth are to be found at Stonehenge. These values are indeed ancient. The Ark of the Covenant and indeed Noah's Ark are both replicated in Christian buildings…but are only found via knowledge of the measures mythologically utilised to create those structures and which applied to the descriptions of the original artefacts.

Much has been hidden via the creative utilization of numerical values as counts of measurement units. In effect, as we frequently gaze upon much of this evidence without recognition, we rightly term much of it an 'open secret'.

Some readers may be familiar with the work of John Michell regarding measures. While some have blindly accepted his judgments, this is the first work that provides undeniable proof of the validity of his assessment of the anciently accepted circumference of Earth. His valuation of a variety of cubit measures, each of which is dependent upon that evaluation of Earth measure, is therefore seen as also being correct. The widespread use of these values can be proven by the individual as is clearly demonstrated in this book.

However, there is disagreement with some of Michell's associated ideas and this work takes the whole concept of historical measure many steps further with evidence that once more is easily verifiable by the reader. We invite interested parties to extend this research, an in depth investigation of the type seen in these two works is long overdue and the primary researcher of the books would welcome feedback from others who take up the cudgel and conduct their own investigations. As will be seen, the concepts are quite simple and evidence is all around us. Nonetheless, as the ideas sometimes contradict modern conventional thinking, they just may take a little grasping.

Be that as it may, we reiterate that once understood, it will seen that the ideas are simple and basic and one does not have to understand mathematics to follow this investigation. All that is required to check the values is a calculator and a little multiplication and division, it really is

that simple. There is no point in applying complex math to what was initially simplistic, and not being mathematicians the authors would be unable to do so even if they saw a necessity for such a move. Trigonometry was not invented in the distant past so why attempt to apply it to the structures of those times? Likewise with astronomical evaluations, we utilise the basic azimuth / elevation system that would have been in use in times past, before anyone started measuring from the celestial equator. Here it is a simple matter of degrees down the horizon from north and degrees upward from there to the target in the sky.

In common with *Deluge* in this book we have the deciphering of texts and as noted above, the unravelling of the measures of ancient [and not so ancient] buildings. These all combine to reveal commonalities that are not, according to conventional history, supposed to exist. Yet the same values applied to the charts that Christopher Columbus utilised…

A little surprisingly it is seen that churches, Norman mottes and some far more ancient sites are set out at specific distances from each other and sometimes at very accurate angles. While the values are in miles most display the same numerical configurations that denote the dimensions of the ancient buildings spatially related by the longer versions. For example 2.112 miles is seen in the 21.12 inches of the cubit value 1.76 feet which is relatively common to religious buildings. There is a considerable amount of connectivity of this nature that came as a complete surprise when making evaluations, initially merely out of curiosity.

We ask readers to check for themselves, do not meekly accept our word, or deny it but check the calculations, and then ask why it is that convention has missed what in many cases is obvious. John Michell's work has been in the public domain for over forty years but has remained ignored by academia…

The proof of the pudding, so to speak, is cumulative as the evidence builds up but the deciphering of a weights system prevalent in India that spread across to Britain confirms all, including the validity of Biblical research. India is the source of much learning, expertise that stems from long prior to the building of the pyramids in Egypt. Both this book and *Deluge* reveal that India holds many surprises, information that in some cases has not been correctly deciphered in the past but has remained hidden…until this investigation revealed just what has been missed by conventional studies.

These works are very unusual, they utilise unconventional methodologies…and by so doing they reveal what the seers of ages past had hidden via those same methodologies. If a subject cannot be deciphered by the more usual methods then other means have to be utilised and here the investigation stumbled upon what transpired to be the same systems that were utilised in the past.

The two books not only complement each other but are irrevocably interlinked. There are two books only because of the volume of information not because separate subjects are involved. A full explanation of the methodology seen in *Deluge* requires *Measurements of the Gods* and a fuller explanation of sections of the *Measurements of the Gods* requires *Deluge*.

Finally we firmly state that much of the Bible and other similar works will take on a different, far more interesting and logical meaning when the information in these two works is absorbed; archaeological sites will raise new questions, queries that the professionals rarely bother to ask…and those who read these works will, with a little effort, be able in many cases to supply the missing answers.

Time creates the sky and the earth. Time creates that past and the future. By Time the Sun burns, through Time all beings exist, in Time the eyes see. Time is the lord of all.

Atharva-Veda (19.54)

MEASUREMENTS OF THE GODS

A legacy from a lost civilisation

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CHAPTER 1

A Legacy from Antiquity

And the Light shineth in darkness; and the darkness comprehendeth it not.

John 1:5.

1.1 Number, Allegory and Religion

It is ironic that while many people wax lyrical about the great inventions of mankind, few even think about the necessary knowledge that by definition must predate these developments. One cannot make anything without a concept of measurement. Even a stone axe had to fit the hand; a spear was made to suit the thrower's physic. In this work it will be revealed that the measurement system with which we were all familiar prior to the onset of the metrication is almost, but not quite, the oldest such development known to mankind. It is a composite structure that embodies human proportion and canonical numeration. In later chapters it will be seen that this system, which here is found mainly, but not entirely, in the form of linear measurement units, was originally derived from intensive observation of the skies. As the skies were directly associated with the gods that continually patrolled the heavens keeping a watchful eye on Earth then it is appropriate that the predominant measures also had 'sacred' connections. Yet this concept stems from a period before the creation of religion as we conceive of it today. This was an era when effectively science and religion were one. The movements seen in the heavens that denoted periods of time were the only regular and constant elements in a person's life and hence these were studied, not primarily for purposes of understanding the Gods but for purpose of survival, for calculation of seasons and tides. Stories of prediction in the Bible and other religious works are no more than mythical tales describing cyclical events in the skies, counts of days, months or years. From the counting involved and the interaction between counts, mathematics was born.

But this is not a work solely devoted to the structure and development of ancient metrology. It is not a book about the history of mathematics as neither author is a mathematician; in part, this is a book about what ancient metrology has revealed in a hitherto unsuspected use of its values. It is a book that reveals how some measurement units have been used to 'openly' hide information; secrets hidden in historical and religious myth, in maps and charts. It also gives a number of practical examples in buildings ancient, mediaeval and modern. In effect, from the information presented, the reader can validate the arguments contained in the book for him or herself.

Previous investigations into this subject of ancient metrology have concentrated upon the mathematical relationships between values and yet there is far more to the subject than the numerical relationships between measurement units. The more important of these values also

occur in associated mythology and much of that myth as hinted at above, is based in reality, effectively in a period when the practicalities of existence were far more important than an abstract concept of the divine. This is a methodology that has continued down the ages, effectively hidden due to a lack of knowledge and understanding by those outside the influence of more recent users of the ancient systems. Other investigators have missed many aspects of the history and yet when the enquiring mind looks at what has been built in recent centuries it is possible to square the ancient measurement units and myths with such structures.

The investigation, however, needed to look further than measurement systems as they are conventionally perceived, because as noted above, elements of time needed to be taken into account. There are definitive links between these values; just as the modern physicist relates time and space, and so did his ancient forebears. The lights in the sky, the gods, gave time, from which mankind derived mathematics and measure; therefore, measure related to time is also related to the gods, hence the title to this work. There is an age-old concept of numbers having religious, and to the mind of many, esoteric, connections; for example, each phase of the moon takes seven days, and seven in a number of cultures is often associated with God. The inference here is that the lunar passage and appearance have long been seen as being of great importance, more so in coastal regions where the moon's phase denotes the height of tide. As heat and light are derived from the sun, so the giver of these basic essentials must be given recognition in return. This is a simple understanding of paying obeisance to one's God but it may explain what Sir James Frazer reported in his work *The Golden Bough*, regarding the Aztecs:

'...conceived the Sun as the source of all vital force; hence they named him Ipalnemohuani, "He by whom men live". But if he bestowed life on the world he also needed to receive life from it. And as the heart is the seat and symbol of life, bleeding hearts of men and animals were presented to the Sun to maintain him in vigour and enable him to run his course through the sky.' [1]

Yet, although the roots of many ancient religions and practices may have their origins in cosmological events, in their more modern counterparts it is found that such notions have generally been hidden by metaphysical concepts.

These metaphysical ideas are derived from stories that can, in reality, be interpreted in a number of ways; literally, as with the fundamentalist interpretations, metaphysically and philosophically as by those who study religious concepts, and both historically and allegorically. In most texts, the history is interlaced with odd sentences, which reveal other things, matters only understood by an interpretation of allegory. As an example of the concept of religious metaphor, one only has to look at the beast of the *Book of Revelations 17*. Here, with its seven heads and ten horns, this beast is obviously not symbolising any known animal, but it would have had a meaning to the original author and associated adepts. Almost certainly this is a lunar reference, where heads refer to days and horns are the two horns of the crescent moon and where five days would therefore be represented by 10 horns. If this is correct then the reference is to the five days leading up to the loss of the moon for two days, the no-moon period. This is related to a concept seen repeatedly in India [here with the no moon period

occasionally counted as three days] that is revealed in the companion work *Deluge* in relation to flood mythology.

Another example is that of Saint Paul (*Galatians 4:24*), who claims that the Old Testament story of Hagar and Sarah (*Gen: 16*) is allegory. This could be construed as a new believer in Christ [purportedly the one who set the new religion on its path], speaking of elements of the Torah of which he was not in favour; whereas only the plain truth was revealed by Jesus and his self-appointed spokesman, Paul.

Nonetheless, there remains a question relating to the relationship of Hagar and Sarah - Hagar was an Egyptian servant girl, while both Abraham and his wife Sarah were from Ur in Chaldea. Given the power of Egypt at that specific time this appears an odd situation. Indeed, this is just one of the many questions raised when the Bible is read in depth from a lateral standpoint and not just accepted literally. Note should specifically be taken of the work of S.R.L. Clark[2], who documents the teachings of Philo, a Jew who lived in first century Alexandria. Philo was inspired by this centre of learning to search out the allegorical meanings of the stories of the Torah. Karlfreid Froehlich comments on this search in *The Oxford Companion to the Bible*:

'The interpretation of an authoritive text as having a deeper meaning (hyponoia) than that which its words seem to suggest, was an old practise among the Greeks...Philo found the key to deeper meanings in entymological phenomena, numbers.' [3]

The use of numbers in religious texts and legends to convey messages is a central theme in the related book titled *Deluge*. *Deluge* is an investigation into 'Great Flood' mythology including Plato's Atlantis story and some essential elements of *Deluge* are repeated in this work. In so far as they affect this discussion we have to note that numbers take us back to measurement and time, the core of the analysis of this work.

In the preface to her translation of Jean Richer's *Sacred Geography of the Ancient Greeks*, Christine Rhone states that,

'In Egyptian astronomical tradition, there was a type of calendar where the beginning of the year was related to the helical rising of Spica. This harked back to a more ancient age, the age of Gemini.' [4]

Here is seen a reference to an age outside the accepted epoch of the ancient civilisation in Egypt, in fact this is taking the calendar back to a period before any conventionally acknowledged civilisation. Firstly, it is generally accepted that the helical rising of Sirius, around the time of summer solstice heralded the start of the Nile flood. When this celestial event was first utilised as a calendrical point is not recorded but shortly before the onset of the dynastic period in 3300 BC Sirius rose at an azimuth [measured clockwise from north] of $120^1/_2$ degrees and by the time the Sun rose Sirius was $29^1/_2$ degrees in altitude above the horizon.

In fact, this rising of Sirius can be traced back, in a practical manner, to circa 9300BC when it rose at an azimuth of 166 degrees to an altitude of just over 4 degrees by sunrise. At

8500 BC Sirius rose at 156 degrees azimuth to $7^1/_2$ degrees at sunrise. So evidently, the *availability* of Sirius as a heliacal marker is something that dates to long before the Egyptian civilisation.

So where does Spica fit into this pattern? In short, it does not. By the time of the Egyptian civilisation, Spica would be too low on the horizon to have been any use as a heliacal marker because it rises along the ecliptic on the same line as the Sun. As a heliacal marker, it would only be available at the summer solstice period and not at any other time of year. So here is a presented question, what would this calendar represent? If Spica is involved then it has to be an event long before the formation of Egypt as a coherent nation. This is because it is not as bright as Sirius and being on the ecliptic, whereas the latter is well away from it, would not be rising high enough above the horizon to be seen during the period of Egyptian civilisation, as the predawn glow would have hidden it. So, if the heliacal rising of Spica commemorated an earlier event what could it be? Strangely, there is a correlation here to a calendar seen elsewhere in the ancient world, a calendar that dates to the *visual* onset of the Age of Gemini, a calendar that dates to the 7th millennium BC, and was recorded by the Greeks and Romans. This was when Spica, at summer solstice sunrise, had already risen to $5^{1/}_2$ degrees above the horizon, when it would therefore have been clearly visible for a short period before the Sun rose. The calendar in question is the Indian Saptarisi calendar that commenced at the spring equinox of 6676BC. [Here we note that Greek and Roman records accept this calendar but make its commencement 111 years earlier, commemorating the birth of Dionysus (Roman Bacchus) a date which is equally acceptable for the visual commencement of the Age of Gemini.][5]

We can add the commencement date of the Indian 'yugas' to this [see *Deluge*] and it seems as if a number of markers denoting the onset of Gemini have been denoted in the literature.

Advanced astronomical knowledge in Egypt also parallels what to the modern Western World, in terms of religion, are no more than strange superstitions, and yet simultaneously these were analogous with great architectural achievements. As Biedermann comments,

' In the Nile Valley permanent states and kingdoms, stone architecture and written language were realities at a time when the civilisation was still marked by ancient notions (including animal totems) that dominated spiritual life.' [6]

A comparison can be made between what might be called the superstitions of the people who built the temples and pyramids of Egypt, and the ideas of those who laboured on the structures of the great cathedrals and palaces of Britain and Western Europe in Medieval times.

During the Middle Ages in Britain, when church and cathedral building was at its zenith, mystical powers were often credited to such things as the key of a church [a cure for a mad dog].[7] Additionally, the Church, both Roman Catholic and the English derivative, made much mileage from the bones of saints and other supposedly sacred relics. Classical Greek religion was panoply of numerous gods and goddesses, yet simultaneously the country produced people such as Pythagoras and Plato, the latter, while being known as the 'Father of

Western Philosophy', also, perhaps surprisingly to us today, advised religious leaders to take guidance from the oracle at Delphi. A similar scenario arose in Rome a short while later, where the engineering skills of the Romans can be contrasted with their extremely superstitious nature and their worship of another, albeit generally related family of gods and goddesses, along with their barbaric and cruel notions of entertainment.

In later chapters, it shall be seen that in many regions, including those mentioned above, there has been knowledge of the dimensions of the Earth for thousands of years, information perhaps not understood in all cases for what it was.

Possibly, in some areas, this was seen as inherited knowledge of sacred values, we do not know. What is certain, however, is that the values existed and they were in use over a very widespread area in antiquity including Neolithic Britain. They were understood in areas such as Greece, Egypt, Mesopotamia and India and in later chapters it is explained from what and both approximately *when* and *where* they were derived.

As can be gleaned from the comments above, that in numerous places are seen sometimes strange, even savage, religious practices in the past, but it should be remembered that the religious or cultural beliefs of a society do not necessarily reflect its nascent technical abilities. A question is also raised regarding the meaning of 'technical abilities'. The natives of the Amazon, for example, are superb examples of those who have developed skills appropriate to their needs; even cures for a number of illnesses with which the Western world has been struggling, are known of by these people, which is why major pharmaceutical companies are taking an interest in what the jungle has to offer. The natives of the Amazonian jungles do not understand modern chemistry but they have, over millennia, developed an encyclopaedic knowledge of what the plants can do for the individual, yet they are not thought of as civilised in the modern sense of the word.

In fact, cultures have varied enormously in their approach to what we generally term development. Those who have always lived in a jungle environment possibly would not develop greatly mathematically, as there would be little need for mathematics other than a basic counting system. In ancient societies, mathematics would have developed where people were involved in astronomy, in places where they had clear access to the skies, whether deliberately created for such vision or via natural open regions. The basic need for counting was for an understanding of *time*. The only constants available to our ancestors were the skies, the rise and set of the Sun, the Moon, the planets and the stars…along with, in coastal regions, the tides. These were observed intensely and gave correlations of numbers; counts of days, of months, of years; mathematics had arrived.

When knowledge of mathematics does develop, it can change much regarding the religion and culture of the society in which it matures. Indeed, as has happened in India, mathematics may well become an inherent part of the religion.

Examples of this influence can be seen in the design of altars, something documented in the Indian texts known as the *Sulbasutras,*[8] with times for worship being based on astronomical calculations.

As the 'lights in the sky' were the only stable elements upon which our forebears could depend, these, not surprisingly, became gods. They brought the seasons and climate change, sunshine and rain and affected the tides. They also fought among themselves and occasionally

became bad tempered and inflicted harm on Earth [meteors and comets] and created eclipses. These gods had personalities. The more was learnt about their movements the more they could be related to, as what happened in the skies reflected what was happening on Earth. The gods, in their ordered way, even when fighting, controlled Earth.

1.2 Studies in Ancient Measurement

Amongst those who have studied the history of measurement are Sir Isaac Newton in the 17th century, Sir C M Watson in the 19th century and in the early to mid part of the 20th century, Algernon Berriman and Livio Catulo Stecchini. Since the mid-20th century, the most renowned author in this field has been John Michell, [who sadly passed away in April 2009] and it is his book, *The New View over Atlantis,* [9] published in 1983, that provided the initial framework for the research behind this study. [Note that *The New View over Atlantis* is not about sunken land masses.]

More recently, John Neal has self-published an in depth study named *All Done With Mirrors* which expands on the work of Michell and Stecchini. The quotation below is from John Neal's commentary on the work of the former.

'John Michell is perhaps the most widely known and least understood modern author who writes upon the subject of ancient science. So controversial is his subject matter that the orthodox scholars, being unable to rationally contradict the points he raises, treat his works dismissively. Based firmly upon Pythagorean and Platonic ideals, these works reveal straightforward common sense with a deep understanding of his subject matter. From the beginning of his career of authorship he recognised the numerical codes that underlie the productions of the very ancient and the classical civilizations…He saw that from whichever culture, the themes of their temple constructions, both literal and allegorical, were rooted in the identical numerical canon.' [10]

For those who wish to make an in depth study into ancient metrology, a science that should be taken up by archaeology but has been very sadly ignored, both Michell's and Neal's work has to be seen as essential reading, the additional material in this volume and *Deluge* will make both of those studies even more interesting and rewarding specifically as there are some disagreements with both of these authors regarding the origins of the relationships between the various measures. The current work greatly extends the studies of both of the above authors in an historical fashion and in the process reveals much that the historians of mathematics have missed.

Alexander Thom, an amateur astronomer and Professor of Engineering at Oxford University, a post he held from 1945 until his retirement in 1961 was the maverick in the field who put forward his idea of a 'megalithic yard' in his 1967 work *Megalithic Sites in Britain*[11]. Thom established the credibility of his unit via statistical analysis with varying degrees of margin; within a very fine degree his 2.72 feet 'megalithic yard' was a unit that was applied in antiquity. However, Thom was unfamiliar with the concepts and divisions applied to

measurement in the ancient world and he should have termed the value a *step* and made further appropriate divisions.

Of course the more conventional academics have ridiculed his efforts simply because they were unable to accept his ideas and utilised one of Thom's own methodologies, statistical analysis to discredit his work. The oft quoted, "There are three kinds of lies:- lies, damned lies, and statistics," appears in this case to have some justification as the same methodology that confirmed the theory was also utilised in its discrediting…Let us make it quite plain here that statistics play no part in the analysis seen in this book and readers can quite easily substantiate the theories and expand the work. In fact we welcome feedback from any who do extend the studies.

It was the work of Michell that inspired what initially was merely a curiosity regarding the source of the British Imperial System. This transpired into what was to be a fascination with the esoteric use of numerals in the transference of knowledge, knowledge not necessarily of a mathematical type but frequently, as noted above, more of a mythical nature. This element of the work emerged from a study of the Deluge myths, predominantly those of Genesis and Plato's Atlantis and the results of these investigations are detailed in *Deluge.*

The initial exploration of the subject matter explored in this work began in the early 1980s ago by a curious carpenter [Harry Sivertsen] who was quite happy to work with the old Imperial System and saw no real necessity to change to metric. Harry had what may be termed as an insatiable curiosity regarding the origination of the measures that he used everyday which he discovered on buildings hundreds of years old and apparently had always been in use. But if these measures, the foot, inch and yard for example, had 'always' been in use, at what point did 'always' begin? Everything has a beginning and so the British Imperial system also must have a beginning. There is always the problem of a source but here, where John Michell claims that there is no point in searching out the source of the measures, this work does just that. Of course we cannot prove our arguments here and have to rely on circumstantial evidence and reconstruction but we feel that what emerges is probably what did occur. The reconstruction fits all the available evidence.

Neal, following on from Michell and others has produced a pure metrological study, but this investigation which as a whole study includes the book *Deluge,* expanded into different territory. Consequently in this volume the metrological element is somewhat simplified compared with that of Neal but, the relationships developed by Neal are included. Also included are some arguments against portions of both Michell's and Neal's work. So in short, the reader of *Measurements of the Gods* will finish the work having a sound knowledge of ancient metrology and its uses and why many historians have utterly failed to understand the abilities of our common forbears. Our other work *Deluge* clearly shows the use of the same systems in myth thereby demonstrating why many have failed to discover the root of stories such as that of the Great Flood and Plato's Atlantis. Again, in *Deluge* we take the reader on a voyage of historical discovery and, as with *Measurements of the Gods* supply all the evidence, much of which the reader can physically check for themselves. We say clearly, do not accept our word but do the calculations, measure the buildings and view the sites. It will make life just that bit more interesting…and we would appreciate feedback!

1.3 The Antiquity of Ancient Measurement

While the current work examines the use of very accurate measurement systems, the roots of these systems are based upon bodily dimensions, approximations in use from the beginnings of human endeavour. The metric system, in comparison, for all its useful attributes, cannot be evaluated in terms such as these…

- The *cubit*, based on the length from elbow to fingertip, is approximately one and a half of the length of one's foot and is known as 1.5 'feet' in length. *(Note: The foot value varies along with the length of the cubit as indeed it naturally would, as we, as adult individuals, vary in height, arm and foot length, but the proportions between these entities remain basically the same.)*

- The *step* is a measure of two and half 'feet'. *(The average length of a stride.)*

- Four *cubits* or six 'feet' [meaning the individual's foot] make an average person's height, or at least it did in the past, with better nutrition today we tend to be considerably taller without a comparable increase in foot size.

These units were, whatever the source, in use for millennia and a similar system for small units of counts involving the hands and fingers is still in use today in some places in the world. It is apparent that here is an age-old system based upon human proportions. The system, in essence, utilises the numerals of ten and six as bases.

The metric system as we are all aware, ousted, albeit not yet completely, the British Imperial System. But what was the foundation of this earlier system? It is reputed that the British Monarchy established the Iron Yard of the King, said to represent his girth, in the 14th century. However, this approximation would not give the interrelated fine units with which those of us who are old enough to remember the Imperial System are familiar, hence the need for an in depth investigation.

It will be seen in a later chapter that the measurement unit values, which are found in the remains of the ancient worlds of Egypt, Sumeria and India, were in use in Europe in both ancient and medieval times and indeed in some cases since then. From this arises further questions regarding who carried these units through the ages and why? This question is not answered completely although there are hints in places [more so in *Deluge* than in this work] which the astute reader may pick up. In fact the measures were an international commonality but the major question that arises in how was very fine accuracy initially derived and how was it maintained between diverse cultures over thousands of years. The investigation is still ongoing and the transference element, covered a little more fully in *Deluge* has still not been fully explained. To summarise, the implication from the statements above is that mathematical knowledge of a relatively high order stems from long before the age of dynastic Egypt, earlier than the generally accepted dating for the development of this science when derived from Greek, Egyptian or indeed, Mesopotamian histories. As Stecchini comments,

'The scholars to whom we are most indebted for the decipherment of the Sumerian language, Julias Oppert and Carl Friedrich Lehmann-Haupt, proved that by the time the Sumerians wrote their first texts at the beginning of the third millennium BC, they were in possession of a highly scientific system of measures, linking length, volume, and weight with the highest precision. All the measures used in the Old World, up to the adoption of the French metric system, are related to this system' [12].

Evidently, this knowledge was developed before the Sumerians had expanded their empire in Mesopotamia. So from where was it derived? The investigation has led to a source that to us appears logical and fits all the available evidence and hence the work is set out in a reverse manner, we progress backwards and this ultimate beginning is seen toward the end of the book. When combined with the companion work *Deluge* this study becomes far more than an examination of simple ancient mathematics, it is an exploration of myth, math and method whereby astronomical information was carried through the ages, and as such, inevitably it is an exploration into the thinking of ancient mankind.

It was noted earlier that John Michell was a major early influence on this work and as stated, it was from his work that initial guidance, and indeed a further whetting of an already ripening curiosity was gained. Throughout this work there will numerous references to his analysis of various values, specifically that of the circumference of Earth as seen in ancient times. There is no doubt whatever that his numerical evaluation of this is correct, as is his evaluation of the major units of measure but again as noted before, there are disagreements with some of Michell's assertions as will be seen later. In fact, given that the element of astronomy in relation to measure is brought into the picture this work differs from the very limited selection of books available that refer to metrological matters, including those of Michell and Neal. This is also the first work of its kind to make a thorough examination of the weights system in use, weights that link from our familiar Imperial system to those in use in India before Egypt had built a pyramid.

From a simple curiosity regarding the source of the British Imperial System some 20 plus years ago, an ever expanding exploration into many avenues has developed. At the beginning no idea could be contemplated regarding where any investigation may lead, however, as the maxim states, from little acorns do large oak trees grow and this specific tree has numerous branches.

CHAPTER 2

An Introduction to the Concept of Ancient Measurement

It (measurement) *is unlikely to have been the discovery of any one individual or of any single tribe; it was more probably a gradual awareness which may have developed as early in man's cultural development as his use of fire…*
Boyer C.B. 1985. *A History of Mathematics.* Princeton University Press. p217.

2.1 The Need for Measurement

Why would mankind need to begin measuring anything? Stechini has the following comment on this question:

… Present English measures are the last survival of a system of measures that is as old as human civilization. The French metric system was the first break in the continuity of measures in millennia. This system of measures was probably organized when agriculture was first developed in the area that goes from Syria to Iran around 6000 B.C. As soon as agriculture became the main source of food supply, it became necessary to calculate how the available stock may be distributed between one crop and the next.[1]

It was, *it is generally thought* by archaeologists, that it was amongst the Sumerians in Mesopotamia that the sexagismal system was developed. This system involves of a count in 6, 60, 600 etc., which evidently includes a decimal factor. The initial development of this system took place, *according to conventional thinking*, between 3200 and 3500BC, the evidence being on the many clay tablets that survive for analysis. Numbers of these display mathematical formulae and exercises, many of which are set out as practice exercises for school pupils, indicating how high a value was placed upon such education in the region. Some of these tablets displayed trade accounts, again showing the necessity of such education.

Although the 'school exercises' are plain enough for mathematicians to understand for what they are, [although using somewhat different numerical processes to those with which we are familiar] there is no reference to an earlier Einstein or Newton, Euclid or Pythagoras or of their methods. In other words, there is simply no record of the development of the mathematics used. History, as we understand the subject, apparently was not on the curriculum. The education of students in mathematics however, would have been important to the state as commerce developed, along with the attendant advances in astronomy and astrology, which at the time were effectively the same thing.

It is possible to speculate and do precise mathematical constructions to obtain the measurement unit values that were in use thousands of years ago and then check the results

against the extant structures and artefacts. However, this exercise does not reveal what happened prior to the development of the finely graded units to which Stecchini refers. All that can be assumed of the earlier period is that the same type of evaluation was firmly in place, i.e. cubits, reeds, steps and feet, with the smaller division of the cubit that corresponded to the hand and its parts. The basic measurement unit, one could assume, would have been a localised affair, probably founded upon a certain individual's foot length or forearm length, much as the humorous claim regarding the girth of the British monarchy for the yard.

In Figure 2.1 is shown the famous drawing *Vitruvian Man* which was drawn around 1490AD by Leonardo de Vinci, which illustrates that he was well acquainted with human proportion and its relationship to geometry. This is far from an idea developed in medieval times, for *Vitruvian Man* is based upon the writings of the noted Roman architect Vitruvius. He compiled a long list of mathematical attributes of an idealised human body based on cubit values and ratios such as 'a man's height is four cubits' [six feet] and 'the length of a man's outspread arms is equal to his height etc.[2]

Given that the calculations for feet and cubits are based initially, as indicated, upon a [human] count of six, it would logically appear that the sexagismal system was the underlying factor behind the earliest measurement systems and not a decimal count. Table 2.1 expands on this idea. Other developments and divisions existed as is later explained but we can start with this basic information. But where do we start?

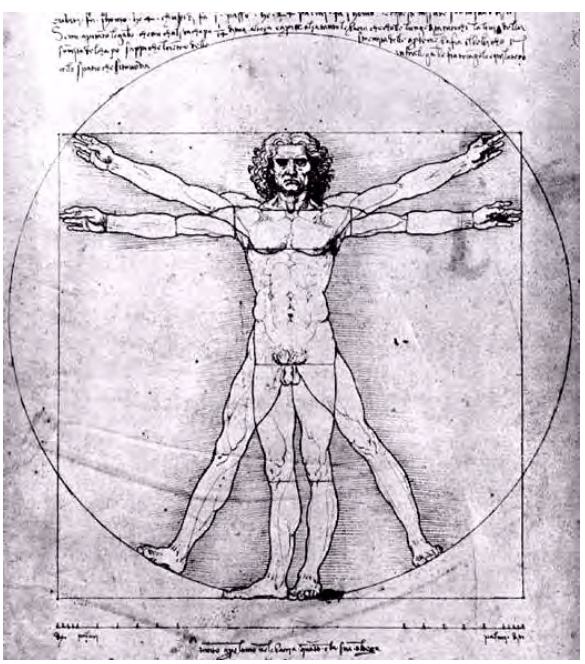


Fig.2.1 Vitruvian Man

Table 2.1 Basic Measurement Unit relationships

12 inches (2 x 6) = foot (1 foot)	6,000(inches)	= stade (500 feet)
18 inches (3 x 6) = cubit(1.5 feet)	7,200(12x 600 inches)	= stade (600 feet)
30 inches (5 x 6) = step (2.5 feet)	60,000(inches)	= mile (5,000 feet)
108 inches (18 or (3x6) x 6) = 1 reed = (9 [1.5 x 6] feet		= 6 cubits)

2.2 A Mathematical World

We live on a world, in a universe, dominated by mathematics; mathematics that involves constants and cycles, counts and equations. Nowhere is this more seen than in the constant known as the *Golden Section.* The Golden Section, sometimes called, in the first case wrongly, the *Golden Ratio* or *Golden Number*, is an *irrational number* or one that cannot be expressed as a simple ratio or a fraction and it has two closely related values that are normally termed by mathematicians as *phi* and *Phi*. The two values are closely related to each other in the equation: *Phi = 1+ phi.* The value of Phi is found from the following expression: $Phi^2 = 1+ phi$. phi is about 0.618 and Phi is about 1.68, a more exact value is seen below, and Phi – phi = 1, as can be deduced from the first expression. Both these values are closely related to the so-called *Fibonacci Numbers.* These are a sequence of integer values where the next number in the sequence is the sum of the previous two.

In this example, beginning at zero, its commencing point, the sequence operates as follows: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55 ... etc. As the sequence extends, the ratio between a number in the sequence and the previous one eventually converges towards Phi, which to 10 significant figures, equals 1.618033988. The Fibonacci numbers and the Golden Section are closely associated with growth and are therefore widely seen in nature. The latter is to be found in numerous places in the natural environment, including the theoretical shape of the perfect wave, the formation of seeds in the flower head of a sunflower, the spiral of snail's shells and indeed the shape of numerous galaxies. As far as *generally accepted* mathematical history is concerned it is *not* clear that the Golden Section was known in the third millennium BC. However, we shall later reveal evidence indicating it *was* known in this epoch in Old Kingdom Egypt and indeed in later chapters we will demonstrate that this was only one part of a canon of mathematical knowledge that far pre-dates this era. But how far back in time did a knowledge of counting, the most basic form of mathematics, exist?

We do not have to look for very ancient evidence of counting to see that mathematics is an endemic part of the natural world. From birds that count to chimpanzees that add, and to salamanders that know the difference between two and three, it looks as though an inborn sense of number is a very basic cognitive ability.

In fact, studies seem to show that animals and people deal with numbers in some remarkably similar ways. [3] It has inevitably therefore been logically suggested that early hominids practised a form of counting [although illogically that idea is not generally accepted]. However, here we will begin our odyssey into ancient measurement at a generally later time, over half-way into the lifespan of modern humanity, a time about 60,000 years ago.

2.3 The Roots of Measurement – Counting in the Upper Palaeolithic

As part of the introductory background to this study of a system that it appears no-one has previously attempted to date, it is felt essential to relate a little of what is understood of human capabilities in the distant past.

DNA evidence indicates that about 120-150,000 years ago the human race as we know it first emerged from the savannah of East Africa, just like their forebears over the previous 4 million years or so. However, for some 60-90,000 years Anatomically Modern Humans [or *Homo Sapiens Sapiens*] displayed behaviour little different to our hominid cousins still alive in the world of the last Ice Age, such as the Neanderthals.

Around 60,000 years ago, for reasons not yet understood, 'modern humans' started to display much more recognisably modern behaviour. For example, stone tool development started to progress rapidly, and humans began to produce portable works of art, such the beads found at *Enkapune Ya Moto* in Kenya, that date to about 40,000 years ago.[4] At around this time also, the grip of the Ice Age in Northern Europe relaxed somewhat and humans began to spread out into the wider world from their base in East Africa and the Middle East. In Europe, modern humans, along with their so called *Aurignacian* toolsets and portable art, arrived in Poland about 43,000 years ago [The Aurignacian culture is the first associated with modern humans, and is named after the site of Aurignac in France where it was found by Lartet in 1860AD].

Over the next 13,000 years modern humans seemingly co-existed in a friendly way with the indigenous population – Neanderthals, as demonstrated by a rapid improvement in the latter's lithic [stone tool] technology. At this point, we should note a key difference between modern humans and Neanderthals, the formers longevity. Even in the harsh conditions of the Ice Age many modern humans would reach the age of 60 or more, whilst Neanderthals rarely lived beyond 40.

It is thought by many archaeologists that this difference produced a sort of 'grandfather effect' in modern humans – the grandparents effectively teaching the children of the group their knowledge while the parents hunted.

In these times this would have been 'learning by rote,' although tally marks would have almost certainly been scratched onto objects such as bones and in this way the phases of the moon, that ever changing, lesser luminescent 'sun' would have been recorded. It is surprising how much knowledge can be handed down in a rote fashion, especially by the utilising of rhyme and chants. This becomes evident in the ancient works of India of which a little is revealed in later chapters. It is a well-known skill of Shamans that we see for example in the Plains Indians of North America and the Australian Aborigines. Some of the former have a race memory extending to 10,000 years and the latter still relate events that happened some 20,000 years ago. It is this skill that is of critical importance here in *Measurements of the Gods* and is demonstrated clearly in *Deluge* for it implies that *it was not necessary for mankind to have developed writing in order to transfer knowledge across vast periods of time.*

In considering the level of technical sophistication of our Ice Age forbears, we should particularly note the accomplished cave painting that we start to see in the latter part of the Palaeolithic period, what is known as the Upper Palaeolithic by archaeologists - the so-called

Images of the Ice Age. The oldest of these were found at Chauvet-Pont-d'Arc in Southern France, and have been in-situ carbon dated in 1995 to as far back as about *32,000* years ago. The extraordinary quality of these somewhat haunting images of a long-lost culture, which existed for several thousand years at this site, shows that humans 30,000 years ago were as good artists as the best today. Effectively we can say that even at this early stage, that there was no limitation in intelligence that would preclude the development of science and technology. Amongst all the images of bison and other animals that Palaeolithic man hunted and in this case some predators, is a common Ice Age image – that of a hand [see Figure 2.2].

It is the hand that differentiates mankind most from other animals and the 'hand' representation is an illustration of how this was seen as such in deepest antiquity. It is thus only natural that later [or probably earlier] the hand had become part of the basis on which counting systems began.

Fig.2.2 'This is my mark this is man' [after Jacob Bronowski, 1973]

There is another major input to counting systems. This is the input of the cycles of the heavens. According to Dr. Michael Rappenglueck, a pioneer in the detection of star charts painted on the walls of Palaeolithic caves, even at the above early date it seems that ancient skywatchers were mapping the heavens. This view is based upon an examination of an ivory tablet found in 1979 in a cave in the Ach valley in the Alb-Danube region of Germany. Carbon dating of bone ash deposits found next to it suggests it is between 32,500 and 38,000 years old

making it one of the oldest representations of a man ever found. It was left behind by the inwards migrating Aurignacian people, and is pictured in Figure 2.3.

Rappenglueck thinks that the depiction is a drawing of the majestic constellation of Orion *The Hunter*. The proportions of the man correspond to the pattern of stars that comprise Orion, especially its slim waist corresponding to its famous belt of three stars with the left 'leg' of the constellation being shorter. The 'sword' on the ivory tablet also corresponds to a famous and well-known feature that can be seen in Orion. Rappenglueck has also used astronomical dating to back up his theory. Using astronomy programmes he found that the stars were in slightly different positions 32,000 years ago because they are moving across the sky at different speeds and in different directions, a phenomenon called 'proper motion'.

Rappenglueck found evidence for a particular star in Orion that was in a different place 32,000 years ago. [5]

Fig.2.3 Depiction of Orion, 32000BP

There is something else that is of more direct interest to us here. The tablet may also be a pregnancy calendar. There are 86 notches on the tablet, a number that has two special meanings. Firstly, it is number of days that must be subtracted from a lunar synodic year to equal the average number of days of a human gestation. This is no coincidence says Rappenglueck. It is also the number of days that one of Orion's two prominent stars, Betelguese, is visible. To ancient man this may have linked human fertility with the gods in the sky.[6] As the annual association here is associated with the night sky and the Moon, this also is appropriate. The need for calendars, for a variety of reasons drove the development of astronomical abilities. [For some unexpected calendar constructs see *Deluge.*]

Around 30,000 years ago the climate in Northern Europe turned colder and would have brought about a more severe competition for resources. In a short space of time, possibly a thousand years[7], modern humans displaced [possibly forcibly] the Neanderthals.

The last Ice Age is characterised in Northern Europe and America by the huge ice sheets that covered much of the hemisphere. The hinterland beyond the ice walls, which were possibly a mile high, was a grassy steppe that was home to the game that modern humans hunted, such as the Giant Bison and Woolly Mammoth.

The hunters '*at the edge of the ice'* as they have been called, were nomadic and did not live in fixed settlements but migrated around the landscape, in some cases across continental areas [a lifestyle known to archaeologists and sociologists as transhumanance]. This migration might have been seasonal, or possibly longer term, for example following the mighty herds across Europe as the climate fluctuated. It can be easily seen that knowledge of time and distance would have been important to such people. Such information would have been derived from knowledge of how far they may have travelled in a given time with direction and periods of days denoted by what was visible in the skies.

It is during a relatively warm period, about 26,000 years ago, that we first see evidence of a widely spaced 'culture' with evidence of so called 'Shaman' burials found at Paviland Cave in West Wales [UK] and at Sungir in Western Russia. At Dolni Vestonice in Czechoslovakia, at about the same time, is seen see evidence of Shamanic activity and the beginnings of the development of an agrarian society.[8] There is also seen considerable development of portable art around this time, and note here the so-called the *Venus figurines* that first appear in the Aurignacian period about 25,000 – 32,000 years ago, the most famous of which is the *Venus of Willendorf*, named after the location where it was found in Austria. Hundreds have been found, and are strikingly similar depictions of a female human body, with exaggerated breasts and buttocks, and an abstract, sometimes non-existent head. Possibly in relation to the 'gods' of Chapter 1 we have our earliest consistent depiction of an 'Earth mother' or goddess, something that is seen in many cultures and times, and is reminiscent of the *Gaia* philosophy of today, adapted from a Greek concept. These early beginnings of some sort of organised society were cut short by a sharp downturn in the climate from 22000 to 18000BP [the Glacial Maximum occurring at 20000BP] and humans retreated to the southern regions of Europe. For example, the Solutrean Industry was a short-lived style of toolmaking, noted for its fine workmanship that flourished approximately 17,000 to 21,000 years ago in Southwestern France [e.g., at Laugerie-Haute and La Solutré, hence the name] and in nearby areas.[9]

From about 18000BP – 13,000BP the climate showed some dramatic changes with very warm periods countered by cold epochs. An explosion of cave art, at sites such as Lascaux in Southern France, and Altemeira in Northern Spain[10] implies that during the warmer eras much greater freedom of movement was seen and possibly a more relaxed lifestyle.

This period [and the 3,000 years after it] in this region are termed the *Magdalenian* by archaeologists and in addition to the cave art, often relating to, and created on top of, the earlier work, it is characterised by other rapid developments in technology and artistic expression. One of the paintings at Lascaux is of particular interest to us here – it seems to depict a horse surrounded by 29 moons in various phases - possibly the oldest known lunar calendar, from

some 15,000 years ago, probably around 14,950 years ago at the peak of a short term warm period. [see Figure 2.4]. The Moon was the most prominent of the 'gods' of ancient times, its cycle being a parallel to that of the human menstrual period and its effect on the tides being the most obvious influences.

Fig. 2.4 Lascaux horse and 'Moons'

As noted above, we also see a rapid development of new tool types in the *Magdalenian* such as the *barbed arrowhead*, and in parallel we also see the creation of exceptional portable works of art, and the development of new technologies such as the *atl-atl*, [a rope attached to a spear that could extend the force applied to the spear giving it a much greater kinetic energy]. [11] It is estimated that some 80% of the cave art found in Europe dates from this later period and, along with the other rapid developments of the Magdalenian, these artistic achievements again demonstrate the intellectual potential of prehistoric cultures – well over 10,000 years ago.

Shamanism is thought by many archaeologists to be deeply associated with the cave art described above, and if so is a remarkably long-lived religion [if indeed religion is the correct term]. Two aspects are of key importance here:

- *The 'religion' appears to have spanned at least one precessional cycle of 25,920 years or at least have had knowledge of this very specific time period.*
- *From our knowledge of the more modern Shamans, for example in North America, we see that there was a keen interest in cosmology, the Sun, Earth, Moon, planets and the constellations with their component parts, the stars.*

The cave art in Europe disappears from the archaeological record about 13,000 years ago, for reasons not understood by archaeologists [though it carried on elsewhere into quite modern times]. Possibly any Shamanic domination of culture in Europe was changing.

We also have to bear in mind that for the next three thousand years the climate fluctuated widely, possibly changing long term social inter-relationships. One aspect of these changes is that from an archaeological viewpoint any violence in the Shaman-influenced world of the Ice Age is not seen until this later period, an example being the evidence found of cannibalism at

Cheddar Gorge in England, about 11,000 years ago.[12] It can therefore be envisaged there being more competitive and less religiously influenced societal groupings during this period. There is a more modern analogue to the change in religious influence. In the 200 years or so before European settlers arrived in North America, many of the tribes amongst the Plains Indians had already become highly aggressive and competitive, after thousands of years of peaceful co-existence. This rise in violent activity was paralleled with a lessening of influence of the tribal 'witch doctor' [or more correctly Shaman]. [13]

After a 3,000 year period of great climatic and associated social upheaval in Northern Europe, at about 10000BP [8000BC] the Ice Age ended, [frequently claimed to have happened in about 30 years – less than a human lifespan but see Figures 2.5 and 2.6]. However, mankind in the Northern hemisphere had survived the Ice Age, possibly as a result of social cohesion over the 30,000 years that he had endured in Northern latitudes. As Bronowski comments on the period:

…Man survived the fierce test of the Ice Ages because he had the flexibility of mind to recognise inventions and turn them to community purpose…[14]

Yet though Bronowski is making a rational argument his thinking does not include the development of measurement systems ultimately based upon the circumference of the Earth.

This was probably because the Northern Europe of the late Ice Age [now recently termed the Epipaleolithic by archaeologists to underline its unique status] is an unlikely source for such developments.

2.4 The Rising of the Waters

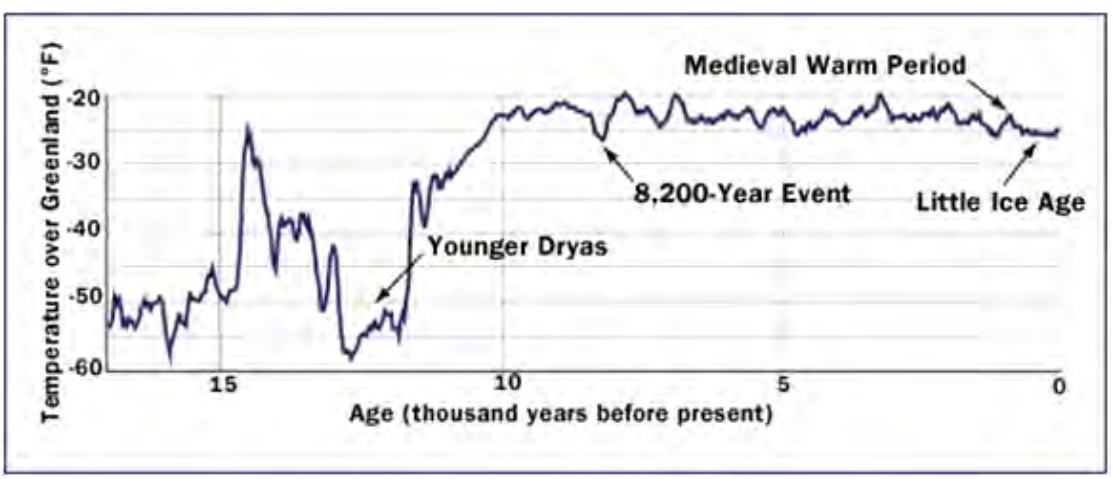


Fig 2.5 Temperature chart at Greenland from 20000 years ago

As noted above and seen in Figure 2.5 the last 3,000 years of the last Ice Age [13000 – 10000 years ago] were characterised by dramatic climatic changes. What is known as the *Holocene* period then began at around 10000 years ago or 8000BC. At that time the rise of sea level was probably at its greatest as the temperatures had climbed to something in the region of today and were melting ice and expanding the seas at a very rapid rate. We cannot see this as a flash flood, in the way we think of floods today, but an incessant rise of water that would be punctuated by normal flood events, the difference to today being that the water never went quite back to its old level. Even when a climatic fluctuation caused the sea level to drop, it soon returned to its inexorable rise to the previous high tide line and beyond. That there was an overall increase of over 300 feet in the depth of the world's oceans is not in question, but there is still not a complete consensus among scientists regarding the total amount of sea level rise for a number of reasons. One rationale is that the Earth's surface is unstable and the melting of billions of tons of ice has resulted in the Earth's surface springing back upwards [the so-called isostatic uplift]. Another factor is the amount of expansion of the world's oceans due to increased temperature.

In summary, we can say that the best estimates for the total sea level rise during the period 10500 – 2000BC [12500 BP or years ago - 4000 BP] are between 300 and 350 feet [over 100 metres]. This sea level increase and an associated astronomical factor play large roles in Great Flood mythology.

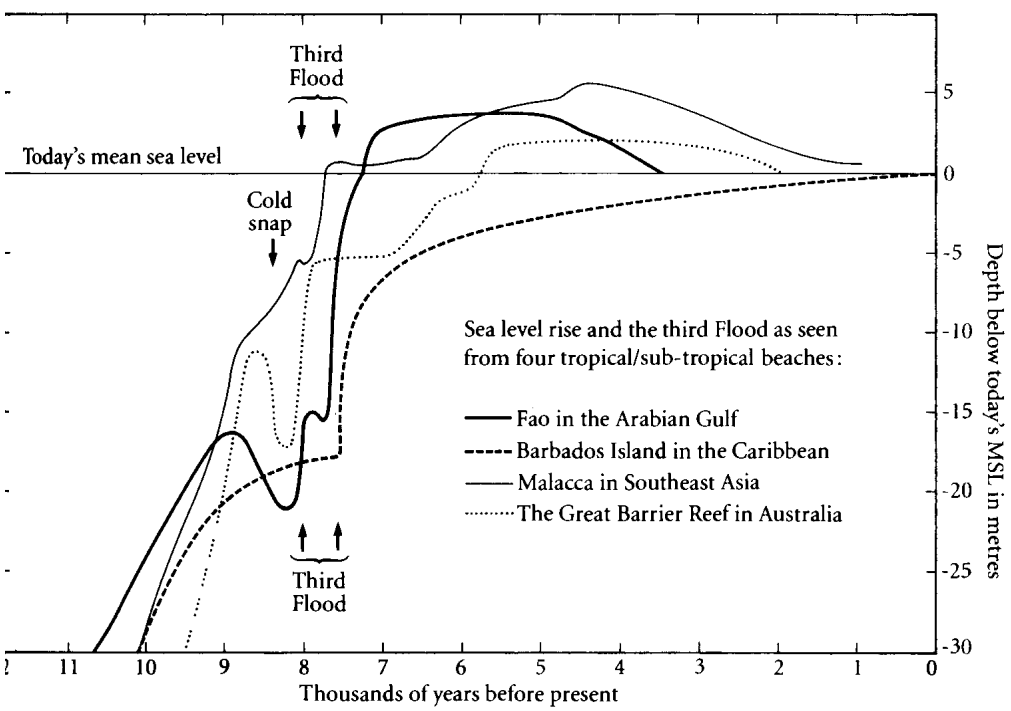


Fig. 2.6 Sea level changes at four beaches [See also:- relevance of this diagram in Chapter 16]

Stechini's comment quoted at the beginning of this chapter is now a little out of date. It is currently thought by archaeologists that at some time around the end of the Ice Age, probably in the region 9-14,000 years ago, the development of agriculture and fixed settlement began, for example in Turkey and Syria. This is thought to be was due to the so-called 'fertile crescent' in this region becoming drier, along with a population increase, the two factors necessitating a more intensive use of the land by the indigenous 'hunter gatherers.' However, evidence from Indonesia would indicate that this process commenced earlier in that part of the world, in an area that was not affected, prior to the sea level rise, to any great extent by the last Ice Age.

Evidence of wild yam and taro cultivation has been found in Indonesia dating between 15,000 and 10,000 BC.[15]

It is here that we believe that the measurement system of antiquity was originally conceived, for reasons that will become evident in later chapters.

2.5 Developing the System

It is clear that a measurement system could be devised that would be dependent upon nothing more than the length of a piece of wood, or a man's foot or any number of other things. Yet this was not the case. There were cubits relating to the forearm length, feet, being the foot length etc. So we can reasonably assume that initially such a method prevailed, perhaps denoted by the local Shaman or at least head man of the community. But for some reason this altered. Probably the reasoning behind a commonality was a combination of things, distance [navigation], and trade. But what then should be applied as a standard, a standard that applied to one and all? It would have to be something associated with a common element. Regarding linear measure there were two possibilities, devise an instrument that gave a distance across a section of sky and denote the transit points of stars or have an agreed measure of something more solid, Earth. But how could they measure the Earth? If this could be achieved then divisions associated with time could be applied but there was a long way to go before this could happen. Distance at that period was probably noted as the time taken for a journey and not a count of measurement units, here however, we see the beginnings of the association between time and distance. A walk between A and B represents *two days* and not as it may be today, 40 or 60 miles.

The ability of early man to make numerical evaluations in terms of time, as seen by the movements of the 'lights in the sky' will have been prevalent for a long time. And importantly for those living in coastal regions where there was a tide of any height, such as Britain, this would have been imperative as it denoted a time for food collection at low tide. As this was based upon lunar movement, one can understand, in part, why the moon was so important to some cultures. Indeed, some finds of tally marks associated with counting the days in the lunar cycle date to 10,000 to 11,000 years ago.[16]

The basic dimensions that we shall see in this work had very specific counts, developed from observations of the 'lights in the sky'; *measures were that developed with definitive relationships to time.*

Such a system would not have been developed by a nomadic culture. Here we are looking for a society that was domiciled in fixed settlements. So the search is for a *civilisation,* one that traded and built structures, and perhaps worshipped one or more of the 'gods', the lights in the sky that gave the counts that became an essential numerical part of the system. Archaeological study around the world tends to state the earliest civilisations arose about 3000BC [with possibly some 'city state' exceptions going back maybe 2000 years earlier]. However, if we were considering an advanced culture or civilisation over 10,000 years ago we must note one point that we discuss above – its remains may lie *underwater*. In looking for an ancient civilisation that may have developed the units of the measurement system of antiquity we immediately come across a conundrum. Another system [or systems] existed apparently separately in the Americas and yet it complies once more with the exact Earth circumference value utilised by the remainder of the system as seen across Europe and Asia.

2.6 Astronomy in the Americas

The Pre-Columbian measurement system in the Americas is related to the same astronomical counts and measurement units as its ancient counterpart in the Old World. The relevant study revealing this, unknown at that time to its author is that by Hugh Harlston Junior and it was John Michell who spotted the connections. So at this point we can state that reference to the Earth's circumference has mysteriously emerged in the Pre-Columbian Americas. Regarding Pre-Columbian astronomical prowess, an example of the calendrical development of the American Maya culture is included here. These counts of time utilised a number of different cycles, which demonstrates the Mayan's ability to manipulate numbers and their extended observance of the heavens. The system of counting is thought to have its roots in a far earlier culture – that of the Olmecs, possibly dating back as far as 1500BC. The Maya were amazingly accurate in their astronomical calculations and were excellent mathematicians. As Allen comments:

'*...the Mayans...had an ephemeris for the moon so accurate that three centuries would have to elapse before it erred by one day. The Dresden Codex contains a catalogue of eclipse predictions that is reasonably reliable…Considering the dissemination of knowledge throughout Europe and Asia, it may be that the Mayans were the only people to discover the mechanics of eclipses in the last 2,000 years…*' [17]

The Mayan cycles were related to movements of the planet Venus [260 days]; the Sun [365 days]; and the Moon in conjunction with the Sun as an eclipse cycle of 347 days. The eclipse half cycle is 173.5 days and it is noted that a ratio of 2:3 applied to 260 days results in 173.3r, hence it can be seen that the two counts 'beat' together over a period of years. These values combine in a variety of series with ultimately the number 1,366,560 being derived. This has been termed the 'super number' of the Mayan Codices. In addition to the above Mayan

schemes, there was another that interlinked with these counts. This was what was known as the 'Long Count', which was based upon the *tun,* a count of 360 days and a 20-day 'month'. Long count values and associated cycles were defined by the Maya as:

20 *kins*	=	1*uinal*	=	20 days
18 *uinals*	=	1 *tun*	=	360 days
20 *tuns*	=	1 *katun*	=	7,200 days
20 *katuns*	=	1 *baktun*	=	144,000 days

A Great Cycle, a period equal to 5,130 years was achieved by multiplying the *baktun* by 13.[18] Yet while the accurate system of the Maya, seen above, is a localised cultural calendar, it is strange and conventionally inexplicable that the Maya and their forebears used elements of the same ancient measuring system as that which spread between India and Britain. The sky is universal, or at least international, the same unit counts of time can be derived from it. The same mathematics can be developed but is it remotely feasible that two different peoples would develop exactly the same units of *linear measurement* in isolation?

The 'measurement system of antiquity' as we term it, shall be shown in later chapters, as we have stated it to be definitively based up the circumference of the Earth. What are the chances of two different societies, on different continents, separated by an ocean, arriving at exactly the same estimate of this dimension?

The answer of course is that this would not happen; there was a central original source for these units, or at least the estimate of Earth's circumference from which they were derived. Yet, the work of Hugh Harlston Junior, which is documented in the books of both Neal and Michell, clearly shows that in Pre-Columbian Central America there was utilisation of measurement units that were also in use in the Old World in ancient times. This argument is reinforced by the fact that Hugh Harlston was unaware of Michell's work when he made his discoveries and that only later did it emerge that the unit he found was in use was the same as a value utilised by the Greek Eratosthenes and which is the width of the lintels of the Sarsen Circle at Stonehenge.

2.7 Ancient Mathematics

Much of modern mathematics is derived from a variety of ancient sources and can be traced historically; for example to Babylon in Mesopotamia, or to ancient Egypt and as will eventually become apparent, even earlier to the civilisations of India, which predate Egypt. The Arabic world in particular had a considerable influence upon modern mathematics, not least in our system of numerals, which supplanted the cumbersome Roman system early in the historical period known as the Renaissance. Indeed, it was from Arabic sources that much knowledge of the work of the Greeks, who are normally credited with being the source of many branches of modern mathematics such as trigonometry, was derived.

Less well known is the Chinese knowledge of mathematics. The oldest known treatise on the subject, *Chou Pei Suan Ching* has been variously dated to between 1,200 BC and 100 BC. It is thought that the words *Chou Pei* apply to the use of gnomons in the study of the circular movements of the stars and planets. Boyer[19] informs us that the work takes the form of a dialogue between a Prince and his Minister. The dialogue concerns the calendar where the Minister informs the Prince that the art of numbers is derived from both the circle and the square.

This reminds us of how both the circle and the square seen in conjunction with the human form in the illustration by Leonardo de Vinci in Figure 2.1 earlier. The minister explains that the square belongs to the Earth while the circle belongs to the Heavens. This concept will become familiar in later chapters.

The examples on clay tablets from Mesopotamia, papyri from Egypt and the writings of the Greek scholars, all imply geometry and arithmetic while the Sumerians are generally credited with inventing not only writing but also the sexagismal system or the count of base 60. It will later be understood, however, that this was not the case, and that the sexagismal method along with geometry and arithmetic stems from an earlier epoch. We should also note here a quote from Sarala Birla Academy, Bangalore, India:

'Geometry is a coinage of the Sanskrit word gyaamiti meaning measuring the Earth.'

Geometry implies measurement. When numbers are involved, they represent a count of something, the numerator, the something being counted, be it feet, cubits or miles being the denominator. The ages-old fractional system, greatly utilised and thought to have its origination in Ancient Egypt, has been described in numerous works relating the history of mathematics.

Over the years, this method has been greatly simplified into the system with which we are familiar. A simple example of this, i.e. using the modern method of expressing fractions, $^{2}/_{3}$ informs us of the numerator two and the denominator three or with the value being two thirds. In geometry, the denominator is linear, square, or volume measurement. In cartography, it is generally a linear or square unit of measure. Yet, these two disciplines, mathematics and cartography, in the context of historical study, seemingly have little correspondence. It will become apparent that this is primarily due to a lack of knowledge by academics of the ancient systems of measurement; a lack of knowledge compounded by a refusal to accept that our distant forebears had such abilities; yet, the 'ancients' produced a system that was in use for millennia.

Something that may not be immediately apparent to the reader is the importance in this type of investigation to utilise an extended numeric range. By way of example, all the calculations here have been undertaken with the use of a calculator that extends to 10 decimal places. This can be improved by the use of a floating-point calculator. With the decimal only extended to two or three places the required accuracy is not obtained.

An example of this use of an extended numeric range is when the 'short Egyptian' cubit value described in Encyclopaedia Britannica[20] is considered.

According to Michell, it does not measure 20.62 inches [1.71833333feet] as described in Britannica. Michell's evaluation, which is accepted here [albeit with an extension to facilitate greater accuracy], is that the short Egyptian cubit measures 1.718181818 feet or 20.61818181 inches.[21] This would result in a difference of 0.8 of an inch over the length of the pyramid. This is a measurable difference, albeit here a small one that should not, with knowledge of the system, make any difference but the consequence of an incorrect measure may well be the application of the wrong cubit. The derivation of the cubit in question here is based upon Petrie's survey results. The difference to the Britannica version as a single unit is minuscule but when attempting to understand the sources of these units it is essential that strictly accurate values be utilised. One can imagine what would happen to a value such as 3.475748571 feet if it were to be abbreviated to 3.475. When counted in multiples such the 150 to make up the stade value utilised in Earth measure by Eratosthenes, the result would be 1.347 inches out. In other words, it simply would not comply and Eratosthenes Earth value would differ to the tune of 5.35 miles.

Let us examine Petrie's work for the evaluation of the relevant cubit value favour without question by all too many. Petrie examined all the monuments at Giza and made cubit values for each from the measures of side lengths, interior passages and chambers. The mean of these evaluations he stated was 20.620 ± .005inches.The value calculated by Michell for this unit, which is readily related to numerous other values in the ancient world, which Petrie's mean measure is not, is 20.6181818181 inches. 20.620 less 20.6181818181 = 0.00181818 of an inch against Petrie's tolerance of 0.005 of an inch. Very clearly this is well within the tolerance allowed and what this value shows as it complies with numerous other measures is that Petrie's evaluations link virtually exactly with those of a later Michell. Michell had discovered the correct target value which Petrie could not find in Egypt as he did not have sufficient other values with which to make the evaluations conducted successfully by Michell. Yet very sadly Petrie's erroneous mean value, since known as the Royal Cubit, is said in academia to be correct…when it is not…it is very close but not precise, an exact value will fit with the measures of other places…as does that of Michell.

Another misnomer applies to this cubit value. Petrie claimed that the digit was related to the diagonal of a square of that cubit. This is not the case. He discovered some small squares in tombs that denoted small fractions of the said diagonal but in fact they have no real relationship to it. The idea stems from the fact that there is a relationship to the square root of two with this diagonal. Divide the diagonal by the square root of two and the original cubit length is the result…or do it vice versa, divide the diagonal by the cubit and the square root of two emerges.

When this was discovered extremely little was known about ancient measures and it was assumed to be a property of this specific cubit hence the diagonal was seen as important…What should have been realised is that this applies to any such cubit…they can be invented and the same result emerges…the square root of two. Other than this mathematical coincidence which applies to any and all such squares, the diagonal has no value and the digit remains a 24th or 28th of the cubit, depending upon whether the handbreadth division is 6 or 7.

While such precision [3.475748571 feet] could not possibly have been achieved in practise, the Red Pyramid [see *Deluge*] interior displays an accuracy to within a millimetre as

indeed do sections of Stonehenge [see later chapters of this book]. However, when accumulations of values occur, we generally find values that are nearer whole numbers and without such accuracy one is liable to be left wondering which, out of a possible three or perhaps more units, is supposed to fit. Accuracy in counting does not necessarily remove all such problems but certainly minimises them as frequently more than one value will fit the same measured space and this indicates that at least the initial measurement unit value will almost certainly be correct. The next step would then be to ascertain which unit was initially meant to take precedence. To give a further example of the accuracy involved, the inner chambers [as against the outer side length mentioned above] of the Great Pyramid in Egypt have variations to the design measurement units of an average of less than 1/5 of an inch. [Note: this has been evaluated via a number of documented surveys in the public domain.] Here the count in cubits is not so great and the evaluations are relatively easy to accomplish.

One may wonder why use decimals when the decimal system as we understand it is not exactly ancient? The truth is that the ancient buildings hold their numerical symbolic secrets in a decimal format. There is no explanation for this other than the decimal concept is far, far older than we have been led to believe. The Egyptians, for example, counted in tens with many noughts following; hence, large numerical values counted in units of ten were familiar to these people. The same occurred in ancient India even before the First Dynasty of Egypt.

The decimal element was probably firstly derived from the concept of the human hands or feet i.e. two sets of five digits resulting in ten, an anatomical accident as noted by Aristotle.

In reality it is the figures not the noughts which convey messages on ancient structures. There is much hidden in *symbolic numeration*. It should be emphasised that the symbolic values of the numerals seen in this work are of ultimate importance. Whether the element is linear, square or cubic measure in feet, cubits, miles or any other unit, or indeed if the element is time, perhaps in days or in years, *it is the number which is important* and not any attached count of noughts. We are dealing with a symbolically and practically coherent system, which utilised a natural progression of factors, a system that was not invented, but a system that, in essence, was discovered.

2.8 Dimension Sets

From this point onwards all references to miles, feet or inches, unless otherwise stated, will be to the British Imperial units. The reason for this is that we have to have a base value with which to work and again, strangely the symbolism mentioned above is generally [but not exclusively] most apparent when units are counted in British measure. [Here we note that as seen in a later chapter, Neal has evaluated the British foot as the base of the system.] The beginnings of this can be seen in that the base of the Great Pyramid has a side length of 7,920 *short Egyptian inches* whereas the diameter of the Earth as accepted in ancient times [and in fact until quite recently], was 7,920 *British miles.* [Note: Michell utilised the concept of 'long and short' measures. Neal has taken this idea much further with additional factors. In this work we generally adhere to Michell's interpretation]. Additionally this clarifies the situation when explaining the values of other units, i.e. one might read of the *Long Greek* foot of 1.01376 feet with its mile of 5068.8 feet. The statement means that the referenced Greek foot has a length of

1.01376 British feet of which 5000 make up the mile. The short version would mean a reduction by the factor 175/176 making the mile 5000 feet at 1.008 British feet or 5040. There is much more explanation of this nature in Chapter 6.

Note: The terms utilised here for differentiating between units, those of Greek, Roman and Egyptian were devised by Michell for identification purposes only. They have no direct connection with the countries named and were utilised internationally and indeed were in common use long before Greece or Rome were even dreamt of as important nations. These units were developed long before dynastic Egypt emerged at 3100 BC.

The combination of the factors 2 and 6 [i.e. using a base of 12] is seen not only in the ancient duodecimal counting system displayed in this work. Based upon the fingers and the phalanges [or sections of the fingers] the system is apparently still in use in a practical manner in modern times. This is seen in some regions of Egypt, Pakistan, Iran and Afghanistan today.[22] The method involves the use of the phalanges of the four fingers of both hands, each of which has three such units, making the full count a total of twelve. Two fingers would therefore evidently represent six in this system. The *standard* cubit contains six of a unit called a *handbreadth*, which comprises four *digits*, [or fingers] so there are 6 x 4 = 24 digits in a cubit. [Note: occasionally there is seen a different division of 7 handbreadths to a cubit where the handbreadth remains the same length but the cubit is increased in value…the 'cubit and a handbreadth'].

Tables 2.2 and 2.3 below set out the basic elements of the system and introduce a measure of stade or stadium, which will be seen more extensively in Chapter 4. Here we should commence with a note to the effect that while various names are put to values in what we term *dimension sets,* e.g. Roman, Greek or Egyptian, in reality the names are meaningless. Michell applied these terms simply for identification purposes and it should be remembered that they are not region specific but that the values were applied over a very wide area.

There is no need for the reader to become entrenched in tables as the older of us may remember from our very early school days, but these lists, introduced when and where appropriate, contain all that is required for a basic understanding of the ancient values and their connections. It is suggested that they are frequently referred to as a guide and at this stage it is a good idea to read through and familiarise oneself with the concepts, if not the values involved. The measurement units will soon become recognizable. Those who take the mathematical element of the study further and read John Neal's work [some extracts of which appear in Chapter 6] will find variations to the divisions set out here and a great many more connections. However, while Neal has extended the numerical element to a number of sets of tables of values, possibly beyond what was in practical use, such cannot be said of this work. The measurement units seen here were in use and what is more, unlike others who have delved into these mysterious waters, this work shows from what the system was almost certainly originally developed. In addition, how this was accomplished and the ultimate source of the basic units, in both time and place is also revealed toward the latter pages of the book.

The mile contained 5000 feet [the 5280 feet of the British system came later]. Each cubit comprised 18 inches or 1.5 feet and was also subdivided into 6 handbreadths with the handbreadth having 4 digits. Occasionally the cubit was enlarged by the measure of a handbreadth [Biblical 'cubit and a handbreadth' making seven handbreadths and 28 digits to

the cubit.] The step, reed and stadia did not vary. The principle variation was with the foot value and that affected the size of everything in the dimension set. However, these dimension sets related one to another via specific factors as shall be revealed. Here we show how the system works when applying the basic British foot.

Table 2.2 The British (or Imperial) Dimension Set

Foot	**Cubit**	**Step**	**Reed**	**Stadia**	**Mile**
1foot	1.5 feet	2.5 feet	9 feet	500 or 600 feet	5,000 feet
12 ins	18ins	30 ins 1.6r cubits	108 ins 6 cubits 3.6 step	6,000 or 7,200 ins 200 or 240 step	60,000 ins 3333.3r cubits
16 digits @ 0.75 in	24 digits	40 digits	144 digits		
4 hands@ 3ins	6 hands	10 hands	36 hands		

Note how the table relates to a base of 6. In addition to the values in Table 2.2, there was a *span*, which is ½ a cubit. There are variations to this in addition to the seven divisions mentioned above but they are not the 'norm' and the configuration seen here is that which is generally applied. There were also double steps, which have the title of *pace*. In this work, these are not utilised as indeed for simplicity sake, as noted, other variants and divisions have been omitted.

Here we introduce a value that will become a mainstay of this work, and indeed is a value utilised throughout the Bible. Above it was noted that the mile had 5000 feet, while the familiar British mile has 5280 making the base unit a value of 1, but the mile length has not altered. Dividing 5280 by 5000 we find the value of 1.056 which in times past was the foot value associated with the length we understand as the British mile. This will be noted again with fuller explanations later in the book.

It should be noted that the evaluations seen in this work are based upon the familiar British foot with its value of 1, hence the *short Greek* mile would be seen as 5040 British feet whereas in the relevant *short Greek* feet there would be a count of 5000 [feet to the mile] at 1.008 British feet. This basic system applies irrespective of the individual values, i.e. the foot could be the base British value of 1.056 British feet or for example, the *long Greek* foot of 1.01376 British feet or indeed the *long Roman* foot of 0.9732096 British feet. The same proportions and rules apply. Here we point out that between these values, British, Greek and Roman, a factor of 0.96 [24/25 or vice versa] can be found. This is an important element. Long and short measures are denoted via a changeover factor of 176 / 175 or vice versa. Much of this information will be occasionally repeated to avoid confusion and the need to constantly refer back to these pages. It is given here as an introduction to the methodology that applied and Chapter 6 has further details.

As a comparison to table 2.2 above, below in table 2.3 we indicate the same unit construction but this time in *long Egyptian* measure [1.056 feet x 1.09090909]. Note that the 1.056 feet seen above is the first British foot measure.

Table 2.3 The Basic Measuring System Applied: long Egyptian units in British feet.

Foot	**Cubit**	**Step**	**Reed**	**Stadia**	**Mile**
1.152feet	1.728 feet	2.88 feet	10.368 feet	576 or 691.2 feet	5,760 feet
13.824 ins	20.736 ins	34.56 ins 1.6r cubits	124.416 ins 6 cubits 3.6 step	6,912 or 8,294.4 ins 200 or 240 step	69,120 ins 3333.3r cubits
16 digits @ 0.864 in	24 digits	40 digits	144 digits		
4 hands@ 3.456 ins	6 hands	10 hands	36 hands		

Various values for the Earth's circumference are seen in Chapter 4. The primary initial understanding of the circumference was either in what have been termed by Michell 'Greek' or 'Roman' miles [see comment above]. There are 25,920 *long* Greek miles of 5068.8 British feet in the circumference of Earth representing the 25920 years of the precessional period. In *long* Roman miles at 4866.048 British feet [*long* Greek mile x 0.96] there are 27000 representing the 27 days of the sidereal month. There are 129600000 *long* Greek feet in the Earth's circumference. In a minute of arc [1/21600 of a circle] are therefore 6000 *long* Greek feet and in a degree 360000 of these units. Hence the value of a count in sixes can be immediately seen. In parallel to the 'Greek' feet there are also 135000000 of Michell's 'Roman' variety. The derivation and development of these units will be seen in later chapters.

It should also be noted at this point that the numerical values seen throughout *Measurements of the Gods* are not derived from statistics, which depend upon the input for the result; while they all correlate with the units calculated by Michell, those not originated from his work are derived from ancient texts, including the Bible, measures of buildings, artefacts and from astronomy, an unusual but very revealing, correlating mixture. It was not until after many cross checks had been achieved and it was discovered that indeed the findings correlated with Michell's undoubtedly correct interpretations of measurement units that the connections were made, connections that enable the research to go forward in directions not dreamt of at its inception.

The next chapter attempts to put a framework onto the remainder of *Measurements of the Gods* by explaining how it is only relatively recently that we had a reasonable idea of how the celestial mechanics of the Solar System actually worked. Two things that we now take for granted, a knowledge of where we are on the globe and what time it is there [and also what time it is anywhere else] have their roots in the advances made at the start of our somewhat arbitrary definition of the 'modern age' as applied to measurement of the Earth's dimensions.

The Renaissance of 15th century Europe has been chosen as the starting point of this element of the journey for two reasons. Firstly, it is at this time that the foundations for the modern scientific investigation of the Earth's dimensions and celestial relationships were laid down. Secondly, the explosion in sea-borne trade necessitated the need for accurate charts and timekeeping for navigational purposes. Charts however, already existed that related to an accurate dimensional model of the Earth – the so-called *Portalano* or Port to Port charts, and some of these will be analysed in Chapter 5 where some of the statements made about these charts by other authors are questioned.

CHAPTER 3

The End of an Era: The Loss of the Mile

'For all peoples, for all time'

Motto of the metric system, Paris, France, 22nd of June 1799

3.1 The Longitude Problem

The massive increase in sea-going trade that occurred during the early part of the Renaissance, and particularly after the discovery of the Americas, highlighted a problem that had blighted mediaeval seafarers for centuries, namely the lack of an accurate method for ascertaining the time difference between a ship and a known reference point, usually its home port. Prior to the development of modern celestial navigation, European mariners in mediaeval times used to chart their course by measuring the direction in which they were travelling, and how long a distance they had traveled. In Europe, from about 1183AD onwards, the magnetic compass had been used to achieve the directional task, while a technique known as *deduced* or *dead reckoning* was used to estimate the distance traveled.

From the end of the 15th century it had been possible to tell one's latitude by measuring the maximum height in the sky reached by the Sun and other celestial bodies [celestial navigation], but there was no accurate method to establish one's longitude without access to an accurate clock. Not knowing one's longitude was a recipe for disaster. Apart from the obvious problems caused by foundering on reefs and the like, off-course ships often missed provisioning stops to restock on fresh food, particularly fruit and vegetables, thereby condemning many crewmen to suffer and die through scurvy, a condition caused by a lack of vitamin C. Dead reckoning was still used by mariners to estimate the distance traveled East or West from their home port. Keith Pickering explains the precise technique used in Columbus's day [in this case with a magnetic compass], at the end of the 15th century:

...the ship's speed was measured by throwing a piece of flotsam over the side of the ship. There were two marks on the ship's rail a measured distance apart. When the flotsam passed the forward mark, the pilot would start a quick chant, and when it passed the aft mark, the pilot would stop chanting. (The exact words to such a chant are part of a lost oral tradition of medieval navigation.) The pilot would note the last syllable reached in the chant, and he had a mnemonic that would convert that syllable into a speed in miles per hour. This method would not work when the ship was moving very slowly, since the chant would run to the end before the flotsam had reached the aft mark. Speed (and distance) was measured every hour. The officer of the watch would keep track of the speed and course sailed every hour by using a toleta, or traverse board. This was a peg-board with holes radiating from the centre along every point of

the compass. The peg was moved from the centre along the course travelled, for the distance made during that hour. After four hours, another peg was used to represent the distance made good in leagues during the whole watch. At the end of the day, the total distance and course for the day was transferred to the chart.[1]

The piece of flotsam was usually quite heavy – more of a log really, hence the term *logbook* used by the captain/navigator to record the passage of the vessel. A heavy piece of wood would more likely follow the most linear path possible in the churning wake of the ship. In addition to the inaccuracies caused by non-linearity in the path of the log, the navigator also had to factor in such things as wind strengths and ocean currents. One does not have to be an expert navigator to see that this system is prone to extreme inaccuracy and one wonders how ships at the time arrived safely across oceanic distances at all, a view that was echoed by Samuel Pepys, who after a voyage in 1683 with the Royal Navy to Tangiers commented:

'...that it is by God's Providence and great chance, and the wideness of the sea, that there are not a great many more misfortunes and ill chances in navigation than there are.[2]*'*

Dava Sobell in her best-selling book *Longitude* describes how large sums of money in the form of jackpot purses were offered around Europe to any one who could come up with a workable solution to what was becoming known as the *Longitude Problem.*

However, whilst there was a flurry of work on a variety of ideas to solve the problem ranging from the potentially viable to the bizarre, for over two hundred years the prizes remained unclaimed.

One of the reasons that marine archaeologists today have a wealth of sites and artifacts to study is that dead reckoning often meant dead men. Over the centuries hundreds, if not thousands, of ships were lost because they did not know their position on the seas. However, it was one particular event that laid the seeds for the eventual solution of the 'longitude problem' when the greatest sea power the world to that time had known, suffered a disaster of previously unimagined proportions. On the cold and foggy night of October 22nd 1707, four of the five ships commanded by Admiral Sir Clowdisley Shovell foundered on rocks off the Scilly Isles after a 12 day voyage from Gibralter dogged by fog. A sailor from the Association, his flagship, had earlier warned Clowdisley that they were dangerously off course by the sailor's reckoning. The sailor knew he was risking his life making his concerns known to the officers, as subversive navigation [as it was called] by the crew was forbidden by the Royal Navy. Admiral Shovell had the man hanged on the spot for mutiny, but paid a terrible price for ignoring the brave seaman – over 2000 soldiers and sailors drowned in the unforgiving seas of that dark night. Admiral Shovell had a little time to reflect upon his decision, as he was one of only two seamen that were washed ashore alive that night. However, his time was cut short when he was promptly murdered by a local woman who had taken a fancy to an expensive ring he was wearing.[3]

Fig. 3.1 John Harrison (1639-1776) and chronometer

The loss of so many ships produced an outcry in Britain, and reinforced civilian seafarers and merchants requests to the government for a solution to the longitude problem. By the spring of 1714, a petition had been drawn up signed by:

…'Captains of Her Majesty's Ships, Merchants of London, and Commanders of Merchant-Men'[4]

… which demanded that the government pay attention to the problem, and set up a committee to the consider the subject. Again, it was requested that a large financial reward be available to anyone who could come up with a workable solution. A parliamentary committee was set up to investigate the issue and asked Sir Isaac Newton, now a grand old man of 72, for his advice.

Newton presented all the current potential solutions to the committee, and commented that while a couple of them were theoretically possible of solving the problem they were all *'difficult to execute'*. Newton's thoughts became part of the committee's report, which resulted in the Longitude Act being passed on July 8th 1714, which set up a Longitude Commission which would oversee a competition offering £20,000 for a method to '*determine longitude to half of a degree of a Great Circle'* [or about 34 miles].

This was a huge sum for the time, worth several million pounds today, and illustrated the desperate need by the world's foremost seagoing nation for a solution to the *Longitude*

problem. The rest of the *Longitude* story is entertainingly told by Dava Sobell in her book, and we will not go over the same ground here, other to note the obsessional drive of clockmaker John Harrison to produce the best clock ever made, one that would lose no more than 2 minutes on a 40 day journey across the Atlantic Ocean, [5] and one that would bring him the prize, 40 years later. John Harrison, pictured with one of his chronometers in Figure 3.1, produced the prototypes of the mechanical chronometers that were used for the next two hundred years in navigation. They have only recently being supplanted by quartz watches, atomic clocks and the Global Positioning System.

It is the alternative solution that is of interest in the context of this work – an astronomical one, which as Sobell relates, was for a long time favoured by the academic community including Newton. There were actually two candidates for an astronomical solution to the *Longitude problem.*

The first solution was based around the apparently 'clockwork' motions of the satellites of the planet Jupiter. Since 1610, Galileo, after using a telescope to examine the night sky, had thought he had discovered the so-called *clock of heaven.* It was then when he first observed what he called the *Medicean stars* [actually 4 satellites of the planet Jupiter], orbiting the giant world, in a similar way to that of the planet's circuits around the Sun. Galileo was well aware of the longitude problem, as was every learned man of his day, and after calculating the orbital period of Jupiter's moons over the next year, he believed he had worked out a solution to the problem. Galileo believed that his tables of the Jovian satellites appearances and disappearances as they circled around Jupiter provided the accurate clock that was required to solve the Longitude problem. However, while his system worked well on land, it was of very limited use at sea. Jupiter is not visible by day or in bad weather, and even if it was a clear night, the movements were hard to discern from the heaving deck of a ship. Not surprisingly, mariners did not take up this idea, but it *was* used on land, and provided a good intellectual platform for future studies of the sky.

A second, and more promising way of using the so-called *celestial clock* to solve the *Longitude problem,* was to observe the relative positions of the Moon and the Sun in the day, or at night, to use a similar technique with the Moon and prominent stars. King Charles II had instigated the setting up of the Royal Observatory at Greenwich in 1676, with its primary aims of measuring precisely the Moon's movements and charting the stars. James Flamsteed was appointed as the first Astronomer Royal, and started work on his star catalogue in October of that year, a task he toiled at for nearly 40 years, it not being published until 1725, several years after his death in 1720. Dr Edmond Halley [of comet fame] succeeded him. Halley is also noted for his observations of the Moon and his discovery of the true motions of the stars i.e. the real movements of the stars in relation to each other. This is an important issue when considering ancient astronomy [as was seen regarding the Paleolithic cave art in Chapter 2].

By the time the Longitude Commission was established in 1714, because of Newton's Theory of Gravitation, the movements of the Moon were much better understood. There was a strong feeling in academic circles that this was the way forward to solve the Longitude problem and indeed Newton and Halley had tried to get Flamsteed's prototype star catalogue published in 1712. By 1721, Newton accepted that a man-made clock would be a useful accessory to navigators but he still considered that the 'celestial clock' would be the main solution to the

Longitude problem in the future, a point he made in a letter to the Secretary of the Admiralty.[6] A massive intellectual effort was made by Flamsteed's successors, Halley Bradley and Maskelyne, amongst others, to make the *lunar distance* system work, and indeed it was extensively used in the late 18th and 19th centuries, until affordable clocks became available to most mariners. In addition, an enhanced dead reckoning system was still in use in Nelson's day, during the early 19th century albeit in association with the new chronometers. As the Historical Maritime Society explain:

'By the beginning of the nineteenth century and more accurate system had been derived. This used a 'log ship', a triangular weighted piece of wood to which was attached a long rope. The log was cast off the stern of the ship and the line allowed to pull out as the log floated stationary in the water. The rope had a series of marks or knots every 48 feet. When the first mark was reached a small sand timer was turned which ran for 28 seconds. The number of marks in the rope that passed in this period was then counted. If exactly one mark passed then the ship was doing one nautical mile per hour or one knot! Knots are still used today for ship and aircraft speed.' [7]

This gave a mile value [a knot is $1^1/_6$ miles] of 6160 feet against the conventional 5280 feet [(5280 / 6) x 7]. 6160 / 48 = 128.333. Here we see a connection to the ancient system because allowing for physical knots, here calculated at 1.5 inches in width, a most practical size for the purpose we find that there were 128 knots to the overall measured distance of $1^1/_6$ miles. [48 feet plus 1.5 inches x 128 = 6160 feet.] 128 is a major value in the ancient Indian system of weights [see Chapter 15] and hence here, for no apparent reason, we find a repetition of the use of the same value. Except in very rough weather this would also have been quite accurate. A mile of 5000 feet derived from this length of 6160 feet would have a foot value of 1.232 British feet. This will be seen again, specifically in relation to another ship and to buildings.

In terms of our interest here, ancient measurement, there is evidence of clock making in the ancient past, such as sand timers in Egypt that go back to at least 1500BC. Knotted ropes are also known to have been used in ancient Egypt with reference from before this era in India for land measurement, so we can conceive of the dead reckoning technique being used in that epoch and we should remember that ship building is an ancient art. Practice in smooth local seas or rivers without a sand clock [although it may have been used] to a count of one, two, three etc up to perhaps 20 or 30 would have produced a similar knowledge of progress through the water. None of the types of clocks that are known to have existed then, with the exception of the sand clock [which would have to have been kept perfectly dry] would have been of use on any ancient long sea voyages. However, it can be imagined that the concept of the *lunar distance method* is potentially an accurate method of solving the *Longitude problem*, as long as one knows the precise position of the moon, relative to the sun and bright stars. Combinations of methods would give seafarers a shrewd idea of their position.

It was seen in Chapter 2 that one of the Ice Age cave paintings at Lascaux in France, a work some 15,000 years old, clearly showed that the movements of the moon were avidly studied even in the very ancient past. We can therefore well imagine that this knowledge was

refined over the millennia that followed. This has important implications for the possibilities of the capabilities of ancient sea-farers, an issue to which we shall return in later chapters.

3.2 Isaac Newton: the last of the Magicians

The quest for what initially was only a 'lost source' of measurement has also been previously been taken up by one the 'great minds' of past years. That 'great mind' belonged to none other than Isaac Newton, and much of the 'esoteric' knowledge relating to measurement for which he searched in vain is revealed in later chapters.

Fig. 3.2 Sir Isaac Newton as a young man (1689, by Sir Godfrey Kneller)

The Earth as an Ellipsoid

Sir Isaac Newton, pictured in Figure 3.2 below, was one of Britain's, if not the world's, greatest-ever scientists. He took a keen interest in the Earth's dimensions for a variety of reasons. From a scientific standpoint he is credited to be the first in modern times to put forward the concept that the Earth is an ellipsoid, or a slightly flattened sphere. This idea was suggested in his *Principia,* published in 1687, where he claimed that the Earth was an oblate spheroid with a flattening element of 1/230. The idea that the Earth was an ellipsoid, had a connection to one of Newton's other contributions to modern science that was also detailed in *Principia* – his Theory of Gravitation, which finally explained the motions of the planets, something that had been taxing the minds of many scholars for over a hundred years. As Newton discovered the Universal Law of Gravitation and there is only one Universe, he has

been described by following mathematicians and physicists as not only the greatest of his age but also the luckiest of men.

If the Earth was a flattened sphere, this has the implication that the gravitational pull at the poles would be stronger as the polar radius would be less than the equatorial radius i.e. the distance from the Earth's surface to its centre would be less. This had been borne out earlier, in 1672, when a French expedition to Cayenne, Guyana [which is near the Equator] discovered that a pendulum clock previously kept in Paris where it had kept perfect time, lost 2.5 minutes in 24 hours at the equatorial location. The reason for this is that a pendulum clock is affected by gravity; the pendulum will 'fall' more slowly if gravity is reduced and therefore its related clock gear train will run more slowly, making the clock appear to run slower.

Newton's assertion that Earth was an ellipsoid was further confirmed by a number of French surveying expeditions in the early 18th century. In 1735, Pierre Bouger travelled to Peru with Charles-Marie de La Condmine to ascertain the length of the meridian (or line of longitude) between various latitudes in the region, which is approximately south of the equator by the same distance as Paris is to the north. The following year in an expedition to Lapland, similar measurements were made by Pierre-Louise Moreau de Maupertuis. Utilising triangulation, these surveyors and their teams confirmed that the Earth was, as Newton had predicted, flattened at its extremities.

Newton's theories therefore, played a large part in the calculations made to ascertain the dimensions of the Earth for the new French metric system that was developed in the latter half of the 18th century.

Newton's Life

Newton's life can be divided into three quite distinct periods, the first being his boyhood days from his birth at Woolsthorpe, near Grantham in Lincolnshire in 1643, up to his appointment to a chair at Cambridge in 1669. The second period from 1669 - 1687 was the highly productive period in which he was Lucasian professor at Cambridge. The third period [nearly as long as the other two combined] saw Newton as a highly paid government official in London with little further interest in mathematical research.

Newton came from a family of farmers but never knew his father, also named Isaac Newton, who died in October 1642, three months before his son was born. Although Isaac's father owned property and animals, which made him quite a wealthy man, he was completely uneducated and could not sign his own name. After an unhappy childhood, in which the young Newton apparently took little interest in schoolwork or managing his mother's estates, he was taken under the wing of an uncle, William Ayscough, who decided that his nephew should prepare for university, and convinced his mother of the same. Isaac was allowed to return to the Free Grammar School in Grantham in 1660 to complete his school education. This time he lodged with the headmaster of the school, and it would appear that despite suggestions that he had previously shown no academic promise, young Isaac must have convinced some of those around him that in fact he did have academic potential. A piece of evidence that points to this, and which shows his religious nature, comes from Isaac's list of sins noted down by him when he was 19. He lists one of his sins as:

... setting my heart on money, learning, and pleasure more than Thee ...

Newton entered his uncle's old college, Trinity College Cambridge on the 5th of June 1661 with the intention of taking a law degree. The philosophy of Aristotle dominated the instruction at Cambridge at the time, and Newton would mirror his wide-ranging interests in later life.

It is not quite clear how Newton developed his interest in mathematics; according to de Moivre it began in the autumn of 1663 when he bought an astrology book at a fair in Cambridge and found he could not understand the mathematics in it.[12] By late 1663, Newton started to study mathematics widely, but by the time he received his bachelor's degree in April 1665, it seems that his genius had not yet emerged.

When the plague closed the University in the summer of 1665, Newton had to go back to Lincolnshire and it is here that his scientific originality became apparent. In a short time of only about two years, he produced revolutionary advances in mathematics, optics, physics and astronomy. These resulted in him being elected to a minor fellowship in Trinity College by October 1668, and the Lucasian chair in 1669 at the age of 27.[8] Newton's contributions to the longitude problem and the development of the metric system have already been noted. His strong religious convictions and their relationships to what has been called *sacred* measurements are also of importance here.

The *Sacred* Cubit

In terms of measurement units and the dimensions of the Earth, it is found that Newton, in his dissertation, *Lexicon Propheticum,* published ten years after his death, was specifically interested in a unit that he referred to as the '*Jewish Sacred Cubit'*. Michell[9] relates that this interest was derived from Newton's view that the layout of Solomon's Temple in Jerusalem, and the dimensions of the Great Pyramid in Egypt represented accurate geodetic fractions. Michell also states that Newton considered the Jewish Sacred Cubit to be 1/12,000,000 of the polar diameter, a value according to Michell's calculations of 3.475748571feet. In actual fact, there is, as related by Stecchini, a more specific document that detailed his interest in ancient and Sacred cubits:

'A Dissertation upon the Sacred Cubit of the Jews and the Cubits of several Nations: in which, from the Dimensions of the Greatest Pyramid, as taken by Mr. John Greaves, the ancient Cubit of Memphis is determined'[10]

John Greaves, Professor of Astronomy and Geometry at Oxford had previously, in 1638, travelled to Italy and Egypt to research ancient measurements.

As Michell relates, in Italy, Greaves managed to deduce, from careful examination of Classical structures, the long and short values of the *Roman foot*.[11] Stecchini then relates that whilst in Egypt, Greaves met Tito Livio Burattini, the first systematic advocate of a new decimal metric system, who was collecting data for Father Athanasius Kircher, the author of

Oedipus Aegyptiacus. They then co-operated in measuring the base lengths of the Great Pyramid.[12]

It was not idle curiosity that spurred Newton's interest in the dimensions of the Great Pyramid. Newton's Theory of Gravitation was dependent upon an accurate knowledge of the circumference of the Earth, which was not known at the time [about 1660]. The Classical Greek calculations of the Earth's circumference made by Eratosthenes and others were seen to be inaccurate; because no-one knew the precise values of the various stades in use. That the stadium values varied was clearly apparent as each survey gave a different value for the Earth dimensions, some by very wide margins. Unfortunately, because there was much accumulated debris at the base of the Pyramid, Greaves and Burattini's measurements were also inaccurate, and Newton's calculations based on them were not to his satisfaction.

Newton then put off further work on the theory for several years until a more accurate idea of the Earth's size was available. In 1671, a French astronomer called Jean Picard accurately measured a [particular] degree of latitude to be 69.1 miles, which was sufficiently accurate for Newton to announce his Theory of Gravitation, based upon an inverse square law. However, it was only after the prompting of Halley in 1684, that Newton begin writing a full treatment of his new physics, and this resulted in the publication of *Principia* in 1687, recognised as the greatest scientific book ever written[13]

[*Authors Note*: It is ironic that over 200 hundred years later, Piazzi Smyth and others were condemned for suggesting a similar theory to Newton's regarding the polar diameter of the Earth. Smyth also suggested that it related to the dimensions of the Great Pyramid of Egypt and postulated adjusting the length of the British inch to make it exactly 1/500,000,000 of what he took to be the Earth's polar diameter. It was this altered inch value, it was claimed, that was the basic unit of measure of the Great Pyramid. Like Newton, Smyth also claimed that within the passages of the Pyramid could be found the history of mankind since creation, marked off in 'pyramid inches' at various junctions and joints, an idea still promulgated in the much more recent works of Peter Lemesurier [14]]

Newton, Solomon's temple, Alchemy and the Rosicrucians

Newton considered Solomon to be '*the greatest philosopher in the world'* and spent a great deal of time trying to reconstruct the Temple of Solomon as a frame for the whole system of the heavens and as a pattern for the future of the human race.[15] Newton reconstructed the ground plan of Solomon's Temple, using information derived from the Bible.[16] His religious convictions led him to the opinion that hidden within the geometry and dimensions of Solomon's Temple were not only geodetic measures, but clues to Biblical timescales and the pronouncements of the great Biblical prophets, specifically, St. John the Divine, Ezekiel and Daniel.[17]

[Authors Note. For a far more informed interpretation of Solomon's Temple it is suggested that readers look to the companion work to this volume, *Deluge* where a complete breakdown of the values involved along with drawings will be found. Connections to other

matters such as astronomical dating and the 'Great Flood' story are also revealed via an understanding of the hidden values in the Biblical description of the temple.]

In England, Robert Boyle and Isaac Newton, who were to transform chemistry and physics respectively, made a deep study of alchemy and were strongly drawn to the Rosicrucian ideal. Newton had a copy of the Fame and Confession of the Fraternity of the R.C., commonly of the Rosie Cross [1652] which was translated by Thomas Vaughn and dedicated to '*The most illustrious Truly Regenerated Brethren of the R.C.*' Vaughn was the brother of the Metaphysical poet Henry Vaughn and tried to spread the Divine Alchemy of the Rosicrucians.[18] In a surviving manuscript from a Mr. F [probably Ezekiel Foxcroft, a fellow of Kings College] Newton recorded his view and approach to the work of alchemy:

'For alchemy doth not trade with metals as ignorant vulgars think, which error has made them distress the noble science; but she has also material veins of whose nature God created handmaidens to conceive & bring forth its creatures…This philosophy is not of that kind which tends to vanity & deceit but rather to profit & to edification inducing first the knowledge of God & secondly the way to find true medicines in the creatures…the scope is to glorify God in His wonderful works, to teach man how to live well…this philosophy both speculative & active is not only to be found in the volume of nature, but also in the sacred signatures, as in Genesis, Job, Psalms, Isaiah & others. In the knowledge of the philosophy God made Solomon the greatest philosopher in the world.' [19]

As Marshall comments in *The Philosopher's Stone*, ironically it was the triumph of Newton's vision of the universe as a machine governed by fixed laws which forced alchemy underground at the end of the 17th century. [20]

Some of Newton's amazing range of interests has been briefly described here. He was not just a scientist, rather, he reminds us of some *Merlin* of fable and to quote the British economist John Maynard Keynes:

'He was not the first of the age of reason. He was the last of the Magicians, the last of the Babylonians and Sumerians, the last great mind which looked out on the visible and intellectual world with the same eyes as those who began to build our intellectual inheritance rather less than 10,000 years ago.[21]

However, perhaps not all of Newton's evaluations should be taken as being correct or even plausible. This comment is illustrated in a story by Jonathan Petre, Religion Correspondent of the Daily Telegraph, which was filed on February 22nd 2000[22] which revealed that Newton had expounded many thousands of words, amounting to 4,500 pages in attempting to decipher the date of the Biblical Armageddon. According to Newton it is set for the year 2060AD when Christ is to return and Newton himself is to take his place as Chief Saint! BBC2 also produced a television programme relating this element of the mathematical genius named *Newton: The Dark Heretic.* For 250 years thousands of these papers were kept unread in a trunk in the house of the Earl of Portsmouth, finally being sold in the 1930s.

Keynes bought many works relating to alchemy and theology but one Abraham Yahuda bought what was, it now appears, much crucial material, texts that have since been stored in the Hebrew National Library. While over the ten years leading up to this discovery much research was undertaken regarding the meaning of the texts, it was only in the year 2000 that the date that Newton had finally evaluated was discovered.

Newton was convinced that the layout of Solomon's Temple contained the chronology of mankind and the future could be predicted from the information contained therein. But Newton had only the Bible from which to work, and then, just as now, there were no extant ruins of the original temple for him to examine. However, others of that era and since have made the same claim about the Great Pyramid, which was accessible and which had been surveyed. One wonders from where this idea emerged because the current work later reveals definitive connections between the Great Pyramid and the Great Flood tale in Genesis. Indeed, as noted above, the Biblical description of Solomon's Temple has a great deal to reveal when its numerical secrets are unravelled. When all is put together a prediction does emerge, an inevitable situation that is cyclic, albeit of an entirely different nature to that seemingly perceived by Newton or any of the other 'prediction' purveyors. As seen above in the work of Smyth and Lemesurier, prophecy from the Great Pyramid and a history of humanity, including the flood, was seen by many to be acceptable for a long period. Indeed, it was from this source that some religious sects, including the Jehovah's Witnesses, originally derived their information regarding such matters including a flood date of 2370BC.

However, this is of no intrinsic value as the 'predictive' or 'prophetic' elements of the religious stories are unassailable, they relate to cycles in the heavens, the only guaranteed repeatable events known in those times. Such visual repetitions need only disguising in a story and the whole tale, based upon fact, becomes known as a myth, something of an imaginative invention. Imaginative inventions these certainly are and have fooled most for thousands of years but they are based upon truth that is merely disguised. In *Deluge* the primary 'return' of the saviour and the 'destruction' associated with the descriptions in the Book of Revelations are fully explained as these are intimately interlinked with the story of the flood.

3.3 A Product of the Revolution - The Development of the Metric System

The story of the metric system begins over three hundred years ago. For many years in Renaissance Europe there had been discussions about the need for a coherent system of measurement in order to better scientific communication and enhance trade.

The above need reminds us of a similar situation regarding standardisation problems in the transfer of scientific data in the 1970's. These were solved by scientists at CERN, the European Nuclear Research Institute in Geneva, who invented *html*, the so-called mark up language of internet web pages, which became the standard format for scientific document transfer during the 1980's.

Standardisation problems abounded in mediaeval Europe; 17th century France in particular had standards of linear and volume measure that varied from town to town across the country, which made trade difficult, and obviously, the subject of much potential dispute. It was in 1670 that Gabriel Mouton, a vicar at St. Paul's Church in Lyon, first suggested a unit

associated with Earth measurement, namely 1/40,000,000 of the Earth's longitudinal circumference.[23] Mouton's proposal contained three of the major characteristics of the future metric system: decimalization, rational prefixes (i.e. a standard set of unit multiples and sub-multiples), and a unit of length related to the Earth's dimensions. Mouton's proposal was debated for some 120 years, but it was not to be until the fall of the Bastille and the creation of the National Assembly that it became a political possibility in France. In April of 1790, one of the foremost members of the National Assembly, Talleyrand, introduced the subject of standardisation of measurement to the Assembly, launching a debate that resulted in a directive to the French Academy of Sciences to prepare a report.

After several months' study of available data [such as Bouger's, which was discussed earlier] the Academy came up with a series of recommendations. The main one of interest to us here was that the Academy recommended that length of longitude passing through Paris be determined from the North Pole to the Equator, and that 1/10,000,000 of this distance would become a new standard length, termed the *metre*. This unit would then form the basis of a new decimal linear measurement system which would be extended to include a new unit of weight, derived from the weight of a cubic metre of water. In addition, the Academy also proposed a list of prefixes for decimal multiples and submultiples.

The revolutionary National Assembly endorsed the above milestone of a report and directed that the necessary measurements be taken. This was formalized on June 19, 1791, when a committee of 12 mathematicians, geodesists, and physicists met with the King, Louis XVI, who gave the Royal Assent to the submitted proposals. Incidentally, the next day, the King and Marie Antoinette attempted to escape from France, but were caught at Varennes. [They would have made it if the coach had not been delayed for a long time in order to load a large trunk containing the Queen's toilet set.] Louis XI and Marie Antoinette were forcibly returned to Paris, where the King was imprisoned and a year later he played his last part in this story. Here, from his cell, he issued the proclamation that directed two engineers, Jean Delambre and Pierre Méchain, to perform the surveying operations necessary to determine the length of the new standard unit.

Delambre and Méchain now set to work to measure the distance on the meridian from Barcelona, Spain, to Dunkirk in northern France, a task so arduous that it was not completed for six years. While Delambre and Méchain were struggling in the field, administrative details were being worked out in Paris and in 1793 a provisional metre was constructed from geodetic data already available. In 1795, a draft law defining the metric standards of length, mass, and capacity was produced, along with the prefixes for multiples and submultiples. The standard metre, as determined by Delambre and Méchain, was formally presented to the Assembly in 1799 and was adopted on June 22nd of that year. [24]

The motto of the metric system that introduces this chapter is ironic here, as one of the key themes of *Measurements of the Gods* is that whilst there were indeed a variety of units of measurement in use, these were linked to a canon of numerical units of measurement based on geodetic dimensions that had existed around the world not merely for a few hundred years, but for *millennia*.

For those who understood, these units were interrelated and posed no problems. Among those who were aware of the values were the designers of palaces, cathedrals and

monastic buildings during the period when metrication or 'standardisation' was introduced in France. We must conclude from this that although a man of the church, Gabriel Mouton was unaware of the geodetic nature of the measurements already in existence and inherent in his own place of worship.

Basic elements of the Metric System

The new metric system comprised a number of elements - the standard metre as derived by Delambre and Méchain, the gram, litre and are. The *gram*, the basic unit of mass, was made equal to the mass of a cubic centimetre of pure water at the temperature of its maximum density [which was defined as 4 degrees Centigrade or 39.2 degrees Fahrenheit]. A platinum cylinder known as the *Kilogram of the Archives* was declared the standard for 1,000 grams whilst the litre was defined as the volume equivalent to the volume of a cube, each side of which had a length of 1 decimetre, or 10 centimetres. The *are* was defined as the measure of area equal to a square 10 metres on a side. In practice the multiple, hectare or 100 ares, [approximately 2.47 imperial acres] became the principal unit of land area measurement. In addition, names for multiples and submultiples of all units had a uniform style, based on Greek prefixes.

The year 1823 saw the introduction of legislation in France to enforce the use of the new measurement units, an enforcement that was still necessary as late as 1837.

This reminds us of the United Kingdom today, where there is still a reluctance to use the 'new' metric measures by many older people who have been brought up using the old Imperial system, in fact a recent move by the government has allowed the old values to remain in use provided traders also display the metric equivalents. Indeed, some building materials such as plywood can still be obtained in imperial sizes…even in 2009!

However, during the period under discussion, the mid 18th to the early 19th centuries, in Britain a similar move toward standardisation was taking place. The Select Committee of the House of Commons was set up to report on the Original Standards of Weights and Measures in 'this kingdom'. On May 26th1758 and April 11th 1759, the Select Committee submitted reports upon the units then in use and recommended that the Ale Gallon of 282 cubic inches should be that which replaces all other interpretations of the gallon. They also suggested that the Troy pound should be the basis of all weight measurement.

Later, after a period of inactivity regarding any standardisation two eminent scientists were consulted by the committee, one Dr. W. Hyde Wollaston, Secretary to the Royal Society, and the other being a Professor Playfair of Edinburgh. Their recommendations as outlined here were finally passed by the Committee in 1816 and were in use at that time.

One of the recommendations that emerged was for a yard that contained 36 inches with the inch derived from an accurately balanced pendulum, sited in the middle of London and that vibrated at 60 times per minute. The length of this pendulum had been calculated at 39.13047 inches of which 36 made the yard.

This basically defined the linear measure as the yard was seen to be 3.3702 inches shorter than the newly developed French metre at 32 degrees Fahrenheit and 3.3826 inches shorter at 55 degrees Fahrenheit. Correlation was therefore seen to two invariable stands, the

measure relating to Earth's meridian circumference of which the metre was 1/40,000,000 and the pendulum in London.

The Select Committee recommended that the pint should be comprised of 34.56 cubic inches with the quart at 69.12 cubic inches and gallon at 276.48 cubic inches. [Note: 69.12 miles = one degree of anciently accepted Earth circumference and 34.56 inches = the Egyptian [as named by Michell of which more later] step measure. Also compare numerical counts to the values associated with Indian weights in Chapter 15.] Here it should be noted that all the liquid measures were conducted at $56^1/_2$ degrees Fahrenheit. A cubic foot of pure water or 1728 cubic inches, at $56^1/_2$ degrees Fahrenheit weighed exactly 1000 ounces Avoirdupois. This was taken as the standard from which all else in the realm of weight / liquid measure evolved as 1728 cubic inches means a cube of exactly 12 inches per side. The volume of water of a single pound Avoirdupois therefore was seen to be 27. 648 cubic inches.

Just a few years later, in 1824, the Weights and Measures Act of that year decreed somewhat different values. The linear measures remained the same but due to the fact that the conditions for evaluating liquid were altered, the volume correspondingly changed and the gallon was now quoted at 277.274 cubic inches making the pint 34.69525 cubic inches against the earlier recommendation of 34.56. In 1824 the temperature for evaluation was set at 62 degrees Fahrenheit with the barometer at 30 inches, which of course meant an expansion of the unit weight utilised to ascertain the displacement volume of water in the pint, gallon etc. If we examine what could have been observed in the case of a weight to ascertain a pint volume for example at the earlier assessment taken at $56^1/_2$ degrees Fahrenheit, the pint, as noted, had a displacement value of 34.56 cubic inches which from the unit numbers involved [34.56, 1728, 6912 and 12], will be seen to be 100 percent compatible with the system that dates to millennia before this event. At the new interpretation taken at the higher 62 degrees, the weight utilised to ascertain the displacement volume had expanded to the volume of 34.69525 cubic inches, an increase of 0.0042436 of an inch or 1/9.277 of a millimetre per side. As the earlier British measures were compatible with the ancient units as seen above, it becomes apparent that the Imperial measures were intimately related to these vastly older units.

In Chapter 16 we return to this subject of weights in much more detail but here we shall look once more to the French initial interpretation of the metre and to the implications arising. The Select Committee noted the reported difference between the yards and the metre at two different temperatures, 32 degrees Fahrenheit and 55 degrees Fahrenheit which naturally gave two different readings. We shall take the lower value which was read at freezing point, 32 degrees Fahrenheit. This difference was 3.3702 inches, making the metre 36 plus 3.3702 or 39.3702 inches in length. This meant that the French calculation for the Earth's meridian circumference was 40000000 x 3.28085 feet or 24854.92424 miles. The ancient's version for a globular Earth was 24883.2 miles, a difference of some 28.2 miles.[25]

The SI System

At this point it is useful to explore a reason for the eventual pervasiveness of the metric system – namely its expansion into a much wider technical and scientific field. The creation of the decimal metric system at the time of the French Revolution can be seen as the first of a number of steps in the development of the present International System of Units, commonly known as the *SI system*.

In 1832, Gauss strongly promoted the application of the new metric system (together with the *second* defined in astronomy) as a coherent system of units for the physical sciences. In the 1860s, under the active leadership of Maxwell and Thomson, the British Association for the Advancement of Science [BAAS] formulated the requirement for a coherent system of units consisting of *base* units, and *derived* units. Consequently, in 1874 the BAAS introduced the CGS system, a three-dimensional method based on the units centimetre, gram and second, using prefixes ranging from micro to mega, to express decimal submultiples and multiples. The development of physics as an experimental science was largely based on this system.

The sizes of the coherent CGS units used in the fields of electricity and magnetism proved to be inconvenient, so in the 1880s, the BAAS and the International Electrical Congress approved a mutually coherent set of practical units. Amongst them were the well-known nowadays, *Ohm* for electrical resistance, *Volt* for electromotive force, and the *Ampere* for electric current. In 1889, the CGS system was amended so that the base units were changed to the meter, kilogram and second. [Note: We now use the French spelling for the meter – *metre*] Later, in 1946, the CGS system was expanded to include the Ampere as a unit of electrical current. Further expansion to include the Kelvin [temperature] and candela [light] was made in 1960, where the modern name of the SI system was born. Finally, in 1971, the current version of the SI system was completed, by adding the *mole* as base unit for amount of substance, bringing the total number of base units to seven.[26]

Alexander Ross Clarke and the advent of British Geodetic Surveying

While France was adopting the metric system, Britain still maintained the Imperial system of measurement, which was standard throughout the British Empire. Indeed, while the French were producing their surveys, in the late 18th century, Britain was also engaged in a similar exercise: the first complete trigonometrical survey of the British Isles. This was to eventually result in what we recognise in modern times as the Ordnance Survey, the *initial* work being completed in 1852.

Alexander Ross Clarke [1828 – 1914], a pioneer in modern surveying, was closely involved in this work, and he published the results of the first geodetic survey of Great Britain in 1861. His calculations of the size and shape of the Earth [known as the Clarke ellipsoid] were the first to approximate accepted modern values with respect to both polar flattening and equatorial radius. The figures derived from his second set of calculations [1866] became a standard reference for geodesy in the United States for most of the twentieth century, even though he had never set foot on North American soil.[27]

3.4 The Last Days: The End of the Imperial Measurement System

The quotation heading this chapter is a little tongue in cheek, in that while it may have been utilised in the context of the new metric system, the system that it was displacing was actually as ancient as human civilisation itself. This system, the *Imperial* measurement system, had already been proven to be capable of being described as *'For all peoples, for all time'*. What we knew as the British Imperial system is but a part of a completely integrated numerical system, which was so beautiful in its connectivity, it was almost like poetry in numbers. Algernon Berriman's fear, noted in his work *Historical Metrology* in 1953, that a heritage of 'great antiquity' was to disappear from daily life began to be borne out during the course of the 1960's, as the process called metrication began in Britain. Feet, inches and other associated units began to be replaced by a unit new to Britain - the metre - and its various offspring such as the kilometre. In a similar way, the British, or rather *imperial*, units of weight and volume were to be supplanted by 'metric' units. This attack on Britain's heritage was incurred, supposedly, via an Act of Parliament in 1963. The word 'supposedly' is used here because there are many who would argue that there was no such Act, and the concept of metrication, whether for good or otherwise, had been hoisted onto the British public by stealth. Whatsoever, by stealth or otherwise, in 1963, a national changeover began. According to Chambers Dictionary, in 1963 the yard was defined as 0.9144 of a metre, making the metre 3.280839895feet or 39.37007874 ins. It is this value that is used throughout *Measurements of the Gods* and is the now internationally accepted interpretation.

The metrication process in Britain has been slowed by a great emotional attachment by the British to the old Imperial units. For example 30 years after metrication, it was still possible to purchase items in Imperial sizes such as sheets of Malaysian plywood, and there are many examples in the world of engineering where the metric system has not taken hold. However, one had to purchase ones building materials, whether metric or imperial in a metricated currency in Britain, as the British monetary system 'went decimal' in 1971, triggering off an inflationary spiral, which has resulted in the pound being worth in 2003 perhaps 10 per cent of its value in 1971. However, four feet, apart from being the equivalent of 1.2192 metres, is still four feet, as indeed, a second is still a second…even when measured by an atomic clock…

Some measurement units in life have altered dramatically while others have remained constant. In this context then, how much longer we will be able to order a very old measure, a pint of beer, [albeit not quite the same measure as that of the 18th century] is a matter of conjecture. But if metrication is to be complete, even this time honoured tradition will be relegated to the realms of history, and the pint and half pint glasses will be consigned to history museums, along with imperial barrels and kegs.

How had the Imperial System come into being? The accepted story has a typically British mediaeval feel about it, and here we examine a part of the history. 14th century statutes recognise a yard of three feet, the 'Iron Yard of the King' [reputedly his girth] with each foot having twelve inches. A barleycorn, according to these statutes, was equal to a third of an inch hence there were 36 barleycorns to a British foot and 108 to a British yard. The standards for these measurement units were kept at Winchester and were known, appropriately, as the

Winchester standards, which incidentally were both reaffirmed by King Henry VII and Queen Elizabeth I.

What seemingly enhances the *apparent* approximations of the measurement units used is that, in the 16th century it was customary to line up sixteen men heel to toe as they left church and evaluate the overall length of their feet. This value was then the local rood or rod length. By the early part of the 17th century, statute had standardised the *acre, furlong* and *rood* or *rod* [also known as the pole or perch] accurately [in British units] to 4840 square yards, 660 feet and 16.5 feet respectively. The *acre* was also defined as 40 rods in length, by four rods in width, giving 160 square rods or 43,560 square feet.

During the 17th century, Edmund Gunter developed the measuring device known as the surveyor's chain based on the acre width of 4 rods [792 British imperial inches, or 66 British feet, or 22 yards]. [Note the 'rod, pole or perch' was a length of 16.5 feet.] This chain is a familiar distance today, even in a metricated world – it is the length of a cricket pitch. It should also be noted here that this supplies a link to the ancient past as this distance is the height from ground level of the head of the Great Sphinx at Giza in Egypt. In fact, the ancient Egyptians among others in the distant past were very fond of this value and it is seen in monuments in the Middle and New Kingdoms as well as the Old. This may be because if this length is converted to inches, the result is a count of 792. The value 792 in various formats occurs very widely in the ancient and not so ancient worlds.

As the anciently accepted diameter of Earth was 7,920 miles of the variety known in modern times as British, it would appear that there is a definitive link as is confirmed in later chapters. Thus it is easy to envisage that the length of a surveyor's chain, which itself is used for geodetic or Earth measurement, is a deliberate representation of numerically symbolic values with which the 16.5 feet of the 'rod, pole or perch' were directly related via a different factor.

The above standardisation of lengths actually began, as indicated, long before the 17th century, and was part of Edward I's statute of 1305. British units, according to the *Encyclopaedia Britannica*, were initially defined in terms of *Northern feet* which were also known as *German feet*.[28] The furlong, 1/8th of a mile and still known to lovers of horse racing everywhere, was 625 German feet although the appendage 'German' is unlikely to have been used as this was a standard measurement. The mile did not change length but with a change of foot value there now were 660 of the new shorter feet to the furlong with 5280 to the mile. The conversion factor from Northern feet to Standard English feet, or what later were known as simply British feet, is obtained by dividing the 660 British feet by the original 625 Northern feet which results in 1.056, i.e. 1.056 British feet is equivalent to the length of the German foot. It has been noted that the British mile is the odd man out in the ancient measurement system as it is the only mile with a count of feet at variance to the original 5,000. However, at this point another issue regarding the history of the mile is raised:

It has frequently been stated that the mile was standardized to 5,000 feet in Roman times. It will become obvious, however, that this is an erroneous idea and that the mile, as a 5,000 feet unit of geodetic measurement, stems back to what is generally termed pre-history.

3.5 Island Earth

The concept of an *Island Earth* when seen from space, as related in the famous 1950's science – fiction film of the same name, is actually one that dates back to Homer of Classical Greek times. However, as Newton suggested, the shape of the Earth is not the perfect globe it seemed in the photographs taken by the Apollo 10 astronauts [see Figure 3.3].

The Earth is actually an ellipsoid, or a slightly flattened sphere but even this is a simplification because it does not take into account the variations of the height of the Earth's surface relative to an average value. Mountains, seas that lie below average sea–level, and variations in the level of the sea itself, all make a precise definition of The Earth's surface difficult. When these are taken into account the resultant shape is known as a *Geoid*, a term, interestingly from a historical point of view, derived from the Greek for Earth.[29] If a global approximation is utilised for the ellipsoid that it is Earth, then in a regional context where the topography is different from the world's average shape, accuracy may well be compromised. For this reason many local ellipsoids have been developed which are based upon the global ellipsoid.

...we can define a best fitting ellipsoid which matches the Geoid to *better than two hundred metres everywhere on its* [Earth's] *surface.*[30]

Fig. 3.3 The Earth 'hanging in space' as first seen by the Apollo 10 astronauts. It is not the perfect sphere that it appears to be in the photograph.

As an example of a local ellipsoid, Britain has for a considerable period been utilising what is known as the *Airy 1830 ellipsoid*, which is designed to best-fit Britain exclusively.[31] More generally, the trend today however, is to utilise a system which best fits the whole Earth,

a geodetic system which is known as GRS80 which is based upon the network of navigation satellites that orbit the planet – the Global Positioning System [GPS]. [32]

The size of planet Earth is now understood to a high degree of accuracy due to the complex observations and calculations which commenced with the launch in 1957 of the first [official] Russian satellite *Sputnik 1*. This venture was closely followed by the launch of the American *Vanguard* satellite and the so-called space race began. International rivalry and military reconnaissance then played a great part in the early development of Earth observation from space. This had a beneficial side-effect in the field of geodesic study, as the instrumentation that was developed revolutionised the accuracy and scale of Earth measurement, or geodesy.

The results of work relating to Earth studies accomplished during the International Geophysical Year of 1957/1958 indicated that further research in the field was necessary and an additional ten years of satellite observations were then planned. This programme, involving numerous lines of research, culminated in the International Union of Geodesy and Geophysics adopting the Geodetic Reference System in 1967.[33] It was this research that gives the basis to our current knowledge of the Earth's dimensional properties. However, various sources, even now, in the 21st century, still give a variety of figures for the dimensions of the Earth that are at variance with each other. In this work, with regard to up to date measurements, we shall therefore refer to the primary source of Earth observation and measurement, the largest, and most well financed space research organisation in the world, the American National Aeronautics and Space Administration, or as we all know it, NASA.

NASA is a major contributor to the International Laser Ranging Service [ILRS] which collects, merges, archives and distributes Satellite Laser Ranging [SLR] and Lunar Laser Ranging [LLR] data. SLR and LLR are the main technologies employed in modern dimensional measurements of the Earth and Moon, and in the case of SLR are accurate to the millimetric level.[34]

As we have noted, the shape of our planet is not a perfect sphere, for example there is a dent towards the south of the Indian Ocean.

It may surprise us to find 'dents' in an ocean's surface, but nevertheless, this depression of up to 328 feet exists and results from anomalies in the geomagnetic field and variations in the thickness of the Earth's crust. It was discovered during the above satellite observations that took place between 1957 and 1967. Other such anomalies exist in other parts of the world, although the above is the largest.

In addition, the Earth does not have a static shape; it is continually changing and evolving, although thankfully for us, in a relatively minor way. Since 1998, NASA has discovered that the bulge at the equator of the Earth has been increasing, rather than continuing the expected contraction that would be expected due to *Post Glacial Rebound (PGR)*.[35] PGR is also called isostatic uplift, and is caused by the land slowly 'rebounding' from its compression from the ice sheets, which disappeared at the end of the last Ice Age. PGR at higher latitudes should result in a contraction at the equator, which had been happening up until 1998. Some other effect must be causing this measured equatorial expansion, and it is interesting to note in a polar context, that the magnetic poles are moving at an increasing rate from their relatively static positions of previous centuries. Possibly there is a connection here. NASA, as part of the

investigation, are currently exploring the theory that the equatorial expansion relates to changes in the relative salinity of the ocean in the region.[36] Isostatic uplift has been slowly raising the land level of many different regions around the world, which in some cases this has caused nearby areas to sink. The actual rate of change varies in different parts of the world according to the local geological and climatic conditions. For example, Scotland has been rising at about 2 mm a year while Scandinavia has a much higher rate, a rise of 1cm/year, due to a much greater isostatic bounce since the last Ice Age. West India is a region specifically at risk from the effects of land movement related to uplift as is seen in the companion book *Deluge*.

Other factors also play a role in affecting the Earth's shape. The Earth's continents are moving up to 10 cm a year relative to each other as a result of the well-known 'Continental Drift'. Even high-pressure weather systems play their part in changing the shape of the Earth, and can 'sink' inland regions as much as 5 mm. Tides can also affect this movement: for example, Britain 'sinks' a few centimetres every time the weight of the tide rises over the continental shelf.[37]

While all the above factors that affect the Earth's shape are interesting in themselves, we assert here that the above anomalies could not have been known, and therefore did not figure in the measurement of the Earth in the ancient past.

3.6 Michell's and NASA's Measurements of the Earth Compared

John Michell calculated that the anciently accepted *meridian* circumference of Earth was 24,883.2 miles. That the ancient figures relate to the meridian [or polar circumference] is a concept stemming from over two hundred years ago. [See earlier commentary regarding Isaac Newton.] It is necessary however, to make a comparison to modern interpretations because in this work that figure is taken to be the circumference of a *spherical* Earth.

Michell's and Neal's work indicate that the polar flattening was understood to exist from at least the time of pyramid building in Egypt. Indeed the records of Greek attempts to measure the Earth indicate a meridian sighting, which would be odd if they already understood that the measurement value with which they worked was of the meridian circumference. It is therefore argued here that the circumference measure was understood to be that of a spherical planet, and originally calculated via an erroneous but still reasonably accurate sighting and calculation. As will be seen later, this was conducted along a meridian line but at an equatorial region and the result was thought to be a measure of a *globe*. This possibly explains why the Greeks were trying to measure through the poles; it appears that they may have been aware that the Earth was not a perfect globe and were attempting to discover its true meridian circumference. Here then is a comparison to the Earth's dimensions as set out by NASA.

The polar or meridian circumference, according to NASA is 24,859.49307 miles, whilst the equatorial circumference is 24,900.9261 miles. The polar and equatorial diameters are 7899.86479 and 7,926.335202 miles respectively. Additionally, the NASA web site gives a *volumetric mean radius* of 6,371 km.[38] This value is defined as: - *The radius of a sphere with the same volume as the body.* By this definition the Earth's dimensions translate into a 41,804,461.94-feet or 7,917.511731 mile diameter and a 24873.59669 mile or 131,332,590.5 feet circumference for the *sphere*. This is the 'mean' circumference of Earth, as if it was

kneaded into a real sphere, and involves some very complex mathematics, and the same knowledge of its actual shape and dimensions as the NASA mathematicians, which it is assumed here *would not* have been available to our ancient ancestors. Of course, this negates the argument before it has begun.

To demonstrate how accurate the ancient measures of the Earth actually were, here is a comparison between the NASA figures for the circumference of Earth, both meridian and equatorial.

These values are compared with the circumference calculated by John Michell [and also utilised by John Neal] and seen by these researchers as the meridian circumference. Michell gives the Earth's circumference, as with most of his measures, in feet: 131,383,296 British feet.[39] Michell also uses a value of pi of 3.15 to change from his meridian circumference to polar diameter of 7899.428571 miles.

Table 3.1 Summary of NASA, the French interpretation for the new 'Metric' measures and Michell's Earth dimensions

	NASA	**Michell**	**French**
Polar circ. miles	24859.49307	24883.2	24854.92424
Polar circ. feet	131258123.4	131383296	131234000
Equat. circ. miles	24900.9261	24902.948	
Equat. circ. feet	131476889.8	131487560	
V.mean circ. miles	24873.59669		
V.mean circ. feet	131132590.5		
Polar diam miles	7899.86479	7899.428571	

As can be seen, the differences between Michell's value for the Earth's circumference and all the various NASA values is very small:
1) Michell v NASA polar or meridian circumference: 23.70693 mile
2) Michell v NASA equatorial circumference: 17.7261 miles
3) Michell v NASA volumetric mean circumference: 9.60331 miles
4) Michell v NASA polar diameter: 0.4362 of a mile

Michell's calculated circumference, seen by both himself and Neal as the meridian or polar circumference, is as evident, extremely close to both of NASA's figures of both polar and equatorial circumferences. It is within less than 24 miles of Nasa's value in one case and less than 18 miles in another, both in nearly 25,000 miles, and giving errors of less than 0.1 %. The *volumetric mean circumference,* as stated earlier, plays no part in any evaluation of Michell's circumference, as it is based on complex calculations which are based upon the other dimensions. However, here we run into problems because according to Michell, the equatorial radius was seen in ancient times to be related to the polar radius by a factor of 289 / 288. He claims that the 'ancients' were aware of the equatorial dimensions of the Earth and gives a value of 3963.4248 miles for the equatorial radius.[40] The diameter was multiplied by 22/7 to

find the circumference. The only evidence for this is a correlation of a single degree of his derived equatorial circumference measuring 365243.22 feet representing the count of days in a year. This is mere coincidence; his claim means that the people in the ancient world measured the equatorial circumference to an accuracy of within two miles of that of NASA. We do not think so. In fact the circumference that was in use, which was seen to be that of a globular Earth, when counted in Greek miles at 25920 and divided by 365.0704225 = 71 and this approximation was utilised in India for a specific purpose as we show clearly in our related work *Deluge.*

So, in analysing any measurement of the Earth made in the ancient past it seems that other historical researchers have arrived at the conclusion that the values must be related to one of two things – a polar measurement or an equatorial measurement. Again, Michell does not verify his assertions relating to the equatorial circumference and does not utilise measures which link or 'lock in' to his estimation, whilst all his units of length actually do relate to his interpretation of the meridian circumference or polar diameter. As the equinoctial sun rises and sets at the east / west line it seems clear that this would be important and measures would quite probably be derived from this, no heavenly body circles in a north south direction. The nearest that he comes to this is to give an estimation of the years solar length multiplied by 360 in terms of British feet. The closeness of Michell's dimensional estimate of the Earth's circumference, with which his measurement units correspond, to both of NASA's equivalent polar and equatorial values makes it impossible to deduce from the value itself whether or not it was calculated in a meridian or equatorial manner. As stated above, because Michell and Neal claim that there was some knowledge of polar flattening in the ancient past they assert, as have others before them, that the Earth was measured in a meridian direction.

However, there is no evidence that anybody surveyed the Polar Regions in the ancient past. In any event, it is argued here that it much easier to measure the value at the equator, without complex and laborious surveying and evaluation of the differences between each successive degree of latitude [all 90 of them!]. At the equator a simple method, which initially would have to be utilised to establish a standard, would be sufficient, merely requiring numerous repetitions of stellar observations, ground measures and calculations for confirmation of evaluation. It is this scenario that leads to the argument put forward in *Measurements of the Gods* that indeed, the Earth was first measured at the equator, albeit in a meridian direction. This assertion is examined in greater depth in later chapters where not only a method is discussed that is based upon astronomical observation, but also a location [to where the research has been led via archaeology and genetics] plus an approximate date that again stems from astronomy.

The Classical Greeks, as will be seen in the following chapter, were apparently attempting to measure the Earth in a north / south direction, i.e. a meridian measure. Yet as will be seen, they already had use of the value that Michell has calculated, that which had been in use for millennia.

The 175 / 176 and other factors, in use at the time of pyramid building in Egypt for changes in measure, are in themselves, according to Michell, Neal and others, indictors of variations in the degree lengths of latitude between 10 degrees north and 66 degrees north [or south] of the equator. But this is insufficient to calculate the meridian measure and so if

Michell's and Neal's assertions were correct, somebody, at least 4,500 years ago must have measured the length of degrees of latitude at varying points on the face of the globe. They had been to the equator from, let us say, Egypt, for this purpose and people from this region had also moved north toward the pole for the same purpose. Where, we ask, is the evidence for these excursions? There are no written records and no archaeological indications whatever.

But if this knowledge was available prior to the Greeks, who utilised the derived measures, and gave, in their calculations, the same circumference as was previously in use, why were they reportedly attempting to measure along the meridian line? Why did the Greeks attempt repeatedly to re-measure what was well understood?

The answer of course is that this specific measurement was accepted as that of a *spherical Earth*, *as some of the Greek commentators described*. Hence, in summary, it is asserted at this point that:

In the ancient past the measurement system was directly linked to a specific circumference of what was taken to be a spherical Earth, 24,883.2 British miles. This was originally derived from measures and calculations made at the equator in a meridian direction and it is associated with another precise value, that of a diameter of 7,920 miles, via an explicit value of π: 3.14181818r.

The methodologies by which these values were obtained are revealed later in this book.

3.7 Measuring Systems in the United States

Before we begin to look in greater depth at the measurement system in use in antiquity, for completeness, we will briefly examine the history of what is the somewhat strange situation regarding measurement units in the United States.

Since colonialists brought with them the measuring methods of their homeland, confusing and contradictory measuring systems came to America. For example, the Imperial gallon used in England did not go to America and the U.S. gallon is actually smaller than the Imperial gallon. The British called the U.S. gallon the *Queen Anne* wine gallon and today, this difference in size between the Imperial gallon and the U.S. gallon causes confusion when converting to the metric system.

The law of 1792, under the new Constitution of the United States, provided for fractional coinage and for the decimal system, whose adoption for coins showed that the American leaders recognised its advantages. In 1795, France tried to convince the United States to use the metric system, but Congress did nothing at the time. Some years later, in 1821, John Quincy Adams wrote a comprehensive report for Congress based on a four-year investigation into the subject. His report dealt with the metric question and the modernisation of the U.S. measurement system and in it he said:

'Weights and Measures may be ranked among the necessaries of life to every individual of human society. They enter into the economical arrangements and daily concerns of every family. They are necessary to every occupation of human industry; to the distribution and security of every species of property; to every transaction of trade and commerce; to the

labours of the husbandman; to the ingenuity of the artificer; to the studies of the philosopher; to the researches of the antiquarian; to the navigation of the mariner; and the marches of the soldier; to all the exchanges of peace, and all the operations of war. The knowledge of them, as in established use, is among the first elements of education, and is often learned by those who learn nothing else, not even to read and write. This knowledge is riveted in the memory by the habitual application of it to the employments of men throughout life.' [41]

This Quincy Adams' report was the first proper U.S. metric study. Although three decades earlier, Thomas Jefferson also had written a report for the Congress on the need for modernisation of weights and measures, the metric system was no more than a concept at that time. Consequently, his report was considered only an alternative idea and was not entertained seriously by the newly founded United States of America. In spite of repeated requests in Congress, there was no legal length standard in the U.S. until 1832. Up until then, more or less authentic copies of the British yard were used as length prototypes. However, in that year, the Treasury Department decided to admit as a legal yard the distance between the lines 27 and 63 of a certain bronze bar, 82 inches in length, bought in 1813 in England for the Federal Survey Department. When the British yard bar, which was destroyed in 1834, was replaced in 1855, a new bronze copy No. 11 was sent to the United States, which became the legal American Yard Standard.

Even though progress was slow, there was gradually an improvement in establishment of the metric standards, which virtually the entire world at the time recognised. Like the United Kingdom, the Americans found it necessary to define their customary measurements in terms of international metric standards and U.S. units of length, mass and volume were now all stated in terms of them. In 1863, the United States was represented at two important international congresses convened to consider matters of weights and measure. The International statistical Congress in Berlin declared that uniformity in weights and measures was 'of the highest importance', particularly for international commerce. Recommendations made by the Postal Congress held at Paris resulted in the adoption of the metric system for the international postal service. Congress then passed a Bill in 1866, which permitted use of the metric system of measurement in the United States. The value for the metre was given as: 1 metre = 39.37inches or 1 yard = 0.914401829metres. The metric prototype chosen was a metal bar known as the *Committee Meter* because it had been guaranteed to conform to the *Metre des Archives* by the French Committee in 1799. In 1873, metric weights were extended to silver coins. The weight of the half-dollar is 12.5 grams; the quarter 6.25 grams; the nickel is 5 grams and the dime is 2.5 grams.

In 1875, the United States entered into a treaty with 17 other countries establishing the International Bureau of Weights and Measures and in 1890, the country received two of the International Prototype metres and two of the kilogram artefacts. One of each of these standards was adopted as the National Prototype Metre and Kilogram and as the primary standards for the United States. As such they became the fundamental standards for determining the yard and the pound. In 1896, and again in 1901, bills were introduced recommending the adoption of the metric system for all weights and measures in the United States, but for one reason or another the bills failed to pass. In the following decades, many

bills were introduced which recommended establishing the metric system as the legal standard of the United States, however, very little action was taken.

In 1968, Congress asked for a three-year, sweeping investigation of the metric question because it determined that the world trend toward metric units called for a new assessment. The new investigation involved public hearings, supplemented by surveys on international trade, business and industry, education, national security -- almost every activity in American society -- and in 1971, the final report titled *A Metric America -- A Decision Whose Time Has Come* was released.

This study consisted of a comprehensive report plus twelve sub-study reports covering all aspects of the enquiry. Finally, in 1975, Congress passed the Metric Conversion Act, where the major provisions of the bill provided for the adaptation of SI as predominant system of measurement units. However, no specific timetable was mandated and participation was voluntary. A 'Metric Board' was subsequently disbanded in 1982 and responsibility passed to the U.S. Treasury Department's Bureau of Alcohol, Tobacco and Firearms. Since that time, the U.S. has slowly headed towards metrication in fits and starts. A timeline of events from that date from the U.S. Metric Association can be found by using the notes to this chapter. This organisation describes itself as:

'The U.S. Metric Association (USMA), Inc., with headquarters in Northridge CA, is a national non-profit organization, founded in 1916. It advocates U.S. conversion to the International System of Units which is known by the abbreviation SI (ess-eye). SI is also called the modern metric system. The process of changing measurement units to the metric system (SI) is called metric transition or metrication.' [42]

Like its sister organisation in the United Kingdom – the U.K. Metric Association, the USMA[43] is very active in trying to keep up the pace of metrication and it is quite possible in the next decade that two of the last four nations in the world that have not adopted metrication fully [the others are Liberia and Burma] will have done so.

As a footnote here, NASA had recent cause to rue the lack of U.S. standardisation. NASA lost a $125 million Mars orbiter because one engineering team used metric units while another used 'English' units for a key spacecraft operation. For that reason, information failed to transfer between the *Mars Climate Orbiter* spacecraft team at Lockheed Martin [its builders] in Colorado and the mission navigation team in California. This navigation mishap pushed the spacecraft dangerously close to the planet's atmosphere where it presumably burned and broke into pieces, killing the mission on a day when engineers had expected to celebrate the craft's entry into Mars' orbit - the 23rd of September 1999.[44]

It is of note that the International Space Station still uses both Imperial and metric units.

However, probably mindful of possible future standardisation problems, it was reported on space technology website *www.space.com* in January 2007 that NASA has now decided that all technology for its new *Constellation* space programme for Moon and Mars manned exploration will exclusively use the metric system.

The quote marks around the term ‘English’ units above are deliberate as these units are not English in source at all. The Imperial system actually has its roots in a connected hierarchy of measurement units that go back into remotest antiquity, as we begin to reveal in the next chapter when we turn to an examination of measurement in the Classical World.

CHAPTER 4

Earth Measurement in the Classical World

Where wast thou when I laid the foundations of the earth? declare if thou hast understanding. Who hast laid the measures thereof, if thou knowest? or who hath stretched the line upon it?
Job 38: 4

4.1 The Spherical Earth

Fig 4.1 Symbol of Classical Greece: The Parthenon pictured circa 1869

Written records indicate that the Classical Greeks were the first ancient civilisation to show an interest in measuring the Earth's dimensions. Academic opinion, nonetheless, is that the Earth's circumference defined by later Classical Greek researchers was inaccurate, with the error value being usually quoted at 4.5%. Some even quote this figure as being much higher. This idea is mistaken – the results that they supposedly achieved were within 0.1% of modern values, possibly for the opposite reason – they did not use the measurement techniques that are historically documented.

It is generally also believed that the Greeks of the Classical world considered the Earth to be spherical. Michell has added a dimension to the globe that was the Greek Earth, a circumference of 25,920 long Greek miles or 24,883.2 British miles.

He also, however, believes he has detected knowledge of polar flattening in Old Kingdom Egypt, [which predates the Classical Greek period by some 2,000 years] and that it was well known from the Classical period [which most historians identify as circa 500 BC to 50BC]. But as previously noted, it is argued in this work that the said value represented what

was thought to be a spherical Earth *and this value was initially measured at the equator*. Similarly, a value for the planet's diameter of 7,920 miles was seen in this ancient world as *the* diameter of the Earth.

The concept of an Earth which had flattened poles was not understood, neither by the Egyptians nor the Greeks. If it were, why should the Greeks calculate the distance of one or two degrees and then multiply the distance to obtain a complete 360 degrees when any flattening would clearly obviate this concept simply because the degree length would alter with latitude change. That they attempted to measure the Earth in a meridian direction is on record but what has not previously been understood is the various stadia values applied to the circumference. When these are understood it is abundantly clear that all were recording the same measurement in different formats. In other words the circumference of Earth was already known and no new attempts were made to *improve upon the accuracy* of the applied value. Much of this history appears to be fabrication because, as we shall see, the practical application of the methodology is in serious doubt.

4.2 A Minute of Latitude and the Nautical Mile

Michell states that the various sets of units, for example Egyptian, Greek or Roman, had what he termed both 'long' and 'short' values and that these were differentiated by the factor 175/176 or vice versa[1]. The non-spherical shape of Earth is the reason for this difference as it affects the length of a given measure of latitude. The measure that is used in navigation is a minute of latitude, which is also defined as the *nautical mile* and has an average length, defined according to one source in modern times, as 6,082.66 feet[2].

This average value of the minute of latitude is to be found at 50 degrees latitude, while obviously, it would be the same at any latitude if the Earth were globular.

At about 10 degrees from the equator the degree length along the line of the meridian or polar circumference changes, as Michell explains:

...'the average nautical mile, or minute of latitude at 50 degrees, is therefore too long to represent a minute of latitude in regions nearer the equator. For those regions navigators used a shorter nautical mile, relating to the longer version as 175 to 176, and thus measured 6,048 feet, which is the length of a minute of latitude at 10 degrees according to modern tables' [3]...

When the above was ascertained cannot be known with any certainty. However, unit values related to this 175/176 factor were utilised in the design of ancient structures such as the Great Pyramid of Giza in Egypt, which *imply* that the concept of polar flattening, or at least the variation in degree length was understood when it was built, around 2500BC. Neal has taken this reasoning much further and has extended the fractional changes to encompass the alterations in the Earth's curvature as far as the 66-degree mark by the use of calculated factors[4].

These additional values also, according to Neal's research, appear to have been utilised in the ancient world, implying that the curvature of the Earth was understood to a greater extent than even Michell asserts. Whilst this may be the case, the *extremities* of the Earth were not

measured and therefore the complete circumference measure that was in use must be derived from elsewhere.

According to the Dent Dictionary of Measure the value used today for the nautical mile is 6,082.66feet. This is, according to the erroneous description found in that volume, the 'distance corresponding to a minute of longitude at the equator'. By referencing back to the comparison chart of Earth measures in Chapter 3 it will be seen that this does not comply with any equatorial measure [minute of arc = $^{1}/_{21600}$ of circumference]. However, the Earth circumference that Michell portrays was seen, according the arguments in this work as the commonly accepted circumference of a globular Earth and a single minute of Michell's value is 6082.56feet, a difference of 1.2 inches per minute of arc or 2160 feet in the nearly 25,000 miles of Earth circumference to that quoted in the Dent Dictionary of Measure. Of course, this value from Dent cannot be correct as described, as the equator, around which longitudinal measures are taken, has a circumference of 131,476,889.8 feet, which then gives a result for a minute of arc of 6086.893046 feet. In any case, the nautical mile is assessed in a meridian direction and NOT around the equatorial longitude.

So from where did Dent obtain this information? Both the direction [which is probably a typographical error] and the distance [which does not comply with modern measurement value] are incorrect.

It is ironic, however, that the dimension fits almost exactly what is argued in this work as the original conception of the measurement value, that which was applied to a spherical Earth.

For the sake of this argument it is irrespective which direction the measure is taken in, longitudinally or through the poles; the fact is, that while such a value has not apparently been historically attested, the metrological units, which are derived from it, *are* very well attested and have been in continual use for millennia. The associated Earth diameter of 7,920 miles can be found represented in numerous places as will be seen later. In fact, the small degree of difference between Michell's value and that of Dent is ignored because in the latter the value is also listed at 1.152 miles, which is exactly 6082.56 feet. Evidently the description in Dent was an error that should have been corrected.

Certainly, the overall circumference derived from this value of the nautical mile [1.152 British miles] applies neither to the equator nor to the meridian circumference. But it most definitely does apply to the circumference utilised for a globular Earth in antiquity, in fact until the onset of metrication, as evidenced in the correspondences with the ancient units of measurement. It is therefore seen to be valid in this work. It applies to the Earth when seen as having a diameter of 7,920 miles and a circumference of 24,883.2 miles with the value for π, as noted in Chapter 3, being one that has been in use for millennia, 3.1418181818.

It additionally applies to charts created in mediaeval times in Europe as will be seen later in this and the following chapters. A later chapter will reveal the use of the ancient metrological units in mediaeval buildings even landscape setting out and hence as documented in the history of the development of the metre, a profusion of measurement units were in use up to that period. It would appear therefore, that the value utilised by Michell and seen in Dent was that of this pre-metric era.

The modern definition of the nautical mile is a minute of arc of latitude, not as Dent somewhat surprisingly relates, a minute of longitude.

A minute of arc of the polar circumference according to the dimensions from NASA is 6076.764972 feet.

This is 1.150902457 miles giving a difference in circumference to Michell's value of 23.7 miles. In reality this value is within 0.22 of a mile to the 6080 feet of the *Admiralty mile* [see below]. What should be taken into account here however is that the NASA figures are based upon the results of satellite surveys not available before 1957, and which have been continually updated since. Additionally the Earth has numerous lumps and hollows and not only is flattened at the poles but is pear shaped, and deformities are seen on the equatorial circumference as well as the meridian line. Hence whatever measure is ultimately applied it has to be a compromise (as seen in the NASA use of π between equatorial diameter and circumference) as a different latitude or longitude measure will arise at every degree point around the circumference. Nonetheless, according to numerous sources the definitive measure in use today for the minute of arc is 6076.11549 feet. This expands the difference to Michell's value to over 26 miles.

Here Russ Rowlett from the University of North Carolina comments on the figures in use and their recent history: -

... The nautical mile is defined to be the average distance on the Earth's surface represented by one minute of latitude...for many years the British set the nautical mile at 6080 feet (1853.18 metres), exactly 800 feet longer than a statute mile; this unit was called the ***Admiralty mile****. Until 1954, the* ***U.S. nautical mile*** *was equal to 6080.20 feet (1853.24 metres). In 1929, an international conference in Monaco redefined the nautical mile to be exactly 1852 metres or 6076.11549 feet, a distance known as the* ***international nautical mile.*** *The international nautical mile equals about 1.1508 statute miles. There are usually 3 nautical miles in a league. The unit is designed to equal 1/60 degree, although actual degrees of latitude vary from about 59.7 to 60.3 nautical miles.*[5]

A plethora of values of the dimensions of Earth have been recorded since the mid-18th century. These are all in quite close agreement to each other in terms of the different equatorial and polar measurement values. None, however, is close to Michell's value for the meridian measure although as seen in the previous chapter by some quirk of mathematical coincidence he has calculated the equator within 2 miles of NASA's version. The volumetric mean value from NASA is the next closest to Michell's meridian measure at 9.6 miles difference. Other modern interpretations are similar, e.g. data from the astronomical constants for Jan.1st 2000 [International Astronomical Union] gives a difference to Michell's 'meridian circumference' for the volumetric mean of 9.7 miles while the other differences, e.g. equatorial and meridian are virtually identical to those from NASA.

Looking again at the values seen in the extract above where the nautical mile was defined as 6080 feet, this would give a difference of 10.47 miles, which is very close to the volumetric mean values already seen. If an average is taken of the equatorial and polar

circumferences from NASA then the difference to the 'meridian circumference' from Michell is a mere 2.99 miles.

Hence it is clearly apparent that Michell's Earth circumference, that which he terms as the 'meridian', is based upon the values from ancient metrology, values which when applied to what is a very close approximation of the modern accepted mean circumference of Earth, correspond to a very close degree. This would seem to reinforce the argument regarding the value put forward in this work that the ancient value was *not that of the meridian circumference* but a value computed in the distant past at the only other logical location for such an exercise, the equator. Given that the Sun, Moon and stars rise in the East and set in the West, the initial divisions of that measurement value, were based upon periods of time denoted by the movements of the aforesaid 'lights in the sky'. However, while in the past the Earth was thought to be a globe, as we shall later reveal, the initial measure was indeed in a meridian direction.

Neal claims that at locations which are multiples of $1/7^{th}$ of the 'meridian quadrant' such as Karnak at 2/7ths, Delphi at 3/7ths and Avebury at 4/7ths, we find colossal ancient monuments. According to Neal this confirms the abilities of the old *geomancers* as they are sometimes termed. The examples of locations that fit to the 1/7 of the meridian measurement are, however, obviously limited. They are limited because there are only so many places where a seventh of the meridian measure, which is 12.85714285 degrees, could be. The measurement value, utilising the anciently accepted circumference measure is 888.6857143 British miles. But what about Giza and the Great Pyramid? This does not fit the pattern and is conveniently not mentioned in this context. Why should Avebury be more important than Stonehenge? Stonehenge is an accurate piece of work with smoothly carved lintels forming a perfect circle and it is constructed in a very precise manner [as shall be seen later]. This cannot be said of Avebury, as large as it is.

Then there is the additional matter of Stonehenge being 15 minutes of arc south of the correct latitude, a distance of some 17.28 miles. This obviates the application of the theory. One can extend this type of argument until it is blatantly obvious that Neal's theory, [and the majority of those of others that relate to similar long distance setting out over hundreds of miles, sometimes involving geometrical shapes] simply do not stand up to scrutiny.

At the time of the Classical Greek geographers, however, things were more than a little different than today, there was a single accepted Earth circumference [25,920 *long* 'Greek' miles] along with a diameter [8,250 *long* Greek or 7,920 'British' miles]. They did not have the ability to measure the meridian circumference and yet the records apparently indicate that this was attempted. It is therefore odd to find that while [according to Michell, Neal and others] the deviations in the length of degree of latitude were understood from the pyramid building epoch onwards, it is found that Pythagoras is credited with envisaging a *spherical* Earth. This statement also applies to Aristotle and numerous others such as Aristarchus, Eratosthenes and Ptolemy. This would appear to be a 'throwback' to the concept of the formerly accepted circumference, the same distance, but understood to be that of a spherical Earth. A closer examination of what is known of the history of Classical Greek Earth measurement and these attempts at measuring the *globe's* circumference is seen a little later.

4.3 Greek and Roman Dimension Sets

Foot values

At this point, it is useful for the reader to briefly look again at the tables in Chapter 2 [Sections 2.8], which illustrate the relationship between the different units of measurement we see in the ancient world. As we can see, some of these generic units such as the foot and inch persist into the more recent Imperial system. However, it is noted here that in general, the units that persist are those from the British set from Table 2.2. In Table 2.3 we see the same dimensional units as the first one, but the basic unit of length, which is asserted by Michell, Neal and ourselves to be the *foot*, is different – the *Long Egyptian* foot is 1.152 times bigger than the British one.

Here it should be noted that we are utilising British feet as a base value and that effectively the names given to these units do not imply there source in those regions-the Greek and roman measures were in use long before these regions became viable nations. The factor of 1.152 we term throughout *Measurements of the Gods* as the *foot value* of the foot in question – in this case that which is termed the *long Egyptian* which relates to its cousin the *short Egyptian* by the factor 176/175. This two version effect is also seen in the Roman units and in theory could be applied to a number of other measures. For example the British mile of 5280 feet reduced via 176/175 results in a mile of 5250 feet with a foot value of 1.05 British feet. This leads to a neat example of how a complex value can be seen to emerge in a clean simplistic count. Note also emergence of 1.05 feet in Table 4.2

In the circumference of Earth a value of 3.475748571 feet which Michell has calculated as the target width for the lintels of Stonehenge can be counted 37800000 times where 72 x 52500 = 37800000. Incidentally, it was this value of 3.475748571 feet that Hugh Harlston Junior discovered to be widely utilised in the structures of the Maya in Mexico, dating to long before any European settlement of the American continent. Hugh Harlston Junior had no knowledge of the work of Michell, Neal or others in this field of ancient metrology but recorded his evaluation of what he discovered to be a value repeatedly found. The accuracy was extremely close; the value evaluated in Mexico [termed Hunab after the Mayan word for measure] was 3.475742454 feet. Utilising this measure, counts in the canonical series widely seen in the ancient world of 108, 216, 432, 864 etc soon became apparent.

The circumference of Earth [using as we do throughout this work, the value designated by Michell] has a count in British feet of 131383296; utilising the foot value derived from Michell's adaptation of the Hunab by terming the Hunab of 3.475748571 feet a step of 2.5 feet, this number representing the circumference of Earth is greatly simplified to 94500000. It will later be seen that the Hunab, discovered in Mexico, is directly related to a value utilised by the Greek Eratosthenes.

Terminology

The British foot as we all know is still in use by some, [admittedly few] but for our purposes here it is merely a *convenient title*, as it is the root of a dimensional system that goes

far back into prehistory, as we shall later understand. Similarly, Egyptian, Greek and Roman units were used in the construction of buildings but again, *they are just names utilised by Michell that help to differentiate the different sets of units.* As noted earlier, Michell identifies several of these *dimension sets*. Neal considerably expands the number of sets and demonstrates their connections in tabular form. He notes that the British foot is the root unit with all others connected by specific factors. However, as revealed both in this work and in *Deluge* in some cases the relationship is more complex – for example, the foot value is sometimes a multiple of foot value *a* multiplied by foot value *b*; for example, 1.152 x 0.968 = 1.115136, where 1056 x 1056 = 1115136. The value 0.968 will be seen later in the work and is a valid foot measure and 1056 is a very important numerical value in the context of ancient measurements. This type of factor multiplication [sometimes by itself] can occasionally be seen in the dimensions of cathedrals and temples. This can complicate the numerical evaluation of such structures although some examples of such evaluations are seen in a later chapter.

Greek Measurements

Whilst the British foot is the root of the system of *dimension sets* in what we term the measurement system of antiquity, it is not the root of the relationship between the system and Michell's circumference of the Earth. This root is *the long Greek* foot, as 100 long Greek feet are equivalent to 1 second of arc of Michell's Earth circumference. One *long Greek* foot is 1.01376 British feet, with 6000 long Greek feet then being equal to 1 minute of arc, or 6082.56 feet as seen earlier. We shall demonstrate this relationship later in this chapter. There is also a *short Greek* foot and here using the same factors for change, we divide 1.01376 by 176 and multiply by 175 for a result of 1.008 feet. We must again reiterate, however, that the names given to these values are taken from Michell and do not indicate the development of, or use of, particular measures in specific locations.

Another question is why was the *long Greek* mile created? Another way of looking at the base of the measurement system could be taken from the *long Greek* mile or the *long Roman* mile. Both relate to periods of time and they interrelate via the factor 24/25 and vice versa or indeed, 0.96. The so-called *long Roman* mile divides into the anciently accepted Earth circumference 27000 times emulating the count of days in the sidereal month. The *long Greek* mile similarly has a count of 25920, which indicates knowledge of the period we term the *precessional cycle*. However, it is not necessary to have records stemming back 25920 years to calculate this approximation because it can be taken from the 2160 years [again an approximation] of the duration of a single zodiacal constellation. In fact in just 36 years half a degree of stellar movement in terms of time of the visual backward movement of a star in its rise [when one observes a star adjacent to the line of the ecliptic] can be observed and as this represents the apparent diameter of the moon, it is not difficult to imagine note being taken of a difference at the night horizon. However, care must be taken as not all stars are so obliging in their movements with some sliding north or south…as well as moving backwards. The precessional period could therefore have been relatively easily calculated. There are so many numerical references to this value in antiquity that coincidence is ruled out and ancient Indic

texts relate that the apparent movements of the constellations in relation to that of the Sun and Moon were well understood long before the narrative was recorded in writing.

Why then is the *long Greek* foot [or mile] not the root of the dimensional systems used in antiquity? At 1.01376 feet, it is 24/25 of 1 *Northern* or *German* foot [1.056 British feet] that we saw in Chapter 3, and we noted the factor *1056* in the relationship between that foot and the British foot. We also said that it is one of the key factors in the measurement system of the ancient world and it also has important links to the numeric aspects of myth and religion.

We now believe that the probable reasons for the British foot, rather than the Greek foot, being the root of the system do not relate to the initial measurement of the Earth's dimensions but rather to a *secondary determination*. These reasons [explained in a later chapter] also answer the conundrum in Chapter 2, where we note that the British mile contain 5280feet, whereas all the other 'miles' have only 5000feet. We shall also see that the factor *1056* is implicated in this discussion.

Roman Measurements

Numerous archaeologists have put different values to the Roman foot, all quite close to each other, but mutually inconsistent.

One of the first researchers into Roman measurement units was John Greaves [mentioned in relation to Newton in Chapter 3] as Michell describes:

'In 1639 John Greaves, professor of astronomy and geometry at Oxford University, travelled to Rome in order to discover, from careful measurements of ancient monuments, the values of the two versions of the Roman foot...' [6]

However, Greaves had some problems in defining the Roman foot, as Neal recounts:

'The foot [Author's note: long version] *is sculpted onto the side of a memorial to one Statilus Aper, a young architect who died at the age of 23. Greaves remarked that he spent above two hours on that measurement: 'so often comparing the several divisions and digits of it with one and other; that I think more circumspection could not have been used'.*

He found that it contained 1944 parts as against the English 2000. At 0.972 feet, this indeed very close to the intended measure, but to attempt to base a standard upon a single example where the cutting edge of a mason's chisel guided by eye is the only criterion of accuracy is preposterous. Another standard is inscribed upon the monument with a published length of 96 millimetres, of which Greaves makes no mention at all. It has come to pass that this Roman foot has, through being constantly repeated, attained an almost Biblical veracity, and has entered the textbooks as the Statilian foot, or pes Statilianus. Another researcher, Matthew Raper, who made an in depth study of Roman buildings about a hundred year after Greaves, remarked in an article in the The Philosophical Transactions, in 1760, that he had found Greaves value to be two parts in a thousand short of the proper standard. Raper's value is then in closest

agreement with the 0.9732096 feet that will be shown to be the correct length of this particular variant.' [7]

We would have thought that Neal would have had some comment regarding the obvious fact that [according to Neal] Greaves, in 1639 already had knowledge that there were two different although related units of measure in Rome termed the 'foot', however, he singularly fails to elucidate further in this matter.

Be that as it may, as Michell states, there is a clear connection between the so-called Greek and Roman sets of dimensions and this is by the factor 24/25, Roman/Greek. We are on fairly safe ground here as many historians talk of the Roman stade being 600 feet, as against the Greek one being 625feet.

For example, *The Dent Dictionary of Measure* claims that the *stadion* was a unit of 600 feet in Greece [608.256 British feet] and 625 feet in Rome [608.256 British feet].[8] The British equivalents here are correct making the Roman foot 0.96 Greek feet of 1.01376 British feet, and in this case the long Roman foot measures 0.9732096 British feet [as stated by Neal above]. The s*hort Roman* foot is again 175/176 of the long variety, which gives us 0.96768 British feet.

It is ironic that at 0.972 feet there is actually a valid unit of measurement, which whether being the accepted 'Roman' foot or otherwise, certainly would have been in use. 9.72 feet as a *reed value* gives a *foot value* of 1.08feet and a cubit of 1.62 feet. As mentioned earlier, transposition of factors amongst various units of the dimension set is common throughout the measurement system used in the ancient world. This is a good example of the connectivity seen above. In this specific case 0.972 feet is 11.664 ins. and 108 x 108 = 11664.

Tables 4.1 and 4.2 summarise some of the information discussed in this section.

Table 4.1 The basic relationships between large units

British Mile	=	5,280 British Feet
Greek Mile[long]	=	5068.8 British Feet
Roman Mile[long]	=	4866.048 British Feet
Greek 600 foot Stadion	=	608.256 British Feet
Roman 625 foot Stadion	=	608.256 British Feet

Note: 6082.56 feet = one minute of arc [1/21600] of Earth circumference as denoted by Michell and seen consistently in the ancient world.

Table 4.2 Relationships between foot values [in British feet]

Dimension set	Short Foot Value	Long Foot Value
Roman	0.96768 feet	0.9732096 feet
Greek	1.008 feet.	1.01376 feet
Northern	1.05 feet	1.056 feet
Sumerian/Saxon	Not applicable	1.1 feet
British	Not applicable	1 foot

The stadion value seen above in Table 4.1 is 1/10 of a minute of arc of Michell's Earth circumference, whose expression as an angular measure is one of the roots of the measurement system used in the ancient world.

4.4 The Stade

The stade or stadion or stadia [usually shortened to stade] is a historic unit of distance originating in the so called *Archaic* period of ancient Greece and relates to an important feature of what we normally view as Classical culture – the Greek athletic field, and it is from this we get the modern word *stadium*. The most famous of these stadiums was the one at *Olympia*, and it was here that the ancient *Olympic Games* were held, hence their name. A religious shrine was built as part of the stadium construction, and its use became part of the festival.

The first of the four-yearly Olympiads started at Olympia in 776 BC, but until 724 BC the only event held was the stadium-length foot race [called a stade]. [Why four yearly intervals we do not know]. After this period the four-yearly Olympiads included longer races such as the 2 stade and the *dolichos* which was 24 stadia or 2.88 long Greek miles [3 Roman] in length. In 680BC, chariot racing was included in the programme of events and the Games then continued for hundreds of years in much the same manner, until the Roman take-over of Greece in the 1st century BC. At the time of Nero, the Romans spiced things up a bit by replacing the athletes with slaves, and their competitors by wild animals, turning the event into a bit of a farce, but nonetheless they continued until they were abolished in 393 AD [the 293rd Olympiad] by order of the Roman Emperor Theodosios I who in 391 AD had forbidden all idol worshipping sanctuaries.

As we all know, the modern Olympics are held in the same quadrennial manner as those in ancient Greece, and have many similar events, and even very similar distances, highlighting a connection relating to measurements between the ancient and modern world. The athletics elements of the modern Olympics are held at venues of similar, but not the same, size. It was possibly the same in ancient Greece – local stadia were all of roughly the same size, but with a constant race length [here we say possibly because we have not been able to substantiate this for certain]. In this event, the value of the stade or stadion then [possibly] related to the *length of the field* and varied from venue to venue.

Archaeological measurements show that the stade was roughly 200 yards in length. For example, according to Russ Rowlett at the University of North Carolina, the stade at Olympus, where the original Olympic Games were held, measures 630.8 feet.[9] It appears that this stade is actually supposed to be 630.6398208 feet, as this is equivalent to 648 *long Roman* feet, [600 x 1.08] which is also effectively a double stade of 324 Roman feet, a configuration we shall meet again later in this chapter. However, it may be that the 600 count was maintained and the suggested long Roman foot was increased by the factor 1.08 as a specific value for the purpose of racing.

Fig. 4.2 The Palaestra, Olympia, Greece: Training building for competition athletes (3rd century BC)

Stades were usually 500 feet or 600 feet in length, but according to many sources the foot value varied from city to city, so a stade could be for example 525 feet or 630 feet in length with the foot value being 1.05 feet or more likely 608.256 which is 600 *long Greek* feet or for the short version of 1.008 British feet per foot, 604.8. Add the two versions of the Roman foot and there immediately are four different but intimately related values. However, we should note that as there were a variety of foot values in use across a wide area and as most of these were numerically interrelated, it does not necessarily follow that different cities did use different measurement units [a mistake made by Neal]. It is the misinterpretation of the dimensional aspects of ancient artefacts and structural remains that have implied this often repeated assertion.

To complicate the issue of the stades even further, some were actually *double – stades* so the stade itself would be half the 500 or 600 'foot' value. The stade recorded by Aristotle was probably one of these 'half double stades' as it has been calculated here to being 324 *long 'Greek'* feet or half of 648 l*ong Greek* feet [see below]. It is recorded that Aristotle estimated there to be at 400,000 stades to the Earth's circumference whereas if the double stade was utilised the figure would be 200,000 stades.

Note that the foot value for this 300-foot stade would be 324/300 or 1.08 Greek feet of 1.01376 British feet, in other words a unit of 1.0948608 British feet. This is equivalent to 13.1383296 inches whereas Michell's circumference of the Earth, to which it relates, is 131,383,296 British feet. It is apparent that here we are looking at a contrived calculation relating to the multiple of 400,000 x 300, or more likely, a foot value that is 1/120,000,000 of Michell's correct evaluation of the anciently accepted circumference of the Earth.

Calculating Stade Values

The precise value of the stade measures used by the Greeks in relation to Earth measurement has taxed many researchers into the history of mathematics and measurement. It is a pity that few in academia read the works of those outside institutions because they miss a great deal. If the work of Michell and those before him such as Stechini had been consulted in the past then there would be little scope for this research, as it would have been accomplished long ago. However, that has not been the case and hence the anciently accepted circumference of Earth, as seen by Michell and more recently, Neal, is utilised for all the calculations in this work…*with positive and checkable results.*

On the surface, calculating these stade values does appear to be a mathematical nightmare: we have a foot that can vary in value (f); a stade value that can vary in value (s); and we do not know the value of the number of stades (n) in the Earth's circumference (c). This gives an equation something like this: $c = n \times f \times s$ British feet, where all are variables!

In practice though, the calculations are not as difficult as they appear. Other researchers have not used Michell's circumference as a target measure.

Here we will use it in that manner and find out the unknown stade values by something mathematicians call proof by induction, in other words finding out the unknown in an equation by working back from the answer. It shall then be found that the calculated stade value has a cross-relationship to another aspect of the measurement system used. The foot value is usually a known value, such as the long Greek foot, or itself has a close tie-in with another aspect of the system. To find out n we need to accurately study the historical records, something we note below that many researchers have failed to do, although in mitigation much of the available information about this period is often contradictory and/or incomplete.

Now that we have a method to determine the stade values supposedly used by the Greeks in their evaluations of the Earth's circumference, we can look at some specific examples in Greek history, starting from the earliest known.

4.5 Early Ancient Greek Scientists and Earth Measurement

As stated earlier, it is impossible in the historical past to completely distil Earth measurement from the related sciences of mathematics, astronomy and cartography, as many early scientists were polymaths. So, in the early days of Ancient Greece, in the so-called Archaic Period [800-500BC] we shall more generally review the contributions made by some key individuals to these sciences.

Homer (8th century BC)

Strictly speaking, Homer is known more as a poet than a scientist, as we discuss later when we look at the Greek *Dark Age*. However, he is also noted for his worldview of the time, encapsulated in the form of maps, and for the fairly recently discovered ideas about astronomy that are contained within some of his texts. Some of these *Homeric* ideas are discussed in the next chapter.

Anaximander (611 – 545 BC)

The history of written ancient Greek philosophy starts with Anaximander of Miletus, in Asia Minor. He was the first to write a treatise in prose, which was known as *On Nature*.

This book has been lost, although it probably was available in the library of the *Lyceum* at the times of Aristotle and his successor Theophrastus. It is from them that we derive the sparse details of Anaximander's life. He is best known as the first speculative astronomer and was the first to introduce the concept of the Earth hanging in space, an 'Island Earth' something not seen by mankind until the NASA Apollo 10 mission some 2,500 years later [as pictured in Figure 3.3 in the previous chapter].

Anaximander is also thought to have produced the first world map [albeit very similar to Homer's earlier conceptual maps] and also was the first to suggest that mankind had evolved from the sea. Whatever his brilliance in theoretical science, however, he is not thought to have actually done much practical observations, and we have no record of him doing any experimental work regarding the dimensions of the Earth.[10]

Thales (624 – 547BC)

Thales is famous as the first known Greek philosopher, scientist and mathematician although his occupation was that of an engineer. He is believed to have been the teacher of Anaximander above, but none of his writing survives so it is difficult to determine his views, or to be certain about his mathematical discoveries. Indeed it is unclear whether he wrote any works at all, and if he did, they were certainly lost by the time of Aristotle [see below]. There are claims that he wrote a book on navigation based on the usage of the constellation Ursa Minor, but it is for the knowledge of geometry that he supposedly got from Egypt for which he is better known. Again, while like Anaximander, being responsible for much of the technical base for Classical Greek science, there is no record of him performing any measurements of the Earth.[11]

Pythagoras (circa 569 - 475 BC)

Pythagoras of Samos is often described as the first pure mathematician, but we know relatively little about his achievements, considering his importance. Unlike many later Greek mathematicians, where at least we have some of the books that they wrote, we have nothing of

Pythagoras's writings, partly due to the society that he led, half-religious and half-scientific and one that also followed a code of secrecy.

The two philosophers, who were to influence Pythagoras, and to introduce him to mathematical ideas, were Thales and his pupil Anaximander, who both lived on Miletus, which Pythagoras visited when he was between 18 and 20 years old. By this time Thales was an old man, and while he probably did not teach him a great deal, he did stimulate Pythagoras's interest in mathematics and astronomy, and advised him to travel to Egypt to learn more of these subjects. This he did later, but his studies were interrupted by a local conflict with the Persians and he actually ended up in Babylon as a prisoner of war, where he had the opportunity to study Arabic knowledge of these subjects as well.[12]

Pythagoras is best known for his geometrical theorems, but he is also generally regarded as the first European to claim that the Earth is spherical, and can be divided into climatic zones [polar, temperate and equatorial]. He also introduced the notion of *antipodes* and of people living on the opposite sides of the Earth.

The Greek word for feet is *pode,* and so Pythagoras called the land on the opposite side of the Earth *antipodes*, or counter-footed, as people living there had their feet pointing in the opposite direction.[13] Pythagoras's views on the antipodes gives us an interesting insight into Greek thinking at the time - they obviously did not think the Earth flat as Homer *apparently* did, but viewed it as spherical. However, for all of Pythagoras's interest in a spherical Earth, there is no record of him ever trying to verify this assertion by attempting any related measurements.

4.6 Aristotle (384-322 BC)

Aristotle is not renowned just as a mathematician; rather he is considered to be the major influence on philosophical thought and scientific knowledge in the Western and Islamic world for some 2000 years after his death. The son of a well-connected doctor, Aristotle, at the age of seventeen, became a student at Plato's Academy in Athens. At the time that Aristotle joined the Academy it had been operating for twenty years. When Aristotle joined, the academy was being run by Eudoxus of Cnidos in Plato's absence. After his student days, Aristotle soon became a teacher at the Academy and he was to remain there for twenty years, however we know little of what he taught there. Aristotle's support for Alexander the Great in the power struggle with his father, Philip of Macedon, reaped rewards as Alexander protected the Academy and encouraged it to continue with its work.

At the same time, however, he sent Aristotle to Athens to found a rival establishment. In 335BC, Aristotle founded his own school - the Lyceum, again in Athens.

Fig. 4.3 Aristotle: detail from the fresco *The School of Athens* by Raphael

The Academy had always focussed on a narrow range of interests, but the Lyceum under Aristotle pursued a broader range of subjects as F.Grayeff recounts in *Aristotle and His School* [London, 1974]:

'According to a tradition which arose about two hundred and fifty years after his death, which then became dominant and even today is hardly disputed, Aristotle in these same years was a lecturer - not once, but two or three times, in almost every subject…
…- on logic, physics, astronomy, meteorology, zoology, metaphysics, theology, psychology, politics, economics, ethics, rhetoric, poetics; and that he wrote down these lectures, expanding them and amending them several times, until they reached the stage in which we read them...
... However, still more astounding is the fact that the majority of these subjects did not exist as such before him, so that he would have been the first to conceive of and establish them, as systematic disciplines.' [14]

Fig. 4.4 The Lost Lyceum? Excavations behind the Byzantine Musuem in Athens, 1997. Archaeologists have not yet decided whether this was where Aristotle taught.

Aristotle is the first Classical Greek philosopher who actually makes a statement about the size of the Earth, and is recorded as claiming that the circumference of the Earth measured 400,000 stades [or stadia]. We have surmised here that he has used a 'short' stade of 324 *Long Greek* feet, where one of these feet equals 1.01376 British feet, giving a stade value of 328.45824 feet. This has been calculated on the basis that 131,383,296feet. [Michell's 24,883.2 mile ancient Earth circumference] equals 129,600,000 *Long Greek* feet and 129,600,000/400,000 equals 324 *Long Greek* feet.

So at some time during the life of Aristotle, say circa 350 BC, was made the first recorded estimate, in a written format of which modern researchers are aware, of the Earth's dimensions. This is ironic because his tutor Plato also knew the diameter of Earth and indirectly revealed it in some of his work. [*Authors Note*: This is explained in our companion work *Deluge.*]

As previously mentioned, the value of *792* relating to a 7,920 British miles Earth diameter is also seen in Egypt, as is reference to the associated circumference. Hence, while this information may have been revelatory to some Greeks, many of them were already aware of these figures for circumference and diameter.

A related measurement is also worth mentioning at this point. This is the assertion by Neal that there are 40,000,000 [of what we term here Neal's] metres in the Earth's circumference.[15] It is apparent that Neal is working with Michell's Earth circumference because his calculated metre value was 3.2845824 feet, which can be found by multiplying the

long Greek foot of 1.01376 British feet by 3.24. [Note: The modern value of the metre is 3.280839895feet.] To re-iterate the calculation:

1.01376 feet x 3.24 = 3.2845824 feet [Neal's Metre] x 40,000,000 = 131,383,296feet.

1.01376 feet x 324 = 328.45824 feet [Aristotle's stade] x 400,000 = 131,383,296feet.

Here can be seen a common factor of *324* that links different aspects of the measurement system together. So, even at this stage, over 50 years *before* Eratosthenes evaluations, we have a figure for Earth's circumference that is very close to the now accepted satellite and computer derived estimations of Earth's dimensions, and which complies *exactly* with Michell's calculations although Michell did not utilise this Greek information. We should note another reported aspect to this part of this history - according to Aristotle, it was not he who made this calculation. In Chapter 14 of Book II of Aristotle's *On the Heavens* he states the following: -

...'also, those mathematicians who try to calculate the size of the Earth's circumference arrive at the figure 400,000 stades' [16]*...*

While he did not state as much, these mathematicians, who he apparently did not name, had to have been using a 'short' stade of 324 long 'Greek' feet. If we take it that this 'short' stade is half a more conventional 600 foot version, we then divide the 324 feet by 300 for a result of 1.08. This is a ruse that was utilised much earlier in India, specifically by the authors of *Srimad Bhagavatam* in their astronomical descriptions. Here we note that it is probably not coincidence that the long Greek foot of 1.01376 British feet x 1.08 = 13.1383296 inches where the Earth circumference as seen pre-metrication was 131383296 British miles.

Henry Davies states that this mathematical work may have been that of *Eudoxus of Cnidus* [17][see above re Plato's Academy] around 370BC.

Pythagoras, in the 6th century BC, is believed to be the first to put forward a belief in a spherical Earth while Parmenides certainly argued in favour of this in the following century. Around 350 BC Aristotle put forward six arguments to prove that the Earth was spherical and from that time on scholars generally accepted that indeed it was a sphere.[18]

4.7 Later Classical Views on the Earth's Dimensions

Dicearchus (350 -296 BC)

Dicearchus was a student of Aristotle and claimed that the Earth's circumference measured 300,000 stades. We remember that his master utilised a different value, that of 400,000 stades, calculated, as he admitted, 'by *other mathematicians'* …

What Dicearchus had used here was a stade of 432 'feet' in length, with the foot value being that of the Long Greek foot of 1.01376 feet again, so by multiplying 432 by 1.01376feet

we get a stade value of 437.94432 British feet. We then again see that 437.94432 feet x 300,000 = 131,383,296feet and we also see that 432 x 300,000 = 129,600,000 long Greek foot - Michell's Earth circumference of 24,883.2 miles again.

432 [36 x 12] is another factor that is seen frequently in the study of ancient metrology.

Aristarchus of Samos (310-230 BC)

Aristarchus of Samos, or *Aristarchus the mathematician* as the Greeks apparently knew him, has not had the attention he deserves from historians until recent times. He was a student of *Strato* of *Lampsacus,* who was head of Aristotle's Lyceum. However, it is not thought that Aristarchus studied with Strato in Athens but rather in Alexandria, as Strato became head of the Lyceum at Alexandria in 287BC. He is credited by Archimedes of Syracuse [see below], via a work named the *Sand Reckoner,* with envisaging a heliocentric [Sun-centred] Solar System. However, this idea contradicted Greek thinking of the day and the concept was not taken up.

There is no record of him making, or discussing any measurements relating to the Earth. However, it is quite possible that he did work in this field. This is because, he is noted for attempting to calculate the distances from the Earth to the Sun and Moon [as well as their relative sizes], in his only surviving work *On the Sizes and Distances of the Sun and Moon.*

Aristarchus determined that the Sun was about 20 times as distant from the Earth as the Moon, and therefore 20 times the Moon's size [obvious because of eclipses]. Aristarchus knew that the Moon shines by reflected sunlight, so he surmised that if one measured the angle between the Moon and the Sun when the former is exactly half illuminated, then one could compute the ratio of their distances. Aristarchus estimated that the angle at the time of half illumination was 87 degrees, whereas the actual angle is 89 degrees and 50 minutes, so he was an order of magnitude out on his calculations, but his method is seen as sound today.[19]

Archimedes of Syracuse (287 – 212 BC)

Archimedes of Syracuse, one of the great Greek mathematicians, is famous for his theory of displacement, which explains how ships that are made of materials heavier than water can float. He additionally spoke, regarding the measurement of the Earth, of 300,000 stades as the:

... as the measurement usually received, a statement apparently founded on the calculations of Aristarchus of Samos (died 230 B.C.), one of the earlier astronomers of the Alexandrian school. But we have no information as to the data on which these first crude attempts were based, or the mode by which the authors arrived at their results....[20]

This implies a stade value of 432 long Greek feet again, as we saw earlier. However, once more we have no evidence as to who did this 'measurement' and how this value was supposed to have been calculated, as he was unable to elaborate on any specific person or method. It should also be noted here that it known that he was interested in the distances to the heavenly bodies, but the surviving information on this aspect of his work is sparse:

...a theory of the distances of the heavenly bodies ascribed to Archimedes, but the corrupt state of the numerals in the sole surviving manuscript (due to Hippolytus of Rome, about 220 AD*) means that the material is difficult to handle*.[21]

There is an implication here of a loss of knowledge due to poor quality of surviving documentation.

4.8 Eratosthenes (276 – 194 BC) and his Measurement of the Earth

Eratosthenes was born in Cyrene, now called Shahhat, which is located in what we now call Libya. His teachers included the scholar *Lysanias* of *Cyrene* and the philosopher *Ariston* of *Chios*, who had studied under *Zeno*, the founder of the *Stoic* school of philosophy. Eratosthenes additionally studied under the poet and scholar *Callimachus* who had also been born in Cyrene, and then spent some years studying in Athens. When Callimachus became the second librarian at the *Great Library of Alexandria* in Egypt, Eratosthenes followed him, eventually taking over in about 240BC [22], [this institution is examined in a little more detail later].

The talents of Eratosthenes have been the subject of much debate by mathematical historians, but it is certainly true that it is generally believed he was the first to 'measure the Earth'. His calculations were detailed in his treatise: - *On the measurement of the Earth,* which like many Classical Greek texts is now lost. However, some details of these calculations appear in works by other authors such as *Cleomandes*, *Theon of Smyrna* and *Strabo*. The method used by Eratosthenes is fully described by the astronomer Cleomandes, in his work *On the Circular Motion of the Heavenly Bodies*.[23]

It is often stated that Eratosthenes was about 4.5% oversize in his estimate of the circumference of the Earth. Some texts go even further - according to Encyclopaedia Britannica, the overestimation may be as much as circa 15% and that a 'plausible' estimation for the stade is 185 metres [606.9553806 feet].

It is shown below that these assumptions are categorically incorrect.

Eratosthenes is reported to have noted that the Sun at noon on the *summer solstice* was directly overhead at Syene [now modern Aswan], in Egypt, and hence there was no shadow visible at the bottom of the well. At the same time of the year he also allegedly measured the angle of the shadow at another well in Alexandria to the north and discovered that the angle was 7 degrees and 12 minutes, which is a 50th part of a circle. The distance between wells, or gnomons, was measured at 5,040 stades.[24] The measured distance of 5,040 stades multiplied by the angular difference of 1/50 of a circle to achieve the circumference resulted in a final figure for Earth circumference of 252,000 stades. [*Authors Note*: Some authorities claim he was using a different approach: measuring the shadows of gnomons, or tall, well-tapered standing stones.]

It would initially appear that here is a system for measuring the longitudinal circumference that actually works. Simultaneously utilise the Sun at the summer solstice in

two positions, one where it is overhead, and the other, to the North, where it is not. In effect it should, in principal, work for a *spherical Earth*…providing the second location *is on the same longitude* as the first. But questions arise immediately. Why invoke the summer solstice? Why not simply measure the shadow angles on the same day and interpolate the results?

In addition, as Michell points out, [25] Syene is not on the Tropic of Cancer, which it would have to be to experience an overhead noonday Sun on the summer solstice. In reality, it is in the region of 37 miles away, which is enough to produce a significant error of about 0.5 degrees.

Furthermore, in order to calculate the longitudinal circumference, [which would then result in the circumference of a circle and not an ellipsoidal perimeter] the two wells would of necessity have to be on the same longitude. They are not: *Alexandria is three degrees or approximately 200 miles west of Syene.*

Eratosthenes would then have had to use spherical trigonometry to ascertain the longitudinal distance between the two latitudes used, which he did not, therefore introducing another error. With regards to the distance quoted, many scholars have questioned how 5,040 stades was measured accurately [it was supposed to have been based on the distance camels travelled in a day], and have queried the angular measurement. Putting the story into further disrepute is that the figure of 5,040 stades has also been reported by many authors as 5,000 stades [See recent example [26]]. The 5,000-stade estimate would result in 250,000 stades for the measure of the circumference not the 252,000 which is generally reported.

However, whatever the doubts we have over his methodology, Eratosthenes, contrary to the thoughts of most modern historical academics, and the writings of earlier researchers including some of his contemporaries, was, in his dimensional interpretation of the Earth, essentially correct, as we explain below.

Let us look again at the work of Michell and his assertion of the Earth's circumference as seen by the ancient world – 131,383,296 British feet or 24883.2 British miles. If the circumference of 131,383,296feet is divided by the 252,000 stades as denoted [supposedly] by Eratosthenes, it is found that the stade used by him has the length of 521.3622857feet [or 1/700 of a degree of the same circumference]. Assuming that this is a '500-foot' stade, then this distance is further divided by 500, which reveals the relevant foot value. The result is 1.042724571feet. Newton was searching for the '*Sacred Jewish Rod',* which Michell claims to be 3.475748571 feet. The foot associated with the value from Eratosthenes, 1.042724571feet, is precisely 1/3 of this value of 3.475748571 feet which itself is 1/12,000,000 of Michell's interpretation of the polar diameter.

There are 150 of these '*Sacred Jewish Rods'* in the stade of Eratosthenes and therefore 37,800,000 *Sacred Jewish Rods* in Michell's definition of the circumference of the Earth. To reiterate:

131,383,296 / 252,000	= 521.3622857 feet
1.042724571 x 500	= 521.3622857 feet
3.475748571 x 150	= 521.3622857 feet

Michell has apparently followed Newton's example with his claim that this '*sacred'* value of 3.475748571 feet is 1/12,000,000 of the polar diameter of the Earth, using another explicit value of π, 3.15, for this calculation. On this basis, the polar diameter is 41,708,982.86 feet or 7899.428571 miles, which is extremely close to the NASA figure.

However, as seen above, Michell did not need to invoke the polar diameter to discover the value of the *Sacred Jewish Rod*. Additionally, the assumption that the '*Sacred Jewish Rod'* was related specifically to the polar diameter is incorrect as the Earth was understood to be globular or at least, the polar measurements were not understood and only one measure was applied to the Earth's diameter. Our research for this work, as seen below, indicates that the polar measure was not understood until well into the Christian era.

[*Authors Note: Double Cubits*: this double measure was occasionally used as can be seen in Michell's *Sacred Rod*. His value of 3.475748571feet is too long to be a step but as a 'double cubit' of 1.737874286 feet is perfectly acceptable. There would then be 300 cubits of 1.737874286feet in the stade of Eratosthenes and 252,000 x 300 = 75,600,000 cubits in the circumference of the Earth where there are 756 British feet per side the Great Pyramid.]

To further indicate the connectivity of measurement units in antiquity, if the Egyptian cubit of 1.728feet is doubled to 3.456feet and then increased by the 175/176 factor the result is 3.475748571feet. Contrary to some earlier commentator's thoughts, it has been shown that Eratosthenes claimed estimate of the Earth's circumference was an accurate one. It complies with Michell's circumference of 24,883.2 miles, a value that is within less than 24 miles, or 0.1%, of today's NASA estimates of Earth's polar and equatorial circumference.

It is therefore something of a historical mystery as to where and when the idea was derived that Eratosthenes calculation was 4.5% in error when it categorically complied withetheknowledge of the day…knowledge only revised by the more efficient surveys initiated by the development of the metric system...nearly 2000 years later.

We should also remember that the measure termed the *Sacred Rod* was the value discovered in Mexico by Hugh Harlston Junior, named by him as the Hunab after the Mayan word for measure. John Neal's book *All Done with Mirrors* [see endnotes for this chapter] details and replicates some of Hugh Harlston's work at Teotihuacan where Harlston discovered the measure.

While we fail to understand how Eratosthenes statements regarding Earth measures could be seen to be so erroneous, we can in fact suggest a highly probable scenario for the transference of the measures to the Americas long before European ingress on that continent plus a date that fits very well.

4.9 China and America

We introduce this subject here because the value that Michell terms the 'sacred rod' will be seen to be closely involved in the Americas…and we also have the question of Chinese explorers in that country.

The clue here is in what is generally thought to be a fictional tale from China. The *Shan Hai King* or *Classic of Eastern Mountains* is traditionally thought to have been written circa 2200 BC and to have been composed by the 'Great Yu' who was emperor at that time. Note

that in circa 2100 BC an observatory was built at Linfen in Shanxi, East China which embodies some of the familiar measures, [see section 15.5 of this book for more metrological details], hence if the Chinese explorations related in the *Shan Hai King* were shown to be reliable then we would almost certainly have the source of the units seen in America. The units were in use among the educated of China at the era of the Great Yu hence there is no doubt of the possibility. Additionally it is thought that the details of the journey and hence the *Shan Hai King* composition was in fact accomplished sometime after he came to the throne but that of course simple means that the record of the journey was officially made into a singular document at the later date. It looks highly probably that here we see the source of the teachers of the American builders of Meso America regarding measures. The date would fit the pre classical period of Meso America when building was just beginning to emerge as a geometrical exercise showing real signs of a mathematical influence in its proportions and consistencies. See section 15.5 of this book for more metrological details.

The *Shan Hai King* is a description of a journey across a country that is found beyond the Eastern Sea, a land that we today know as America and the work entails some rather accurate descriptions of places that are familiar to many today. Not only locations but directions from one location to another are included…and the directions are quite accurate…as are the descriptions. The *Shan Hai King* and its remarkable knowledge of the geography of America is mentioned in Noorbergen's *Secrets of the Ancient Races* but *Pale Ink*, a 1953 publication by Henriette Mertz is a work solely aimed at the question of Chinese explorers in America in the distant past. Mertz gives very much more detail than Noorbergen even to the distances cited by the Chinese author. The relevant distances, given in 'Li'refer to a measure that averages to a unit of three miles…repeatedly. It is very clearly apparent that the same unit was in use consistently. In section 15.5 of this book we look a little closer at the value and its implications.

The unit used denotes the various locations with accuracy, the descriptions are accurate and the narrative leaves the reader with no doubt that the author or at least the recorder had in fact made the journey…or it is an invention based upon to date maps which did not exist until the 20th century. A later work from China purportedly by a Buddhist monk named Hoei-Shin and dated to circa 550AD also details locations, animals and people in the Americas. Once again we are surprised at the accuracy of direction, distances and descriptions.

Effectively this explorer replicated the journey of the 'Great Yu' and during the period 1761 to 1885 over 50 European scholars examined the documentation of this and the earlier journey and failed to arrive at any conclusion regarding the veracity of the narratives. This was before the onset of archaeology as we understand the subject in our modern era and that makes a large difference. Some of the commentaries in the texts are not seen as impossible or doubtful today but are emerging as 'possible but unconfirmed'. Taking the analysis a little further as Mertz has achieved it seems almost certain that indeed these explorations did take place and even more probable that the earlier expedition was repeated more than once prior to the efforts of the Buddhist monk.

Certainly the measures were understood in China and somehow found their way into Meso America. While it may be relatively easy the create a fictional picture that can be used to describe a generalised view of a region it is difficult to accept that this is the case here as how

can one describe the absolute singularity of the Grand Canyon and have the description fit any other location?

There are numerous places with the distances between accurately noted and views of people and their cultures noted in the text, making it difficult to deny the credibility of the documents. There is even an accurate description of a sea otter at a location almost certainly among the Aleutian Islands. The location here, according to Henriette Mertz in her work Pale Ink is almost certainly the island of Amchitka where a large colony of these animals lives. This would be exactly on an island hopping route to Alaska that entailed no sea journey over 200 miles. As human remains have been found over 30 miles from Japan on a small island-with those remains dating to the early days of modern humans-with the island in deep water and not made more accessible by the low water of an ice age, we can have no doubt of the development of boats of various descriptions in the region.

The otters in question have a description that many would see as mythical or fantastical. These were described as 'wild beasts' that resemble cattle but have no horns, that go in and out of the water, that have a dragons body and beat their abdomens but have the face of men. To anyone who had come from a land with a tradition of dragon lore and description this would make sense in that these animals have a coat like cattle and a body shape not unlike that of the mythical dragon, they have no horns and are frequently seen on their backs in the water exposing their abdomens while eating. However, the telling element here is that one of the principal foods of these particular otters is hard shelled molluscs which are opened by means of beating the shell held between both forepaws against a rock specifically chosen for the job, a stone that the otter cleverly balances on its chest, and of course the face of an otter is similar seen from the front to that of a human.

Such descriptions are accurate but all too often are seen as no more than fantasy. However, how many of the works detractors have actually observed sea otters feeding habits?

Much later, albeit a millennium before Columbus, a Buddhist monk named Hoei-Shin is also said to have journeyed along a very similar route and made recordings that comply with what is understood of the locations visited. He named the land Fu Sang. There are some possible correlations between Chinese and Mayan early scripts in addition to some calendar similarities in terms of names of months but to date there is no confirmation of this.

Given a lack of other evidence these old Chinese works can be viewed as the records of folk who remain strong contenders for the source of the ancient measures arriving in Meso America. The above is the most plausible answer to date for the appearance of the familiar measures in Meso America, in fact *the only* evidenced explanation. The current author would urge readers to examine the case as presented in *Pale Ink* by Henrietta Mertz available from Bibliobazaar. Additionally there is the 1875 work by Charles Godfrey Leland titled *Fusang or, The Discovery of America* which covers the story of Hoei Shin and is now published by Cossimo Books. Both of these very informative works can also be read at sacred-texts.com.

It is useful to compare these descriptions of American locations and their relationships to one another that were written of long before Europeans set foot on the land with the description that Plato gives to his island of Atlantis. Many refer to Atlantis as a confirmed land location but to date no-one has provided anyfirm evidence of any nature for this place to exist anywhere on Earth. And yet these accurate descriptions of America sen in Pale Ink have been

disputed and doubted while the elusive Atlantis with no evidnec for its Earthly location remains in the minds of many to be a reality. The one doubted has quite firm evidence for its numerous locations while Atlantis has none! As we demonstrate conclusively in the companion work Deluge Ftrom Genesis to Atlantis Plato was referring to allocation in the sky and a period of time…reference to a location on Earth is coincidental only. We must allow for allegory in such tales as we also need do to works such as Bible and the Indian narratives where events in the skies are important.

4.10 Posidonius, (135 - 51BC)

Posidonius, studied under the Stoic philosopher *Panaetius of Rhodes.*[27] He apparently took note of Eratosthenes' methods and adjusted his own estimates to suit, so not surprisingly, arrived at the same Earth circumference although the figures were different because they utilised a different stade value. According to *Cleomandes* who wrote his works in the first century AD, [28] Posidonius arrived at the conclusion that Alexandria and Rhodes were on the same longitude. [In fact there is over 2 degrees difference between their respective longitudes]. He utilised the star *Canopus*, in the constellation *Carina* for his calculations. This star was seen to rise to an elevation of 7.5 degrees at Alexandria and merely skim the horizon at Rhodes. His calculations concluded that the meridian length was 48 times the distance Alexandria to Rhodes [the ratio 360 degrees / 7.5]. This he estimated to be 5,000 stades making the longitudinal circumference 5,000 x 48 stades = 240,000 stades.[29] The stade used here can be deduced as follows:

131,383,296 / 240,000	= 547.4304 feet
540 x 1.01376feet [the *Long Greek* foot]	= 547.4304 feet

Therefore we can conclude that there are 540 *Long Greek* feet to each stade. There is also a more complex relationship between some of the ancient measuring system *factors*, as we term them here, and this stade:

500 x 1.0368feet [1/10 of the long Egyptian reed] x 1.056 = 547.4304 feet

As noted earlier, *1056* is another important factor in the field of ancient measurement. The above stade value also makes an oblique reference to the minute of arc [whether we think it of an average longitudinal value, or ancient 'spherical' value], for this stade, when multiplied by 11.1111111 [or 11 $^{1}/_{9}$] = 6082.56 British feet.

Cleomandes also claimed that Posidonius later altered his estimation of the distance between Alexandria and Rhodes to 3,750 stades. Seemingly, he was following Eratosthenes in producing a measurement for this distance utilising posts and shadows. A result for the Earth's circumference of 180,000 stades was now apparently achieved. It is commonly thought that it was from this work that *Ptolemy* [see below] and *Marinus of Tyre* obtained their figures. How one could measure some 355 miles of sea via shadows and posts, however, is another matter entirely! We once more have a correct figure from a doubtful proposition of a method. The

calculation of Posidonius, if indeed it was his calculation, of there being 180,000 stades in the Earth's circumference, results in a stade, using Michell's circumference, of 729.9072 feet. Given a 600-foot stade, the foot length would be 1.216512 British feet [replicating the British inches in the long Greek foot] or 1/5,000 of a minute of arc. The stade used here can be deduced as follows:

131,383,296 / 180,000 = 729.9072 feet
600 x 1.216512 feet (1/5,000 of a minute of arc) = 729.9072 feet

Posidonius, on this basis, was advocating a mile (5,000 feet) that was equal to a minute of arc of the circumference of the Earth. But the foot value here will be seen to have been in use long before the time of Posidonius many miles from Greece.

It can be seen, nonetheless, that as Michell and Neal state, these people were seemingly attempting to measure *through the poles* although the statements of results are of the measurement value of the Earth that was in use millennia before their time. It is concluded that it was realised that the Earth may not be a sphere and that these researchers were attempting to calculate the polar circumference, unsuccessfully, and were therefore [in possibly a deliberate policy] replicating the old and accepted value under different guises, with different stade values.

4.11 Later Ideas: Ptolemy (85 – circa 165 AD) and Vitruvius

Fig. 4.5 This picture from a 15th Century book shows Ptolemy using an astrolabe [See Chapter 5 for more details of this]. The artist has confused him with an Egyptian king of the same name, which explains the crown.

One of the most influential Greek astronomers and geographers of his time, Ptolemy propounded the geocentric [Earth – centred] theory in a form that prevailed for 1400 years. Very little of Ptolemy's life is known, however.

What is definitely known is that he made astronomical observations from Alexandria in Egypt during the years AD 127-41. His name, Claudius Ptolemy, is a mixture of the Greek Egyptian *Ptolemy* and the Roman *Claudius*, indicating that he was descended from a Greek family living in Egypt and that he was a citizen of Rome. This would probably be as a result of a Roman emperor giving that 'reward' to one of Ptolemy's ancestors.

Ptolemy is thought to have been taught by Theon of Smyrna, but it is not thought that his great works *Almagest* and *Geographia* came as a result of this. Instead of Theon's observations, it is thought that Ptolemy used the vast resources of the Great Library of Alexandria as the main sources for his theories. It is this feature of his work, and the related claim that he fabricated results to conform to them, which has created much controversy among scholars in more recent times, Sir Isaac Newton for example being one of his harshest critics:

'(*Ptolemy) developed certain astronomical theories and discovered that they were not consistent with observation. Instead of abandoning the theories, he deliberately fabricated observations from the theories so that he could claim that the observations prove the validity of his theories. In every scientific or scholarly setting known, this practice is called fraud, and it is a crime against science and scholarship'* [30]

Nonetheless, whatever their true source, Ptolemy's works remain some of the most influential scientific texts on astronomy, mathematics and geography ever written. It should be noted however, that if Newton was correct then the source of Ptolemy's works was older than he.

With regard to Earth measurement, Ptolemy effectively stated that 500 stadia equated as a single degree of the Earth's circumference.[31] On this basis there would be [500 x 360] or 180,000 stadia in that circumference.

Clearly, this evaluation was still understood, or at least it was known much later because *Abraham Cresques* echoed it in his notation on the 1375AD *Catalan Atlas* [32]. Additionally, either this information was passed on via another source or the first Latin translation of Ptolemy's *Geographia* was earlier than currently thought. Cresques' work on this map was executed 30 years prior to the earliest known translation of Ptolemy's work. However, Cresques' addition of equating this with 20,052 miles appears to be in error. The evaluation does not link to any units of measurement so far discovered in the course of research, certainly not to anything commensurate with measurement of the Earth and could possibly be a garbled interpretation of the Eratosthenes estimation of the Earth's circumference of 252,000 stades.

4.12 Vitruvius (1st century BC)

Marcus Vitruvius was a Roman Architect who is noted as the author of a famous treatise [as well as being the source of Vitruvian Man, pictured in Figure 2.1 in Chapter 2]. His *De architectura* is divided into 10 books dealing with city planning and architecture in general; building materials; temple construction; public buildings; and private buildings; clocks, hydraulics; and civil and military engines. Vitruvius was an admirer of Greek architecture and wished to preserve the classical tradition in the design of temples and public buildings.

De architectura was used as a classic text book from ancient Roman times to the Renaissance, and is still studied by students of Architecture as a contextual reference today. [33] The interest of Vitruvius in all things Greek extended to measurement and he stated that Eratosthenes, *by means of mathematical calculations and geometrical methods*, discovered the circumference of the Earth. And it is John Neal who reminds us of Vitruvius's description of the method employed:

…ascertained by the Sun's course and the equinoctial shadows of the gnomon and inclinations of the sky [34] *…*

However, the location for the sightings and some indication of the accuracy of the result is not stated, still leaving us with no detailed valid explanation of how Eratosthenes is supposed to have performed his measurements.

From the above it is obvious that there is no real idea of how the Greeks performed their measurements [if indeed they did them at all] and it is necessary to fundamentally rethink how such measurements could have been made in the ancient past. This is achieved much later in this work.

It is apparent that the Greeks are recorded as measuring in a North / South direction and if they had demonstrated a suitable method then Michell and Neal and others would be justified in accepting the circumference value as that of the meridian. However, the statements in Michell and Neal's works leave one in no doubt that the measurement values existed at the time of pyramid building in Egypt, millennia before the time of the Classical Greeks. Again, if the Greeks were as smart as we are led to believe [and some doubt is thrown onto that idea in this chapter] they would have realised that a non-spherical Earth cannot be dimensionally appraised by the short lengths of its surface that were measured and then certainly not by the multiples of 360. It is therefore concluded that these attempts [if indeed, they are not merely inventive stories where a well-known value was repeated in a series of 'myths' about these mathematicians], were not to discover the dimensions of a non-spherical Earth simply because such a concept had not at that time arisen. The Earth was seen as a globe and hence the idea of a variation in degree length did not arise. If this was the case during the time of Classical Greece then so it probably was at earlier epochs and the variation in degree length around the meridian was simply not even contemplated.

4.13 Earliest known reference to the measure of the Polar Diameter

The Roman philosopher Macrobius, writing around 400 AD, gave the diameter of the Earth as 80,000-stades.[35] Newton was supposedly searching for a unit of measurement that was reputedly 1/12,000,000 *of the polar axis*.

The polar axial diameter of 12 million *Jewish Sacred Rods* [Michell] when divided by 150 results in a value of 80,000, which is the number of stades, claimed by Macrobius to be in the diameter of the Earth. 80,000 stades multiplied by 3.15 [the value of π used by Michell to relate what he thought was the meridian circumference to the polar diameter] then reveals the circumference denoted by Eratosthenes of 252,000 stades, as seen earlier.

Macrobius was therefore apparently referring to the same stade value as Eratosthenes, therefore Macrobius, in 400 AD is relating the same dimension for the diameter as Michell gives for the polar diameter.

The diameter evaluates to 7899.42857142 miles. This is the earliest record of Earth measure where the proportions comply with Michell's circumference / Polar diameter configuration.

The 15th century cartographer *Leardo* claimed an *approximation* for the polar diameter of what *may be 6,857 Arabic miles*[36]. When 6,857 is divided into Michell's 'flattened' polar diameter of 41,708,982.86feet [7899.42857142 miles], the result is a 6082.686722 feet which is very close to the anciently accepted measure of a minute of arc of the Earth's circumference of 6082.56feet. When dividing the ancient value for a minute of arc, the Posidonius mile, it is found that there are 6857.1428571 of these units in the polar diameter as denoted by Michell against the *approximation* of 6,857 *Arabic miles*. Clearly here is correspondence that has to be seen to be correct. So, when the *approximate* diameter from Leardo of 6,857 'Arabic' miles is evaluated in a polar context, the mile in question is almost exactly a nautical mile, or a minute of arc of Earth's circumference. It would appear that the ancient value for the minute of arc was still in use but was applied also to the polar diameter.

It would now seem that from the time of Macrobius, around 400AD, the flattening at the poles was in the process of being understood. The probable reason for this is Roman surveyors measuring lands well to the North of Rome during their conquest and occupation of a great deal of Europe. It would then indeed seem odd if Leardo was unaware of this knowledge, in his own field, available a thousand years before his own time. Yet in effect, this odd situation is precisely the type of scenario that has arisen. Indeed, Cresques garbled interpretation of Eratosthenes figure indicates that the geographers and cartographers of his day were simply repeating what had been handed down to them.

It appears that he may have had the correct figure to associate with one earlier scholar, i.e. Posidonius, but not having been given an accurate interpretation, and failing to comprehend the various stade values, he confused the information available about Eratosthenes.

4.14 Fra Mauro and Ancient Maps

Fra Mauro, a Camaldulian monk from the island of Murano near Venice, was active in about the middle of the 15th century AD. He seems to have been a *professional cartographer*, which is substantiated by the monastic records that document expenditure on materials and colours for mapping, wages for draftsmen, and so on. Between 1457 and 1459AD Fra Mauro worked on a commission granted by King Alfonso V of Portugal, a map of the known world, which when finished became known as Fra Mauro's *Mappamundi.* [Note: A Mappamundi is a type of mediaeval map that we shall explain in the next chapter.] In his map Fra Mauro had attempted to improve upon the work of Ptolemy, but he admitted that he had no real idea of the size of the Earth's circumference. It had been put, he said,

'...at various figures such as 22,500 or 24,000 miglia, or more or less according to opinion.[37]

But when we examine these figures against the result of Michell's investigations, the results are commensurate with precise fractions of the minute of arc of Michell's circumference that we discussed earlier [6082.56feet.]. When Michell's circumference of the Earth is divided by 22,500 we get 5,839.2576feet which is 0.96, or 24/25 of Michell's minute of arc. The alternate figure, that of 24,000 *miglia*, treated the same way, results in 5,474.304feet or 9/10 of Michell's minute of arc. This is equivalent to 54 of Michell's seconds of arc or 5,400 long Greek feet. The *miglia* measure is interesting because we find that it is exactly ten times the stade value attributed to Posidonius. Effectively it is a mile of 5,000 feet where the foot value is 1.01376 Long Greek feet x 1.08, a unit seen earlier in this chapter.

4.15 Sources of Greek Knowledge: The Great Library of Alexandria

When considering the origination of the knowledge of the Greeks of the Classical Period, we ought to initially look at the earlier periods of Grecian history. Many scholars consider that the Classical Age really begins with the development of the Greek city-states or *polis,* which began to emerge as a new form of social and political organisation in the eighth century BC.

The earlier period of the history of the polis, between the eighth and the mid-sixth century BC, is often termed the *Archaic* period and it is here where we first find Greek writers such as Homer, producing poems and lyrical texts. In the 8th century BC, Homer described, in his epic poems *The Iliad* and *The Odyssey*, the events of the *Trojan War* that supposedly occurred about 400 years earlier. [He was also the producer of one of the world's oldest maps, something we will return to in Chapter 5.] The Trojan War [if it really happened] followed the collapse of the *Mycenaean* civilisation around 1200BC, ushering in what is often called the Greek *Dark Age,* which lasted until the development of the polis about 800BC. The severe economic conditions of the Dark Age apparently caused the Greeks to lose their knowledge of writing as Martin recounts:

'The most startling indication of the severe conditions of life in the early Dark Age is that the Greeks apparently lost their knowledge of writing when the Mycenaean civilization was destroyed, although it has recently been suggested that the loss was not total. In any case, the loss of the common use of a technology as vital as writing is explicable because the linear B script used by the Mycenaeans was difficult to master and probably known only by a restricted group of specialists, the scribes who worked in the palaces keeping records. They employed writing only for recording the flow of goods into the palaces and then out again for redistribution…When the redistributive economy of Mycenaean Greece was destroyed, there was no longer a place for scribes or a need for writing. The oral transmission of the traditions of the past allowed Greek culture to survive this loss by continuing its stories and legends as valuable possessions passed on from generation to generation.' [38]

In tracing the source of the scientific and philosophical thinking that started to emerge in the 5th and 6th centuries BC, during the so-called *Golden Age of Athens* [the largest, and most well-known of the Greek city-states], it therefore has to be concluded that the bulk of this knowledge *was not* developed natively in ancient Greece.

Whilst scientific and astronomical knowledge from the East may have filtered into Golden Age Athens, the authors believe that the primary source for early Greek knowledge was a single location, and we believe that location to be Egypt. [*Authors Note*: We would qualify that assertion by saying that after the time of Alexander the Great, it becomes apparent that there was a considerable amount of Indian influence.]

It is known that key members of the philosophical, scientific and legal establishment began to visit Egypt early in the Greek Classical period. Perhaps the most famous was *Thales of Miletus* [624-547 BC], [39] who was [and still is] well known as the first Greek philosopher, scientist and mathematician, as we saw earlier. There are several testimonies to this - Proclus [circa 450 AD] claimed that Thales introduced geometry into Greece from Egypt, whilst *Hieronymus*, a student of *Aristotle*, *Plutarch* and *Pliny* wrote of Thales measuring the pyramid's height by the use of shadows; *Solon the law-giver*, the supposed source for *Plato's* Atlantis story was another visitor to the land of the Pharaohs.

At the meeting point of three continents - Asia, Africa and Europe, Egypt has been a natural cradle of civilisation. Indeed it is not far from here in East Africa that mankind itself originated. After more than 3000 years of development of the Pharaonic culture, the later Greek dynasties, beginning with the Ptolemies, made it possible for Alexandria, named after another student of Aristotle, *Alexander the Great*, to be the world's intellectual and commercial capital and metropolis. It was in Alexandria in the 4th century BC that the reputation of Egypt as a centre of learning was enhanced by the Ptolemiac dynasty, to a level where it is still remembered today.

We are talking here, of course, of the setting up of the legendary *Great Library of Alexandria*.

4.16 Two Great Libraries

On the 16th of October 2002, the *Bibliotheca Alexandrina* opened at Alexandria in Egypt [see Figure 4.7]. Funded by the United Nations Educational, Scientific and Cultural Organization [UNESCO], this will be the largest library in the Middle East and Africa, marking the rebirth of the institution founded over 2000 years ago. One of its main projects will be to clarify the history of its more ancient counterpart, which is somewhat unclear, as is seen below.

The Great Library of Alexandria, set up in the 4th century BC, became the world's first university, with its college scholars including such famous names as *Euclid*, *Erastosthenes, Heron* and *Archimedes*. The Great Library, which also served as a publishing house, was built at the side of a Museum - the *Mouseion*, or *Temple of the Muses* [*Museum* in Latin]. Anticipating our modern libraries in the way it was run, it had a catalogue of all the works it possessed – maybe up to 700,000 of listed and classified manuscripts, even in the 3rd century BC. It also enjoyed *legal deposit rights*, therefore was entitled to make a copy of every book that entered the country.[40]

It is generally thought that it was *Demetrius of Phalerum*, an Athenian statesman and the counsellor to King *Ptolemy I Soter* who suggested to the monarch the idea of establishing a great research centre in Alexandria, which would also have an important library attached to it. The precise date of the foundation of these two institutions is not known, but it is probable that Soter took the very first measures towards their establishment around about 290BC. The task was fulfilled during the reign of *King Ptolemy II Philadelphus* who appointed one of Eratosthenes' teachers Callimachus as the second librarian.

When *King Ptolemy III Euergetes* succeeded his father in 245 BC, he persuaded Eratosthenes to go to Alexandria as the tutor of his son Philopator. On the death of Callimachus in about 240 BC, Eratosthenes became the third librarian of the institution.[41, 42] Given that Eratosthenes spent much of his life as the institution's librarian, eventually starving himself to death [possibly suicidally] after succumbing to blindness, he would certainly have made much use of its resources.

Fig. 4.6 The New 'Great Library' of Alexandria

The library was the greatest repository of knowledge in the ancient world, and contained information that was possibly in some cases, more ancient to the ancients than their time is ancient to us. The principle aim of the Library was to translate all knowledge that could be accrued from all sources into the Greek language, as well as perform its function as a museum although the precise organisation of the institution and even its actual location is a bit vague. Ellen Brundage, who has studied both modern and ancient 'histories' of the library, considers the library of Alexandria to more of a legend, than an understood historical reality:

'The library of Alexandria is a legend. Not a myth, but a legend. The destruction of the library of the ancient world has been retold many times and attributed to just as many different factions and rulers, not for the purpose of chronicling that edifice of education, but as political slander... Much ink has been spilled, ancient and modern, over the 40,000 volumes housed in grain depots near the harbour, which were supposedly incinerated when Julius Caesar torched the fleet of Cleopatra's brother and rival monarch. So says Livy, apparently, in one of his lost books, which Seneca quotes… 'Yet while we know of many rumours of the destruction of 'The Library' (in fact, there were at least three different libraries co-existing in the city), and know of whole schools of Alexandrian scholars and scholarship, there is scant data about the whereabouts, layout, holdings, organization, administration, and physical structure of the place' [43]

We will never know exactly what gems of erudition were stored in the library, as its fate after the time of Cleopatra VII [the last and famous one] is somewhat unclear, as even the modern library explains:

'Despite serious contradictions between different studies on the fate of the Library of Alexandria, we can piece together the history of its destruction over some 450 years. The first fire was in 48 BC during the Alexandrian war in which Julius Caesar became involved to support Cleopatra VII against her brother Ptolemy XIII. According to some sources nearly 40,000 books were burned in the fire of 48 BC, other versions of the story place the number at 400,000. Marc Anthony compensated Cleopatra with the gift of the 200,000 scrolls from Pergamum …The Mouseion itself was destroyed along with the Royal Quarter sometime in the third century AD during the strife and accompanying power struggles that shook the Roman Empire. The 'Daughter Library' survived till the end of the fourth century. A decree by Emperor Theodosius in 391 AD forbade non-Christian (pagan) religions…
[This was the emperor who also stopped the holding of the Olympic Games as described earlier. The concept of religion being associated with public entertainment had now gone; religious intolerance now became the norm, unfortunately something that has prevailed in one form or another to the present day]. To continue with the modern library's history of the demise of its ancient counterpart:

…Theophilus (the Bishop of Alexandria from 385 to 412 AD) destroyed the Serapeum and its Daughter Library as being the house of pagan doctrine. Scholars survived for another generation until the murder of Hypatia in 415 AD and the end of the era of Alexandrian scholarship. In 415 AD, the Christian historian Orosius visited Alexandria and reported: "There are temples nowadays, which we have seen, whose bookcases have been emptied by our men. And this is a matter that admits no doubt" (Orosius 6.15.32).
His statement confirms that the library never existed since the fifth century. This was over two centuries before the Arab conquest of Egypt in 642 AD. [44]

This was a sad end indeed to the world's greatest ever temple of learning, if the above was the case. It was indeed, we feel, a real repository of knowledge, rather than a legend, a view that is implied when in Chapter 5 we look at its legacy. Our view is backed up by the fact that Alexandria was certainly important enough in antiquity to host great structures. Built about 270BC, the most famous of these was what has been claimed to have been the world's first lighthouse; the *Lighthouse of Pharos* was built to warn sailors of the treacherous sandbars off Alexandria, one of the busiest ports of the ancient world

Fig. 4.7 Another of ancient Alexandria's attractions: The Lighthouse of Pharos, one of the 'Seven Wonders' of the ancient world.

One of the Seven Wonders of the World, the Lighthouse of Pharos [a likeness of which is shown in Figure 4.7] lasted for 1500 years rendering guidance to sailors coming to the harbour. The Greek architect Sostratus designed the lighthouse during the reign of King Ptolemy II and it consisted of a three-stage tower, decorated with sculptures of Greek deities and mythical creatures. On top of the tower stood a lantern with a giant bonfire whose light may have been focused by mirrors, perhaps made of polished bronze, into a beam visible 35 miles out to sea. Reported to be 300, even 400 feet tall, it was among the tallest man-made structures until the completion of the 1,050-foot Eiffel Tower in 1889. The lighthouse was still functioning when the Arabs conquered Alexandria in AD642, but an earthquake damaged the lantern about 50 years later.

The Lighthouse of Pharos was hit by another earthquake in 1303, and by 1349 it was in ruins; in 1480 Qait Bay's fortress was built on the site. Many of the stones in the fort are now known to come from the ruins of the lighthouse.

There are no corresponding remnants of the library building extant, although a reconstruction by Carl Sagan is reproduced in Chapter 5. The Great Library of Alexandria must have contained maps of the ancient world, and we examine the notion that such maps may have been roots of charts used in later times. Maps are the subject of the following chapter.

4.17Conclusion and Introduction to Chapter 5

It has been shown that the calculated values of the Earth's dimensions that are ascribed to Eratosthenes, Aristotle, Macrobius, Ptolomy and even Leardo are correct, accurate representations of the circumference of the Earth and all are commensurate with each other although noted in different values. Aristotle recorded the measure of Earth's circumference around 350 BC, as calculated by unnamed others from an even earlier period. The seemingly inherited knowledge of the Greeks indicates, as they stated, that they envisioned a spherical Earth. The measurement value earlier utilised for the sphere was still in use, as the measure through the poles could not be achieved at that time. Consequently it is virtually certain that the Greeks were unaware of the polar flattening.

Knowledge of the polar diameter or axis is not recorded until 400 BC at the earliest and any belief that it existed much earlier is no more than that, a belief that is unfounded except by circumstantial mathematical coincidence.

It is apparent that Eratosthenes did not use the method for his calculation of the Earth's circumference as described by his chronicler Cleomandes, but there is no indication what he really did use as a measurement method, as his own work is lost. Cleomandes has either generated, or copied from unknown sources, a false methodology. Aristotle did not make the calculations to back up his claim for the Earth's circumference. Posidonius could not have calculated either of the figures credited to him from measurements relating Rhodes to Alexandria, and Ptolemy is thought by historians to have simply copied him. As a result there is not a single credible method from this period that would produce the correct, accurate representation of the circumference of the Earth that is found. It is a logical conclusion, therefore, that the Greeks must have been working from knowledge acquired elsewhere.

Given the association with Eratosthenes [who is also remembered for his map-making] and others associated with cartography, the Great Library of Alexandria must have contained maps of the ancient world, maps that may have been roots of maps used in later times. The so called *Portolano* charts of mediaeval times have attracted much controversy ever since Professor Charles Hapgood published his book *Maps of the Ancient Sea Kings* in 1966, which purported to show that the charts depicted an ice-free Antarctica. Many writers have followed Hapgood into considering that these charts are a relic of a long-lost civilisation that existed when Antarctica was supposedly ice-free 10,000 years ago. As it is now proven that Antarctica was *not ice-free* at that time this view is now generally discredited, but certain aspects of these charts are of specific interest in this study – their scales. To understand these scales it was essential to give at least a background to the ancient measurement system, which has been accomplished. The charts, then, are the next subject of this investigation.

CHAPTER 5

Ancient and Mediaeval Charts: Maps of the Ancient Sea Kings?

'And concerning the number of books, the establishment of libraries, and the collection in the Hall of the Muses, why need I even speak, since they are all in men's memories?'

Athenaeus on the demise of the Library of Alexandria circa 250AD

5.1 The Need to Make Maps

Why does mankind need to make maps? There are many answers today, but even in the ancient past there were a multiplicity of reasons. The focus in this chapter however, is in the maps produced at a later time – the mediaeval age and how those two map-making periods link together. [Note: There is a large body of research which has been conducted into the history of mediaeval charts and maps, of which the best known type is generally known as a *Portolan* or *Portolano* chart, in essence meaning 'pilot'. We shall not repeat that work in any depth, as it is adequately covered elsewhere[1]].

At its most basic level, making a map is creating a view of one's world, possibly from a religious standpoint, or for practical reasons, or possibly it is an expression of the mapmaker's philosophical vision at the time. This latter suggestion is reflected in the map making of the Classical Greeks where progressive changes in worldview can be perceived, as will be seen later in this chapter. With regard to modern map-making, it can be seen that this concept of change in worldview still occurs today, as the famous *Mercator* map projection is now being challenged by many others.[2] One of the reasons for this, is that in these politically correct times the Mercator projection is often frowned upon because it exaggerates the size of Europe at the expense of Africa.

Maps are also very useful ways of establishing land ownership, and the amount of land allocated to individuals. In the ancient world, there are many examples of where some form of local map would be helpful in settling disputes, for example in ancient Egypt, settling land claims after Nile floods. On a wider scale, maps would provide leaders of ancient empires with a view of their territorial possessions [and those of others] and have possible military value.

Maps in themselves can be historical records, and their role as souvenirs, should not be underestimated as suggested at *Catal Hoyük* below. These records may be of town and cities, of general geographical content or some specific interest such population distribution. Today, the Global Land Information System [GLIS], an interactive computer system developed by the U.S. Geological Survey [USGS], holds a vast amount of mapping and ancillary data relating to regional, continental, and global land information including land use, land cover and soils, cultural and topographic data and remotely sensed satellite and aircraft data.[3] This is all highly

accurate, as it would be because of the technologies used to collect it. However, we note that these sorts of geographical map do not *need* to be as accurate as they are nowadays, in order to perform their information function. Their accuracy is the product of the modern technology in use and in the distant past localised maps would not create a driving force to investigate the dimensions of Earth. The motivations for the calculations that eventually gave the accurate circumference of Earth were derived from an entirely different set of circumstances.

One field where maps were used in a strictly practical sense in the ancient world is in the field of geology, probably relating to mining extraction, a key need of civilised societies. In the modern age, it is generally accepted that the English surveyor William Smith introduced the concept of maps indicating geological strata in 1815. Smith's objective was to draw up a complete geological map of England and Wales, but unlike those who had worked on much smaller regions prior to this attempt, Smith utilised the principles of fossil succession and not specifically rock formation. With the assistance of 400 subscribers who underwrote the project, production of the map commenced in 1812, and was complete in 1815 when it was finally published, a large sheet 16 x 10 feet.[4] Only 43 copies of the map are still extant and 11 copies of an accompanying pamphlet describing the fossils associated with the various geological strata.

While Smith's criterion may have been a new method at the time, when the *Turin Papyrus* [see Figure 5.4] is examined this concept of geological mapping does not, however, appear to be an entirely modern concept. Again, although important, geological mapping in the ancient past would not have produced a need for the accuracy of the measurement system we see in the ancient world.

There is a close link between astronomy and map-making, as knowledge of star positions is a way of telling the time. The work of Flamsteed and his successors as British Astronomer–Royal in the late 17th, and 18th centuries, followed on from the work started by Ptolemy which, as seen later in this chapter, was continued by Islamic scholars. Star charts are then closely related to advanced forms of navigation.

Mapping the heavens and / or the motions of celestial bodies can also have religious connotations, and it also highlights the roots of astronomy in astrology. Indeed, there is much evidence of an interest in the sky by prehistoric early mankind, as far back in time as the earlier part of the Later Upper Paleolithic [or around 40,000 years ago]. Indeed, as seen in Chapter 2, an interest in the phases of the Moon and the form and movements of the stars is demonstrated in the spectacular cave art of the period.

Another possible primary reason for the development of an accurate measurement system in the ancient world was the need for accurate maritime navigation. We shall discuss sea faring in the distant past again in a later chapter, but would like to point out here that there was extensive sea borne trade over various routes and eras long prior to the time of the Renaissance. One example is in the Later European Bronze Age [around 1000BC], where Cunliffe has noted extensive trade routes between the Mediterranean and Britain. Another example is in Southern Asia - India was trading along the coasts of the Arabian Sea *at least* as long ago as 3000BC.

Another well-known group of ancient navigators was the Phoenicians and their offspring, the Carthaginians. Carthage in the 6th century BC controlled the entire North African

coast from the Atlantic Ocean to the western border of Egypt, as well as Sardinia, Malta, the Balearic Islands, and part of Sicily. Up until this time the Carthaginians had been explorers and traders, plying the western Mediterranean and the Atlantic coast, trading Cornish tin, West African gold and ivory. One of Carthage's greatest explorers was *Hanno the Navigator*. His expeditionary voyage [probably in the early 5th century BC] along the Atlantic coast of North Africa and the African west coast, took him at least as far as modern Senegal.

Upon his return to Carthage, he erected a stone tablet at the temple to the god Baal, where he described his voyage in the Punic language. The account has been translated into Greek and is known as the *Periplus of Hanno*.[5]

A third major trade route, in the late 1st millennium AD, was along the East coast of Africa, then around Arabia and India to reach destinations as a far away as China. This route followed the trade winds in the Indian Ocean that blow alternate ways at different times of the year. There are other examples, but there is a similarity in them all – a coastal navigation system, which avoided the issues associated with the *Longitude problem* examined earlier. This system employed along the liminal areas of the coastline would rely heavily on two inter-related things - charts and the knowledge of the men who read them – the navigators, as the history of *shipping* in these times has often been termed the history of *shipwrecks.*

5.2 A Selected History of Ancient Mapmaking

Catal Hoyük, Turkey 6200 BC

The earliest so-called terrestrial map currently known was found in Turkey about 40 years ago, and has been in-situ carbon dated to about 6,200BC - over 8,000 years ago, some 3,000 years before the beginning of what we know as Ancient Egypt, at around 3000BC. This time horizon is often thought as a boundary between civilised cultures and the Stone Age, as the dawn of several Middle Eastern civilisations are traced to about that date. The absence of written evidence before about 3000BC is the reason for this view – for it is the dawn of *recorded* history. However, the *recorded* dawn of history need not be the dawn of civilisation. To answer a question raised in Chapter 2, relating to cultures prior to '*historical periods*', we find here in Turkey an organised society, albeit a somewhat strange one from our modern viewpoint, and far earlier than would be generally expected. This is a society known by archaeologists as the *Tell culture* and it spread widely throughout South-Eastern Europe after the end of the last Ice Age, continuing until about 1000BC. The map in question is a wall painting, approximately 9 feet in length, which was discovered by James Mellaart during his extensive excavations in the 1950's and 1960's at *Catal Hoyük,* a Tell site in the middle of the central Turkish Anatolian plain.

The site dates back as far as 7000BC, and at the time was one of the oldest known.[6] The painting [see Figure 5.1] at first appears to be a ground plan of this ancient city, and even depicts a nearby volcano erupting, which has been confirmed by geologists as being active during the period in question. As Henry Davies notes:

'The twin cones of the volcano suggest that an eruption of Hasan Dag, rising to a height of 10,672 feet, and standing at the eastern end of the Konya Plain and visible from Catal Hoyük, is recorded here. These local volcanic mountains were important to the inhabitants of Catal Hoyük as a source of obsidian used in the making of tools, weapons, jewellery, mirrors and other objects. Furthermore, from graphic embellishments around the mountain, Mellaart has speculated that the depiction of the volcano in an active state is accurate since vulcanism in this area continued for some 4,000 years later' [7]

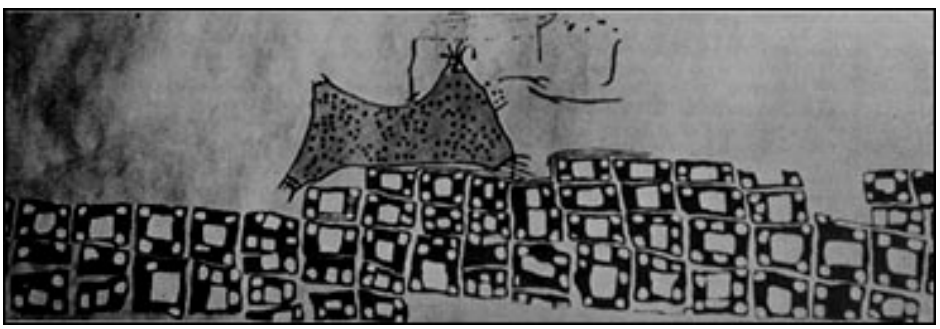


Fig.5.1 'Catal Hoyuk' Town Map

However, Rudgeley has suggested an even more remarkable scenario regarding the *Catal Hoyük map* – that it is not a map of this site at all, but a map of an even earlier settlement, nearer the twin peaked volcano. *Hasan Dag* is a long way from Catal Hoyük, some 60 miles, and not really visible from the site. The site at *Asikli Hoyük*, in the valley opposite the volcano, has been more recently excavated and has been found to date to about 8000BC, right at the start of the *Tell* period. Rudgeley considers that the map may be a folk memory of the earlier site. Another possibility is that the map is a form of souvenir, as some of the residents of Catal Hoyük certainly visited the area to get obsidian and other rocks.[8]

In the context of the overall theme of *Measurements of the Gods*, a search for the source of the Imperial measurement system [and its ancient counterparts], we shall spend a little more time discussing the Tell culture here. Catal Hoyük, the best excavated of the thousands of Tell sites throughout South East Europe demonstrates an extraordinary, if not bizarre culture, one that is not understood at all by archaeologists. The settlement of about 9,000 inhabitants consisted of a large number of closely packed mud 'houses,' so densely packed together that there were no streets, necessitating that the means of entry was through the roof. About every 30 years the buildings were filled with rubble and new structures built on top. This process was then repeated over time until the mound or *Tell* [*Hoyük* in Turkish] was 40 feet – 50 feet high [or approximately 1000 years old] when the occupants would then move on and repeat the process. It is not even known if the term *house* is appropriate – the occupants may have lived in the open on the roof, and used the 'houses' for some ceremonial purposes. These buildings were certainly very strange in our eyes and often contained some human remains underneath the floor, hinting at some sort of ancestry worship or reverence.

Mellaart found possible evidence of an *Earth Mother* religion at the site as many clay figurines were found which possibly suggested this. However, given the site's overall strangeness, this attractive *New Age* proposition is at least open to question. There is an interesting feature about the older site, *Asikli Hoyük* – which although similar to its larger cousin, also has some differences, some of which suggest that the older site was more advanced in a cultural sense. For example, there is a thoroughfare through the ancient town, and it is surrounded by walls. This reminds us that cultural development in the past, and particularly in the *very ancient past*, cannot be seen as a continuous development and it sometimes seems to have evolved in fits and starts. This is demonstrated again later in the book.

Was the Tell culture a potential source for the ancient measurement system? There is some evidence of a form of tablet based writing in some of the proto-urban or so-called *Natufian* cultures of the Eastern Mediterranean region prior to 3000BC [of which the Tell culture is one], as described by Denise Schmandt-Besserat.[9]

However, there is nothing in general that would suggest the technical capabilities that would produce the sophistication of the system that we describe here. As shall be seen from Chapter 7 onwards, the source of the system is far more likely to have been far to the East of this region.

There is one exceptional technical feat that we can associate with the Tell culture though, at Catal Hoyük and elsewhere – the manufacture of smooth mirrors from the natural volcanic glass *obsidian*, and whose production technique remains a mystery, particularly considering the date of 6-7000BC.

Here we have to look at another site, not for reasons of maps but in copmparison to Catal Hoyuk. Above it was noted that this site is unusual in that the occupants apparently infilled the dwellings with rubble on a regular basis and built again on top. We have another example of a site within the borders of Turkey, Gobekli Tepe where the monument comprising of large exquisitly carved T shaped stones was buried, apparently deliberately. This one dates to circa 10,000BC. Here we have a 'tell' at the top of a hill and that 'tel'l is the result of the burying of what can only be viewed as some sort of temple or observatory. Pictures carved in relief on the pillars indicate animals that were thought to be seen in the skies such as those of the familiar zodiac. But why bury the site? This is a large site that has many more individual regions to yet uncover, only known about due to topographic scans.

Extract from https://en.wikipedia.org/wiki/G%C3%B6bekli_Tepe

The tell includes two phases of ritual use dating back to the 10th-8th millennium BCE. During the first phase, pre-pottery Neolithic A (PPNA), circles of massive T-shaped stone pillars were erected. More than 200 pillars in about 20 circles are currently known throughgeophysical surveys. Each pillar has a height of up to 6 m (20 ft) and a weight of up to 20 tons. They are fitted into sockets that were hewn out of the bedrock.. In the second phase,pre-pottery Neolithic B (PPNB), the erected pillars are smaller and stood in rectangular rooms with floors of polished lime. Topographic scans have revealed that other structures next to the hill, awaiting

excavation, probably date to 14-15 thousand years ago, the dates of which potentially extend backwards in time to the concluding millennia of the Pleistocene. The site was abandoned after the PPNB-period. Younger structures date to classical times.

The purpose of the structures is not yet clear. Excavator Klaus Schmidt believed that they are early neolithic sanctuaries.

So here, approximately 330 miles east of Catal Hoyuk we have a similar situation but here the site is of what probably was a temple/observatory complex instead of the houses at Catal Hoyuk. There has to be a commonality here in these actions, a culture that buried itself after a given period or when a specific condition applied, a somewhat strange idea but again we read in the Zend Avesta of a creation myth when the world was regularily increased in size to suit a growing population…If the world is increased in size was the smaller, earlier earth buried under the new extension of its surface?

This is from a culture that prospered in the region at a later period. Could this Earth expansion idea be instigated by observations and folk memory of these two sites and perhaps others not as yet discovered?

Babylonian tablets

Another ancient civilisation is thought to have produced maps. Babylonian clay tablets have been found which depict a variety of map–views ranging from local topographical to world vistas, and amongst a number of these we find another so-called earliest known map. This was discovered in 1939 at the excavated city of *Ga-Sar*, which is close to Harran in modern Iraq, about 200 miles north of ancient Babylon [which was roughly halfway between the modern Kuwaiti border and Baghdad]. The map [See Figure 5.2] is on a clay tablet 7.6 cm x 6.8 cm in size [virtually exactly 3 x 2.64 inches]. It is not immediately obvious as to what Figure 5.2 represents so the image representation is graphically explained in Figure 5.3.

The majority of authorities place the date of this map-tablet to the dynasty of Sargon *of Akkad* [who is thought to have reigned around 2300-2500BC] but one eminent scholar in this field, Leo Bagrow, places its date to 3800BC in the *Agade Period.* The depiction is of a central plot of land surrounded by a number of place names, only one of which has been identified.

One aspect of this map is of note - North, East and West are indicated by inscribed circles, implying that maps were aligned in the cardinal directions then as they are now. In addition, this tablet also illustrates the sexagesimal system of mathematical cartography developed by the Babylonians. The central plot was noted to be 354 *iku,*[10] a unit of land area that is thought by archaeologists such as Joan Oates to be about 200 feet a side [40,000 square feet], or about 0.35 of a modern hectare.[11] [Note that there are 354 days to a synodic lunar year]. However, when we examine the dimensions of the Ziggurat of Nabu at Barsipki in Chapter 7, it shall be seen that the *iku* was far more probably a measurement unit that was equivalent to a square of 210 British feet or 200 x 1.05 British feet per side. It would seem that this was utilised as a basic land measure. Perhaps this was a common division among various

cultures as the area at 200 feet per side of square results in 1/625 of a square mile of whatever value that mile may be. [200^2 = 40000 and 40000 x 625 = 5000^2]

An interesting associated note here is associated with the Earth diameter at 7920 British miles.

7920 miles = 41817600feet = [200 x 1.056 or 211.2] x 198000
316.8 [79.2 x 4] x 625 [see above] =198000.
31680 miles is known as the Square containing the Circle of the Earth [see Chapter 6.6] and this count in any units can be seen as having that representation.

Fig. 5.2 Clay Tablet with Map from Gar Sur

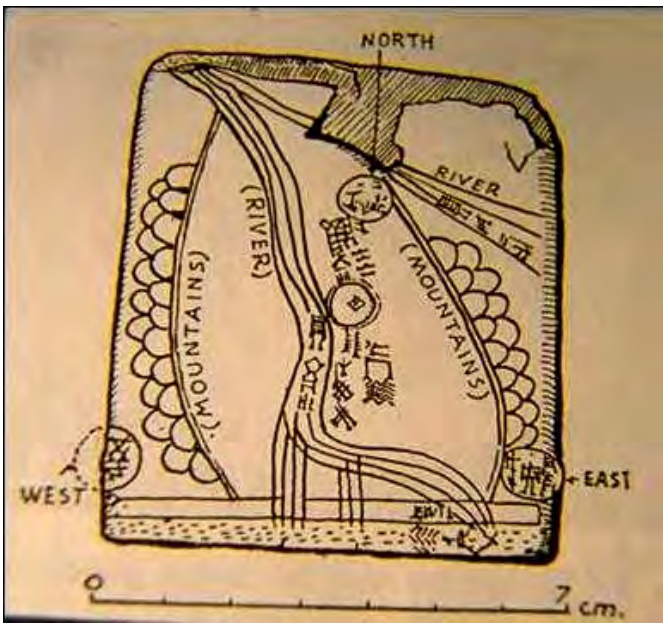


Fig. 5.3 Interpretation of Gar Sur map

The Turin Papyrus

The *Turin Papyrus* has been called 'perhaps the greatest extant Egyptian achievement in cartography. According to geologists who have examined the papyrus [an interpretation of it is seen in Figure 5.4]; it appears to be a depiction of the various types of rock to be found along one of the natural routes of ancient Egypt. This is the famed passage from *Coptos* [Qift] on the Nile through the eastern desert via *Wadi al-Hammamat* to the port of *Quseir* on the Red Sea. This route was used in ancient times in the course of regal expeditions to the Red Sea for trading voyages south to the mysterious land known to the Egyptians as *Punt*. The central area, between *Bir Al-Hammamat* and *Bir Umm Fawakhir*, was visited as a source of ornamental stone and of gold and it is rich in rock tables recording quarrying expeditions and has much archaeological evidence of ancient gold mining.

The Turin Papyrus was 'collected' by Bernadino Drovetti sometime before 1824, and is now preserved in the Egizio Museum in Turin, Italy [hence the map's name].

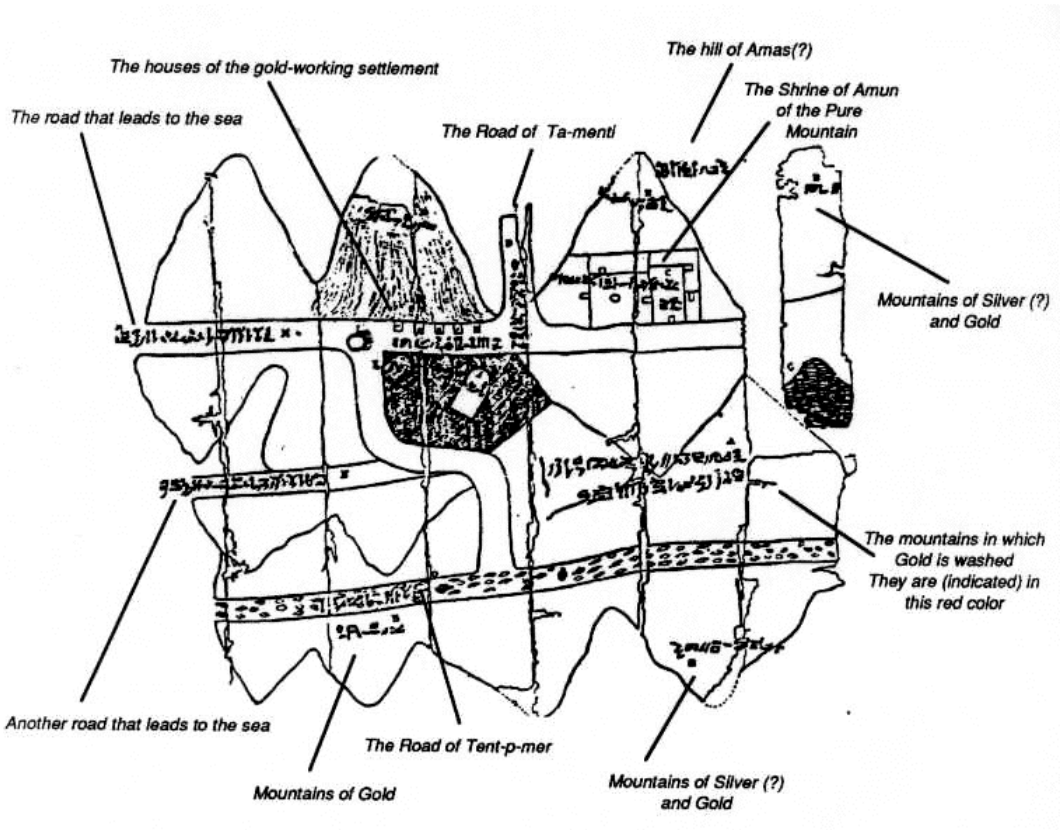


Fig. 5.4 Interpretation of Turin Papyrus

The topography of the Turin Papyrus in terms of hills and valleys is clearly evident.

As a map, it is difficult to tie down the precise indicated location, but there can be no doubt that it does depict the *wadi* topography that exists between Egypt and the Red Sea. Some idea of place can be derived from the routes of roads in use today, in conjunction with the surrounding hills, which would appear to confirm the Egypt/Red Sea location. But, we should note that the topography of sand dunes is not constant, hence the difficulty in identifying the location that the map describes exactly.

Dating of the *Turin Papyrus* suggests that it was produced around 1150BC, in the reign of the 20th Dynasty pharaoh Rameses IV. There are interesting aspects to this map, and pharaonic connection – firstly two sketched plans [a form of map perhaps] contemporary to the date of Rameses IV tomb have survived, the most famous and complete of which is drawn on a different papyrus which is also now located in Turin.[12] In addition, the papyrus on the *Turin Papyrus* is drawn apparently dates, according to some sources, to about 3100BC, possibly symbolising the map's importance and linking it to the beginning of the ancient Egyptian civilisation as we understand it. Henry Davies comments on why such a map was important to the Pharaohs:

'The enormous expenditures of the Pharaohs and the priesthood were met principally by taxes on the land, payable usually in the form of grain crops. For purposes of such taxation, the land was carefully measured and registered, and the boundaries marked. There is reason to believe that this type of data was put down on maps. Centuries later, the Greek scientist Eratosthenes made use of these early Egyptian measurements in his treatises.' [13] [Emphasis added by authors, considering our statements in Chapter 4 and later in this chapter.]

Homer (8th century BC)

The designation of *father and founder* of geographical science in Greece is generally attributed to Homer in the 8th century BC. The *Stoics* [Stoicism being one of the philosophical movements of the Hellenistic period] and *Strabo* [64/63BC - 23AD], both attribute the establishment of this science and the consequential title to Homer. The maps produced by Homer indicate a flat, circular world surrounded by a sea, or a continuous river *Oceanus* which populated his vision of the inhabited Earth as the plateau of a mountain, with *Hades* beneath. Below *Hades* lay *Tartarus*, the place of continuous, eternal darkness.

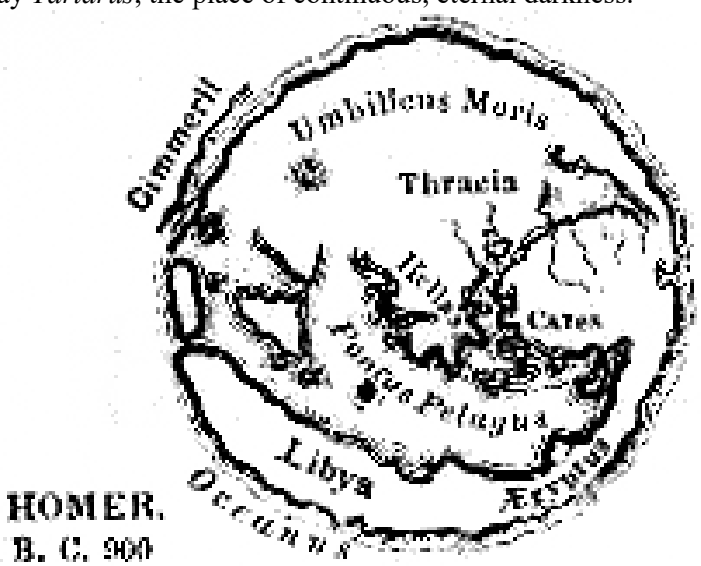


Figure 5.5 2-D interpretation of Homer's world-view

Fig.5.6 3-D interpretation of Homer's world-view Circa 900 BC

Above were the skies where the Sun, Moon and stars moved in a never-ending circuit around the centre of the universe, Earth. [Note: 2 and 3 dimensional interpretations of his worldview are given in Figure 5.5 and Figure 5.6 respectively] There are references to Homer's poems on the original map redrawn in Figures 5.5 and some of the constellations are described, for example *Orion* and *Ursa Major* [or the *Great Bear*], and well-known star clusters such as the *Hyades* and *Pleiades*. The map does appear to encompass, in a metaphorical form, the whole of known humanity, and the interdependence of its individuals.

This concept is emphasised by the encircling sea, which gives us a vision of a world where none can escape, implying that all are brothers, dependent upon the elements and each other.[14] But this map is not an attempt at a geometric evaluation of the Earth's surface. It is an artist's conception, which conveys numerous messages; in other words, a poetic interpretation. Given this, it is difficult to understand the praise endowed upon Homer for his cartographic abilities, as he gives no dimensions or other information seen as a necessary part of conventional mapmaking.

Nonetheless, according to many sources, the ancient Greeks and others saw the concept of the encircling sea as a reality as the extremities of known lands have been thought to have had great seas at their edges. [A reason for the anciently illustrated view of the world supplied

by numerous sources in the modern world… a notion that, apart from the illustrations, is not derived from the ancient world.] However, there is more to the work of Homer than simple story telling. His 'stories as poems' show he was a master in the use of the metaphor, for it now emerges that hidden beneath the surface of the *Illiad* and *Odyssey* are astronomical texts, [15] the major players of his story being the movements of the constellations of the night sky. The encircling sea may well be seen in this case as a river in the form of the Milky Way as indeed the Egyptians saw the Nile in the sky. [We could contrast these works with the highly acclaimed Hamlets *Mill*, by von Dechend and de Santillana, a study of the Norse epic, the *Edda*,[16] which finds that similar astronomical themes underlies the Norse verses].

There is an important and valid point to be made regarding the work attributed to Homer. His works are thought in modern times to be modified from orally transmitted poems modified by a variety of authors, with the *Illiad* being earlier than the *Odyssey*. If, as it now appears to be, that the work of Homer describes celestial events, and such knowledge was handed down orally, how much more in past times had been kept alive in a similar fashion? We noted the concept of *learning by rote* in Chapter 2 and can see that such information is invaluable to navigators.

Here it should be remembered that coastal navigation systems were used by the vast majority of mariners up to the 15th century AD. In the case of celestial events, perhaps other tales were utilised in a similar fashion, conceivably by adding details to a basic cosmological theme.

Hecataeus of Miletus (550-480 BC)

Hecataeus' map of the inhabited world, the *oikumen*, was engraved on a copper plate, and showed the world as he knew it - basically parts of Asia, Europe and Northern Africa. It was apparently based upon the work of his forebears and appears to have been structured around the concepts of Anaximander of Miletus [circa 611-546BC], who was mentioned in Chapter 4. Once more, to comply with what is thought to be the contemporary thinking of the day, a sea or ocean appears to surround the world.[17]

It is not apparent from his work, or indeed of from that of his contemporaries in Classical Greece, whether he saw the world as spherical or cylindrical, and again, there are no dimensions or scales.

Herodotus of Halicarnassus (484 – 430BC approx)

Many maps have also been constructed by cartographic historians according to the writings of *Herodotus,* the so-called *Father of History.* While much has been written about him, we know very little about the man himself, and the precise extent of his reported extensive travels in the Classical world. To a large extent Herodotus appears to have liked anonymity, in fact the only thing he really tells us about himself is his name and origin:

'These are the researches of Herodotus of Halicarnassus, which he publishes, in the hope of... (Book 1:1)' [18]

There has been a major debate regarding Herodotus for the past 200 years, concerning his veracity, sources, and scientific method. Indeed Stecchini devotes a whole chapter to this debate in his *Persian Wars.*[19]

Stecchini concludes that his almost statistical method of collecting data from anyone and anywhere and then reporting it, is more scientific than a structured historical study. To summarise our view of him here, we feel that he can be considered a useful and unique source of these times [the middle of the Classical Greek period or the *Hellenistic Age*]. However, care must be taken with his information, as it is as likely to have come from folklore, as being a historical fact which is why until more recent decades he was insultingly known by died in the wool academic historians as *The Father of the Lie.*

Although appearing [according to academic opinion] to accept the flat circular Earth concept he also, by virtue of his observations and notations, was aware of the argument supporting the spherical world image, but he did not supply a circumference or a diameter.

Eratosthenes

In Chapter 4, it was described how the Greeks were supposed to have estimated the dimensions of the Earth. The only reported detailed methodology is that of Eratosthenes, with an identical principle followed by Posidonius. Both seemingly utilised a system, which, if applied correctly, could only at best give a very approximate idea of the size of the planet. It is obvious that the recorded result is not the consequence of the recorded application of the method.

But as was seen in Chapter 4, the results accredited to these people were very accurate, and yet we have no real indication in the records of how and when this measuring was achieved. Certainly, the recorded methodology would not have produced the stated results. It appears that unexpectedly, there were ready-made accurate records of the dimensions of the Earth. When examining Classical Greek maps, there appears to be no grounds for any figures for the dimensions of the Earth to exist in the first place. Most of these old maps are inaccurate; some are of the *Mappi Mundi* type [discussed later] while others are like those of Homer, *apparent* fabrications of the mind with possible metaphorical aspects. Some maps, such as those of Eratosthenes [See Figures 5.7 and 5.8] and Ptolemy [Figure 5.9–5.11], depicted the known world of the time reasonably accurately, but within very severe limits as they only covered an area from Western India to the Atlantic and from Northern Africa to Northern Europe. We can conclude that the knowledge of the ancient world known to the Classical Greeks, *in contrast to their knowledge of the skies*, was limited. It was only assumed by the Greeks that the Earth was spherical [although this can be considered to be a logical conclusion based upon the observation of lunar eclipses].

Fig. 5.7 Eratosthenes and Strabo 200 BC to 20 AD

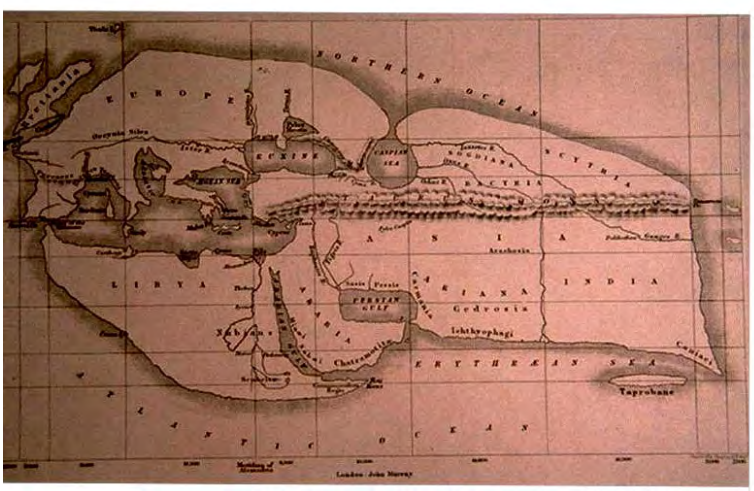


Fig 5.8 Eratosthenes 194 BC

Nonetheless, Eratosthenes made many contributions to the progress of science that interests us in one way or another in *Measurements of the Gods*, as O'Connor and Robertson note:

'Eratosthenes made many other major contributions to the progress of science. He worked out a calendar that included leap years, and he laid the foundations of a systematic chronography of the world when he tried to give the dates of literary and political events from the time of the siege of Troy. He is also said to have compiled a star catalogue containing 675

stars…Eratosthenes made major contributions to geography. He sketched, quite accurately, the route of the Nile to Khartoum, showing the two Ethiopian tributaries. He also suggested that lakes were the source of the river…

A study of the Nile had been made by many scholars before Eratosthenes and they had attempted to explain the rather strange behaviour of the river, but most, like Thales, were quite wrong in their explanations. Eratosthenes was the first to give what is essentially the correct answer when he suggested that heavy rains sometimes fell in regions near the source of the river and that these would explain the flooding lower down the river' [20]

Ptolemy

Significant advances in mapmaking began around the time of Claudius Ptolemy [circa 160AD] where we start to see an indication of longitudinal curvature and lines of latitude and longitude [See Figures 5.9-5.11].

Fig 5.9 Ptolemy's World Map 160 AD

Ptolemy's choice of 15 degrees for each space between a line of longitude, with its implication that there is a connection between time and linear measurement is notable, as the Sun can be seen to traverse 15 degrees of longitude per hour.

The method of mapmaking that he developed, he then applied to the known world of his era, but this method was obviously expandable as the world was explored, enabling it to encompass newly discovered sections of the globe.

Fig. 5.10 Ptolemy's Regional Map: *Tabula Asia*

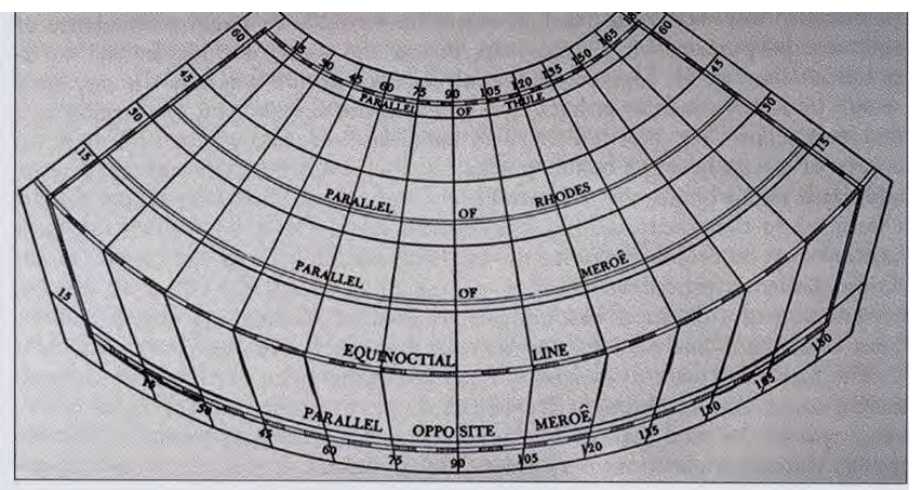


Fig 5.11 Ptolemy's Conic Projection

Ptolemy's methods did not generally start being used widely until some 1400 years later, when we see examples [in later sections of this chapter] of *Portolano* charts that are constructed with scales that are related to a minute of arc of the circumference of a globular Earth. This value is again Michell's Earth circumference that was accepted in the Classical and more ancient worlds, that of 24883.2 British miles. As such, these maps are related to the circumference of the Earth as seen by Ptolemy and others, as seen in Chapter 4. It would seem then that the mapmaking skill and knowledge of geodetic measurement of the Greek era and locality had somehow crossed over a thousand years.

How had this happened in the so-called European *Dark Ages*?

5.3 Bridging the Gap: The Legacy of Alexandria

As noted above, it was not until the beginnings of the Renaissance period in Europe, that mapmaking improved to the level achieved by Ptolemy, some 1400 years earlier. The source for this knowledge is rooted in what was saved when the Great Library of Alexandria finally ceased to exist sometime in the 5th century AD. As was noted in Chapter 4, there is no reliable extant report that describes the appearance of the Great Library. Possibly, the best guess available is that given in the reconstructions shown in Figures 5.12 and 5.13 that were produced for Carl Sagan's television series *Cosmos.*

Fig. 5.12 A reconstruction of the main hall of the Museum of Alexandria. The wall portraits show Alexander the Great (left) and Serapis.

The last days of the Great Library are similarly unclear and are bound up in the religious turbulence and campaign against paganism that erupted in the late 4th century AD. According to the Byzantine encyclopaedia *The Suda*, *Theon* was the last head of the Museum at Alexandria. It is his daughter *Hypatia* who is more famous, as she was an accomplished mathematician, astronomer, and Platonic philosopher.

Many important and influential people of her time came great distances to study with Hypatia. Hypatia has been called the world's first female scientist, and her prominence was accentuated by her femininity and that she was a pagan in an increasingly Christian environment.

Shortly before her death, *Cyril* was made the Christian bishop of Alexandria, and a conflict arose between Cyril and the prefect *Orestes*. The prefect was apparently disliked by some Christians and was a friend of Hypatia, and rumours started that she was to blame for the conflict. In the spring of 415AD, the situation reached a tragic conclusion, when a band of Christian monks seized Hypatia on the street, beat her, and dragged her body to a church where they mutilated her dead flesh with sharp tiles and burned her remains.

Hypathia will be particularly remembered for one of her several important works - a contribution to what may have been the transit of ancient knowledge from the 4th century AD to the Renaissance. This is the editing work she did on the third book of her father's *Commentary on the Almagest of Ptolemy*.[21]

Fig. 5.13 In this reconstruction, the doors from the Museum lead to storage rooms for the Library. Most of the books were probably stored in *armaria*, closed, labeled cupboards of a type that were still used for book storage in medieval times.

Alexandria, was the home of Ptolemy [85AD to 165AD]. The title of his book, *Almagest*, which many think to be the greatest work of science written before Newton's *Principia*, some 1300 years later, shows how it was passed from culture to culture through the ages. The original title of Ptolemy's work in Greek was *The Greatest Mathematical Compilation*. Later Arab translators kept only the word *Greatest* [in Greek – *megiste*] which in Arabic became *al-majisti*, and then in 12th century Latin finally becoming *Almagestum*.

It is known that some of the knowledge of the ancient world managed to survive the European Dark Ages via the Islamic world of the late 1st millennium/early 2nd millennium AD. For example, the caliphs of Baghdad, *Harun al-Rashid* and *al-Ma'mun* became avid collectors of Greek manuscripts. The most celebrated collector was one of these two men, who were father and son. Harun-al-Rashid [caliph from 786-809AD] which means, in English, *Aaron the Just*, was the hero of several of the stories in the famous *Arabian Nights.* When Harun was only eighteen years old he showed such courage and skill as a soldier that his father, who was then caliph, allowed him to lead an army against the perceived enemies of the Mohammedans and he gained many great victories in the years that followed.

He later commanded an army of ninety-five thousand Arabs and Persians, sent by his father to invade the Eastern Roman Empire, which was then ruled by the Empress *Irene*. After defeating Irene's premier general, *Nicetas,* Harun marched his army to *Chrysopolis* on the Asiatic coast, opposite the capital of the Eastern Roman Empire [or *Holy Roman Empire* as it more usually known].

The court of the Emperor in the capital Constantinople, also known as Byzantium [now modern Istanbul], fearing that they would be overrun by the army encamped on the heights, decided to negotiate. Harun spared the capital after being promised a tribute of 70,000 gold pieces a year, a tribute that was paid with great fanfare until 802AD, when *Nicephorus* became Emperor, provoking further conflict.[22] Harun was not just known for his military victories. Harun-al-Rashid, being a scholar and a poet invited any learned men in his own or neighbouring countries to his court, treating them with great respect. He became widely known as a wise man through these acts.

Considering our earlier interest in the *Longitude problem* and the need for accurate timekeeping for navigation we should note the apparent importance here of the gift of a *clock,* which *indicates* that it was of great interest to the early Islamic world. Hayun's son *Al-Ma'mun* [caliph between 813-833AD] continued the patronage of learning started by his father and founded an academy called the *House of Wisdom* where Greek philosophical and scientific works were translated into Arabic.

It should not be thought that the Arabs who were translating these Greek texts simply sat down with a pile of Greek manuscripts and translated them. Most of the difficulty in performing the task related to the search for the manuscripts that were to be translated. In order to find manuscripts of the works of Aristotle and others, al-Ma'mun sent a team of his most learned men to Byzantium. One of these learned men was Abu *Zayd Hunayn ibn Ishaq al-Ibadi* who is famed as the leading translator of mathematical documents of the day. Although trained in medicine, Hunayn, being more skilled in the Greek language than any of the other scholars in Baghdad, was a key man on this expedition and many others, and went to great

lengths to obtain the source documents as O'Connor and Robertson of St Andrews University Mathematics Department describe:

As an example of the lengths that Hunayn went in order to find a particular manuscript we quote his description of a search for a medical manuscript - 'I sought for [the manuscript] earnestly and travelled in search of it in the lands of Mesopotamia, Syria, Palestine and Egypt, until I reached Alexandria, but I was not able to find anything, except about half of it at Damascus.' [23]

As an indication of one document's importance, Al-Ma'mun acquired a copy of Ptolemy's *Almagest* as part of a peace treaty with the Byzantine emperor, which finally settled the dispute between the Eastern Empire and Baghdad.

Islamic science also apparently benefited from astronomical knowledge obtained from India.[24] The Classical Greeks had supposedly stimulated Indian astronomy after *Alexander the Great's* conquests in the late 4th century BC. [Note: We shall examine this erroneous assertion relating to Indian knowledge of astronomy in Chapter 13]. In 773AD, a man from India appeared before *al-Mansur,* the then Caliph of Baghdad. This man was an astronomer, and could apparently calculate eclipses and so impressed the caliph that he ordered that the Indian's books be translated into Arabic. Why was the caliph so interested in eclipses?

There is another reason here for the need to make maps, as we can see that his reasons were possibly practical - his subjects had to pray facing Mecca, and so he needed good maps of his Empire, so that they could properly execute one of the key aspects of their faith. Good maps mean good measurement of latitude and longitude. As seen in Chapter 3, latitude is relatively easy to find, simply by sighting the pole star, but finding one's accurate longitude requires accurate timekeeping. Without accurate portable clocks, longitude can only be found by sighting a star in two different places at the same time. A lunar eclipse gives astronomers in two places a natural way of adjusting their clocks to the same time.

Returning to the slightly later time of Caliph Al-Ma'mun, he is noted for recruiting the most talented men for the House of Wisdom, such as the scientist and mathematician *al-Khwarizmi,* and al-*Hajjaj,* the first translator of Euclid's *Elements* into Arabic. Here they worked with Hunayn, who was mentioned earlier. Not all of the work of *Al-Ma'mun* involved documentation and astronomy however because in 820 AD he also became the man who gained forced entry into Great Pyramid.

In 833AD, al-Ma'mun was succeeded by his brother *al-Mu'tasim*. However this did not affect the *House of Wisdom* and it continued to flourish under al-Mu'tasim and successive caliphs.

For example, al-Khwarizmi [770-840AD] wrote his *Al-jabr wa'l muqabala* [from which our modern word algebra is derived] while working as a scholar there. In addition to this treatise, al-Khwarizmi also wrote works on astronomy, on the Jewish calendar, and on the Hindu numeration system. Al-Khwarizmi is particularly noted for publishing the <u>first known astronomical tables</u> in his book *Sindhind zij* which was based on Indian astronomical works:

... as opposed to most later Islamic astronomical handbooks, which utilised the Greek planetary models laid out in Ptolemy*'s "Almagest"...* [25]

The Indian text on which al-Khwarizmi based his treatise was one which had been given to the court in Baghdad around 770AD as a gift from an Indian political mission. The *Sindhind zij* contained calendars, and tables of sines and tangents, amongst a lot of other astronomical and astrological information. Al-Khwarizmi's tables were used to find days of the new Moon, list the rising and setting times of the Sun, Moon, and planets, and to predict eclipses. The tables were labour-saving devices for astronomical calculations, and because they made these easier, they served the same function as today's computers. In fact, we use al-Kwarizmi's name in our word *algorithm* [derived from the Latin form of al-Khwarizmi's name], which means a rule or procedure for calculating. What is of note here is that his book of tables *introduced the Indian system of decimal numbers to the West*.

Islamic astronomers also perfected the *astrolabe*, a device used by Ptolemy for telling time at night by measuring the positions of bright stars. The astrolabe is both an observing instrument and a computing device, and the earliest surviving Islamic book on the astrolabe was written by al-Kwarizmi, again, highlighting the links between mathematics, astronomy and mapmaking. O'Connor and Robertson also note that :

'Al-Khwarizmi wrote a major work on geography that gave latitudes and longitudes for 2402 localities as a basis for a world map. The book, which is based on Ptolemy's Geography, lists with latitudes and longitudes, cities, mountains, seas, islands, geographical regions, and rivers. The manuscript does include maps which on the whole are more accurate than those of Ptolemy...

... In particular it is clear that where more local knowledge was available to al-Khwarizmi such as the regions of Islam, Africa and the Far East then his work is considerably more accurate than that of Ptolemy, but for Europe al-Khwarizmi seems to have used Ptolemy's data. [26]

An Islamic astronomer in Cordoba, Spain later revised al-Khwarizmi's tables. Here, the caliph [whose empire at the time extended this far] had built an observatory. Astronomical tables in this era gave the time of sunset for one location, such as Baghdad. Astronomers in other cities required extra calculations to get the correct time of sunset in their own city, and so the Cordoba tables were re-computed to work best for astronomers in Cordoba.

This is one sign that Islamic astronomers were not just copying old astronomical knowledge; they were keeping the knowledge and method *alive*.

Around 950AD another Muslim is found who made a significant contribution to the development of mapmaking in mediaeval times, a man who has been referred to as the *Herodotus and Pliny of the Arabs*. *Abul Hasan Ali Ibn Husain Ibn Ali Al-Masu'di* is reputed to have been an expert geographer, a physicist and historian, and was born in the last decade of the 9th century AD. Al-Masu'di was a Mutazilite Arab, who after spending many years exploring distant lands died at Cairo in 957AD. Al-Masu'di travelled to Fars in 915AD, then to

Istikhar, Baghdad and India where he visited Multan and Mansoora before returning to Fars. In 918AD he travelled to Gujrat, where more than 10,000 Arab Muslims had settled in the sea-port of Chamoor. Al-Masu'di also visited Deccan, Ceylon, Indo-China, China, Madagascar, Zanzibar, Oman and Basra, in modern Iraq.[27] At Basra Al-Masu'di completed his book *Muruj-al-Thahab* that contained descriptions of his travels and meetings with various peoples of different countries, cultures, religions and climates. During the course of his life he wrote a number of volumes, all relating to his experiences and thoughts, the final work being completed during the year of his death. Although not noted specifically for cartographical works, he certainly has the reputation of being an excellent geographer.

It can be concluded that if Ptolemaic material lay within the Muslim domain, then Al-Masu'di may have been regarded as an excellent geographer because he had studied and understood this material.

Omar Khayyam

Awake! For Morning in the Bowl of Night
Has flung the Stone that puts the Stars to Flight:
And Lo! The Hunter of the East has caught
The Sultan's Turret in a Noose of Light.

Dreaming when Dawn's Left Hand was in the Sky
I heard Voice within the Tavern cry,
"Awake, my Little Ones, and fill the Cup
Before Life's Liquor in its Cup be dry.

From *The Rubaiyat of Omar Khayyam* [Edward Fitzgerald translation in 1859]

Omar Khayyam is best known as a result of Edward Fitzgerald's popular translation in 1859 of nearly 600 short four line poems known as the *Rubaiyat.* His fame as a poet has generally overshadowed his scientific achievements in mathematics and astronomy which were much more substantial. Yet as seen above with his description of the dawn, his references were often to the skies; it is also notable that if the dawn had a left hand then the right would be in West and the heavenly head to the North. Khayyam was born in 1048AD and he grew up in a much more turbulent environment than his predecessors.

The political events of the 11th Century AD played a major role in the course of Khayyam's life. The *Seljuq Turks* were tribes that invaded southwestern Asia in the 11th Century and eventually founded an empire that included Mesopotamia, Syria, Palestine, and most of Iran. The Seljuq ruler Toghrïl Beg proclaimed himself sultan at Nishapur in 1038AD and entered Baghdad in 1055AD. It was in this difficult and unstable military empire, which also had religious problems as it attempted to establish an orthodox Muslim state that Khayyam grew up.

Khayyam himself commented on the difficulties he faced in a violent political environment and an increasingly hostile, anti-scientific, fundamentalist Muslim faction in this society several times. In particular, he described the difficulties for men of learning during this

period in the introduction to his *Treatise on Demonstration of Problems of Algebra* [see below]. Perhaps this quotation sums up how lucky we are today to have had the knowledge transfer through the Islamic world that we describe in this chapter:-

'I was unable to devote myself to the learning of this algebra and the continued concentration upon it, because of obstacles in the vagaries of time which hindered me; for we have been deprived of all the people of knowledge save for a group, small in number, with many troubles, whose concern in life is to snatch the opportunity, when time is asleep, to devote themselves meanwhile to the investigation and perfection of a science; for the majority of people who imitate philosophers confuse the true with the false, ... and they do nothing but deceive and pretend knowledge, and they do not use what they know of the sciences except for base and material purposes; and if they see a certain person seeking for the right and preferring the truth, doing his best to refute the false and untrue and leaving aside hypocrisy and deceit, they make a fool of him and mock him. [28]

The political situation later calmed down. Toghril Beg, the founder of the Seljuq dynasty, had made Esfahan the capital of his domains and his grandson Malik-Shah was the ruler of that city from 1073AD. An invitation was sent to Khayyam from Malik-Shah and from his vizier Nizam al-Mulk asking Khayyam to go to Esfahan to set up an Observatory there. Other leading astronomers were also invited and for 18 years Khayyam led the scientists to produce work of outstanding quality. An example of particular interest to us here is that Khayyam measured the length of the year as 365.24219858156 days. This shows an incredible confidence to attempt to give the result to this degree of accuracy. [It is known now that the length of the year is changing in the sixth decimal place over a person's lifetime.] The value is outstandingly accurate. For comparison, the length of the year at the end of the 19th century was 365.242196 days, while today it is 365.242190 days.

After another period of political instability when Malik Shah died, Khayyam moved to *Merv* [now Mary, Turkmenistan] which Malik-Shah's third son Sanjar had made the capital of the Seljuq Empire. In this great centre of Islamic learning Khayyam wrote further works on mathematics. We will not go into this work in any depth here, as it is well covered elsewhere, other than to note that Khayyam was well aware of the capabilities of *Indian* mathematicians:

'*The Indians possess methods for finding the sides of squares and cubes based on such knowledge of the squares of nine figures, that is the square of* 1, 2, 3*, etc. and also the products formed by multiplying them by each other, i.e. the products of* 2, 3 *etc. I have composed a work to demonstrate the accuracy of these methods, and have proved that they do lead to the sought aim...'* [29]

It is noticeable that the Indian knowledge and methodology and were relatively new to the Islamic scholars and therefore were not known from Greek sources.

Nasir al-Din al-Tusi

Over a hundred years later, the contribution to this knowledge transference through the Middle Ages made by the scientific advisor to the grandson of the Mongol emperor Genghis Khan, *Hulegu* is of note. Again it is amazing how lucky it seems we are that such work was done in a period of great wars and mass migrations. *Nasir al-Din al-Tusi* [1201-1274AD] was an Islamic scholar at the time of the Mongol invasion and for some time avoided any involvement with the destruction in the region [modern North–Eastern Iran]. This is because he had accepted an offer by the Isma'ili ruler Nasir ad-Din 'Abd ar-Rahim to join the service of the *Assassins,* where he became a highly regarded member of the Isma'ili Court. The Assassins, who practised an intellectual form of extremist Shi'ism, had in the past been involved in suicide attacks on prominent opponents [which gave them a fearsome reputation], controlled the castle of Alamut in the Elburz Mountains,[30] and other similar previously impregnable forts.

In 1256AD al-Tusi was in the castle of Alamut when it was attacked by the forces of Hulegu, who was at that time set on extending Mongol power in Islamic lands. Some Islamic scholars claim that al-Tusi betrayed the defences of Alamut to the invading Mongols, as after Hulegu's forces destroyed Alamut, he treated al-Tusi with great respect. However this view ignores Hulegu's known deep interest in science. On the other hand, it may be that al-Tusi felt that he was being held in Alamut against his will, for certainly he seemed enthusiastic in joining the victorious Mongols who appointed him as their scientific advisor. Al-Tusi was also put in charge of religious affairs under Hulegu, and was with the Mongol forces when they attacked Baghdad in 1258AD. As one could imagine, Hulegu was in a very positive frame of mind after the fall of Baghdad to his forces, and so when al-Tusi presented him with plans for the construction of a fine Observatory, he was happy to approve them. Hulegu had made *Maragheh*, in the Azerbaijan region of North - Western Iran, his capital and it was here where this particular observatory was built, becoming operational in 1262AD.

Interestingly, Chinese astronomers assisted the Persians in the construction and operation of the observatory.

The observatory had various instruments such as a 4 metre wall quadrant made from copper and an azimuth quadrant which was the invention of Al-Tusi himself. [Our word azimuth derives from Arabic *as-sumut* meaning *compass bearings*.] Al-Tusi also designed other instruments for the observatory, such as an ingenious mechanical device called the *torquetum*, for computing star positions. The observatory was far more than a centre for astronomy. It possessed a fine library with books on a wide range of scientific topics, while work on science, mathematics and philosophy were vigorously pursued there, following on in the tradition of the *Great Library of Alexandria* and the *House of Wisdom* discussed earlier.

Al-Tusi put his observatory to good use, making very accurate tables of planetary movements. He published *Zij-i ilkhani* [the Ilkhanic Tables], written first in Persian, and later translated into Arabic, after making observations for 12 years. This work contains tables for computing the positions of the planets, and it also contains a star catalogue. This was not the only important work which al-Tusi produced in astronomy.

Al-Tusi made the most significant development of Ptolemy's model of the planetary system up to the development of the heliocentric model in the time of Copernicus, by developing the theorem of the *Tusi-couple* which resolves linear motion into the sum of two circular motions. Al-Tusi wrote many commentaries on Greek texts. Ptolemy's *Almagest* was one of the works which Arabic scientists studied intently and in 1247AD al-Tusi wrote *Tahrir al-Majisti* [*Commentary on the Almagest*] in which he introduced various trigonometrical techniques to calculate tables of sines.[31]

In summary, Al-Tusi and his pupils, like Khayyam and their forebears made an enormous contribution to the revival of mathematics and astronomy in the Mediaeval Age. O'Connor and Robertson quote Vladimirov's summary of Al-Tusi's importance:

'Al-Tusi's influence, especially in eastern Islam, was immense. Probably, if we take all fields into account, he was more responsible for the revival of the Islamic sciences than any other individual. His bringing together so many competent scholars and scientists at Maragheh resulted not only in the revival of mathematics and astronomy but also in the renewal of Islamic philosophy and even theology'. [32]

The European Explorers

In relation to the expansion of European knowledge of world geography, we should note the contributions made by two mediaeval travellers. The first, *Marco Polo* [1254-1324AD], is probably the most famous Westerner who travelled on the famed *Silk Road* to China. His journey through Asia lasted 24 years in total, and he reached further than any of his predecessors, going beyond Mongolia to China. In China he became a confidant of *Kublai Khan* [1214-1294AD], which enabled him to travel the length and breadth of China, and return to tell the tale. This journeying became his great travelogue *The Description of the World* or *The Travels of Marco Polo.*

The story begins however, with his father and uncle Maffeo and Niccilo Polo, two Venetian merchants, who in 1260AD arrived at Sudak, a port in the Crimea. The brothers went on to Surai, on the Volga river, where they traded for a year. Shortly after, a civil war broke out between Barka and his cousin Hulagu Khan (who was seen above regarding al-Tusi], which made it impossible for the Polos to return with the same route as they came.

The Polos therefore decide to make a wide detour to the East to avoid the war and found themselves stranded for 3 years at Bukhara, one of the most ancient cities of modern Uzbekistan, and once a major commercial centre on the Silk Road. The marooned Polo brothers were abruptly rescued in Bukhara, by the arrival of a VIP emissary from Hulagu Khan in the West. The Mongol ambassador persuaded the brothers that Great Khan would be delighted to meet them for he had never seen any Latins and very much wanted to meet one. So they journeyed eastward, and they finally reached the new capital of the Great Khan, Bejing in 1266. The Polo brothers were well received by the Great Khan Kublai in his impressive new capital, built after the Mongols took over China in 1264AD.

One year later, the Great Khan sent them on their way with a letter in Turki, addressed to Pope Clement IV asking the Pope to send him 100 learned men to teach his people about Christianity and Western science. To make sure the brothers would be given every assistance on their travels, Kublai Khan presented them with a golden tablet a foot long and three inches wide, and inscribed with the words:

By the strength of the eternal Heaven, holy be the Khan's name. Let him that pays him not reverence be killed.

The golden tablet was the special VIP passport, authorising the brothers to travel throughout the Great Khan's dominions and receive such horses, lodging, food and guides as they required. It took the Polos three full years to return home, in April 1269AD. [Note: Although the Polo brothers blazed a trail of their own on their first journey to the East, they were not the first Europeans to visit the Mongolia. Giovanni di Piano Carpini in 1245AD and Guillaume de Rubrouck in 1253AD had made the dangerous journey to Karakorum and returned safely; however they did not travel as far as the Polos and reach China.] At the end of year 1271AD, carrying letters and valuable gifts for the Great Khan from the new Pope Tedaldo [*Gregory X*], the Polos once more set out from Venice to the East. They took with them 17-year-old Marco Polo and two friars. The two friars hastily turned back after reaching a war zone, but the Polos carried on. They passed through Armenia, Persia, and Afghanistan, over the Pamirs, and all along the Silk Road to China, where they were again warmly received by the Great Khan.

Marco, a gifted linguist and master of four languages, became a favourite with the Khan and was appointed to high posts in his administration. He served at the Khan's court and was sent on a number of special missions in China, Burma and India. Many of the places where Marco went were not seen again by Europeans until the 19th century. The Polos stayed in the Great Khan's court for 17 years, acquiring great wealth in jewels and gold, but by the end of this time they were anxious to leave. This was because they feared that if Kublai, now in his late seventies, were to die, they might not be able to get their considerable fortune out of the country. Reluctantly, Kublai Khan let them go, and it took nearly two years to return home in the winter of 1295AD after a perilous voyage.

Although Marco Polo received little recognition from the geographers of his time, portions of the information in his book became incorporated into some of the most important maps of the later European Middle Ages, such as the *Catalan World Map* of 1375AD. In the next century, it was also read with great interest by *Henry the Navigator* and by *Columbus.* Marco Polo's system of measuring distances by days' journey turned out to be remarkably accurate and was used by later generations of explorers.

Today topographers have called Marco Polo's work the precursor of scientific geography, and as geographer Henry Yule notes:

'He was the first traveller to trace a route across the whole longitude of Asia, naming and describing kingdom after kingdom' [33]

An English input to the expansion of European knowledge of far-off lands in the mid 14th century should be noted. *Sir John Mandeville*, is a long forgotten Knight who was once the most famous writer in mediaeval Europe, even though he only wrote one book, a volume known simply as *The Travels*. In his book he described how he travelled further afield than any European in history, including Marco Polo, about 50 years earlier. Mandeville set out from St.Albans near London, England in 1322AD, with the intention of visiting the Holy Land. When he returned home some 34 years later he came back with some amazing stories of his travels which took him as far as Sumatra. Mandeville's book was amazingly popular, being particularly prized by geographers, who used his information to upgrade their maps, and was acquired also by kings and priests who were keen to study these unknown lands.

By the time he died in the 1360's AD monastic scribes had copied his work into every European language. As Giles Milton relates:

'*The sheer number of surviving manuscripts is testament to Mandeville's popularity: more than 300 handwritten copies of The Travels still exist in Europe's great libraries – four times the number of Marco Polo's book.*'[34]

It should now be evident that Arab and Muslim scholars were crucial links in knowledge transfer from the Classical to the mediaeval world of the Renaissance. Indeed, they did more and actually added much to the Classical knowledge that they gleaned from ancient documents as well as inputs from other sources such as India and China. It now even appears that one of these scholars, an Arab 'alchemist' *Abu Bakr Ahmad Ibn Wahshiyah* 'cracked the Rosetta code' some 800 years before the famous achievement by Jean-François Champollion, a student of ancient languages.

The well-known story of the *Rosetta Stone* is still recognised as one the greatest achievements of 19th century scholarship.

French engineers during Napoleon's campaign found the Rosetta stone embedded in a fort wall in Egypt. The stone, now displayed in the British Museum contains a text in Greek, Coptic and hieroglyph, but still required another 23 years' work to be decoded, a task achieved by Jean-François Champollion, a student of ancient languages. Champollion's breakthrough came in 1822 when he realised hieroglyphs should be read, not as symbols of ideas or objects, but as a phonetic script. The sound associated with each symbol was crucial to deciphering it. ''Je tiens mons affaire [I've done it],'' Champollion shouted, before falling into a dead faint for five days. He awoke to continue his work, but died 10 years later of exhaustion and is buried in Paris's Père Lachaise cemetery. Pieces of papyrus are still placed on his grave in recognition of his great work.

After years of painstaking research, Dr Okasha El Daly of University College London's Institute of Archaeology is now convinced that Western scholars were not the first to decipher Egyptian hierglyphics. An expert in both ancient Egyptian and Arabic scripts, El Daly spent seven years chasing down Arabic manuscripts in private collections around the world in a bid to find evidence that Arab scholars had unlocked the secrets of the hieroglyph. He eventually found it in the work of the ninth-century alchemist, Ibn Wahshiyah by comparing his studies

with those of modern scholars. El Daly realised that Ibn Wahshiyah understood completely what the hieroglyphs were saying.

It is notable that El Daly stresses that Muslim scholars had not simply been handed the secrets of hieroglyphs after Egypt was taken over by Islam. Rather, the secret of the hieroglyphs was lost and then rediscovered by Arab scholars, who used diligent work to break their code, eight centuries before Champollion. [Note: A reminder perhaps of the similar loss of knowledge in the Greek Dark Age that was discussed earlier in Chapter 4] El Daly noted that *'These were people who possessed great astronomical and mathematical knowledge.* [As seen in this chapter] *Decoding hieroglyphs was just the kind of thing they would have been good at.'* [35]

A Spanish Input

To complete the particular 'bridge' regarding maps from the time of Ptolemy until the general availability of accurate maps in the 15-16th centuries a Spanish input needs to be noted.

After Cordoba returned to Spanish rule, King Alfonso X ordered his astronomers, led by Isaac ben Said, to construct new tables. The *Alphosine Tables* were assembled from 1263AD to 1272AD, reached Paris around 1320AD, and were then used in Europe for the next three centuries.

The eagle-eyed reader will note there is something missing here in this account of the transmission of knowledge from the world of the Classical Greeks to the Renaissance in mediaeval Europe – there is no mention of the measurement of the dimensions of the Earth.

Why was this – when all its associated sciences were present? Was it because the dimensions of the Earth were common knowledge amongst these mathematicians /astronomers of the Middle Ages and it was thought that there was no need to do any further work?

The authors assert that this probably was the case, as will be found when we examine some of the three types of charts in use in Mediaeval times – the *Mappa Mundi*, *Portalano* and *Mercator-type* charts.

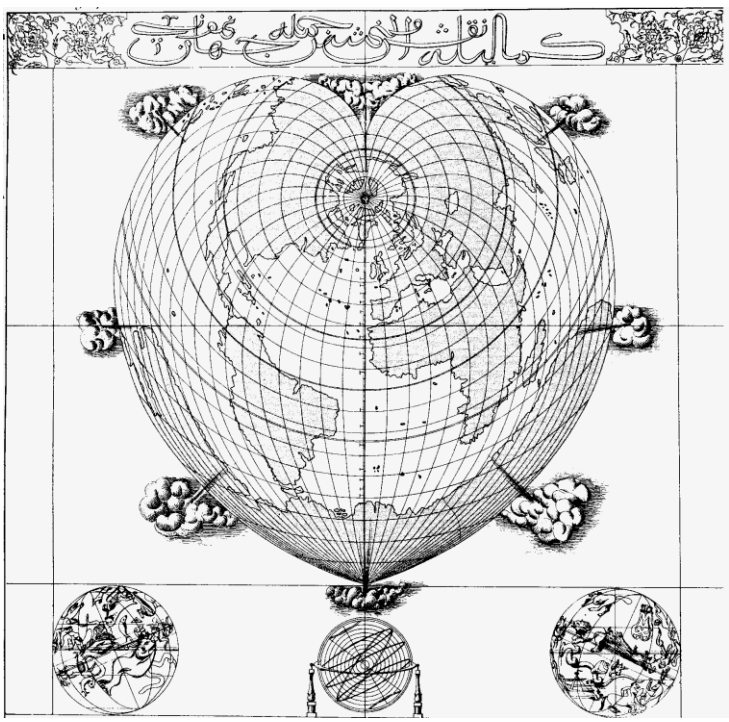


Fig. 5.14 Hadji Ahmed World Map (1550AD)

Finally, to illustrate the skill of Islamic mapmakers we include a late example [there are earlier exemplars] – the Hadji Ahmed World Map of 1550AD, which displays their skill in spherical geometry.

5.4 Mappa Mundi Charts

There was a considerable overlap between techniques in the mapmaking profession in Mediaeval Europe. Three types of chart were in use during most of the period. The oldest of them the *Mappa Mundi* style of map, which was mainly supplanted by the *Portolano chart* from the middle of the 15th century. Both styles of map were in use long after a more modern form of map started to be produced by the mainly shore bound cartographers, such as *Mercator.* This third type of map started developing the projection first promulgated by Ptolemy some 1,400 years before. The question obviously arises - why did it take so long for this method to develop? The answer probably lies in the religious and political turmoil that existed in Europe and Western Asia from the time of the Roman Empire turning to Christianity,

until well into the Renaissance. In addition this period saw several climatic downturns and a succession of plagues. As seen in the previous section, we have the world of Islam to generally thank for this latter knowledge of map-making to have reached the late European Middle ages at all.

The Mappa Mundi type of chart is depicted by Christian scholars as least as early as the 7th century AD and had a basic religious purpose, for example often including the location of Paradise or Eden, and commonly depicting mythical people and animals. To the modern viewer, these appear confusing, even chaotic, and yet are simplistic in their presentation.

The Mappi Mundi chart has its roots in the maps of the early Classical Greeks, such as those of Homer and Hecateus that were simple representations of Asia, Africa and Europe surrounded by the *Ocean Sea*. This representation of the Earth had its model in the work of St. Isidore of Seville in the early 7th century AD in his *Etymologiarum sive Originum libri XX* which was a 'compilation of compilations' of the knowledge of the day in the early Christian world. This work was hugely influential on later mapmakers and scholars up to the early 17th century and the basic form of the Mappi Mundi [seen in an example of such a map in Figure 5.15] seen in it, carried on until that late date. [36]

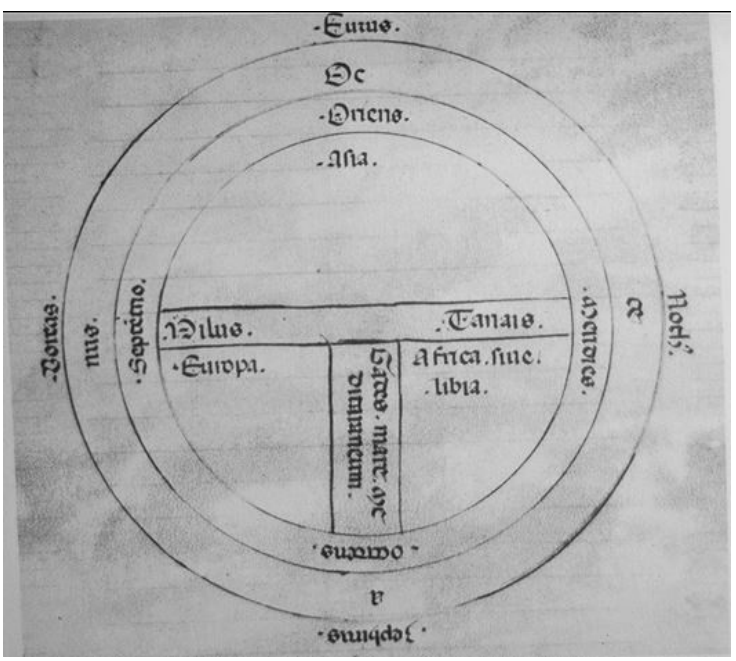


Fig 5.15 T-O map of unknown origin

In this format of mediaeval Christian maps, the authority of the Bible was paramount; in them we see that the three sons of Noah, namely Shem, Ham and Japeth each received a region of the Earth. The idea of the surrounding *Ocean Sea* was combined with this biblical concept to form the schematic world map that became so familiar in medieval Europe, and is

now known as the T-O map. Its structure was simple: with East at the top, three named continents were separated by the Mediterranean and by the rivers Don and Nile. These waters then formed a T within the O of the encircling Ocean.[37] This basic form of T-O map became elaborated by the addition of many place names, along with images from the Bible and medieval legend. Such additions to the basic T-O map coalesced into the Mappa Mundi type of map, the larger examples of which grew into encyclopaedias of medieval belief. These supposedly religion-based charts were copied, modified and recopied with little adaptation until late medieval times. The 14th century AD map that can be seen in Figure 5.16 demonstrates an example of this type of artistic creation. This map is the famous *Hereford Mappa Mundi*, which is typical of its type for the period, albeit one of the better known.

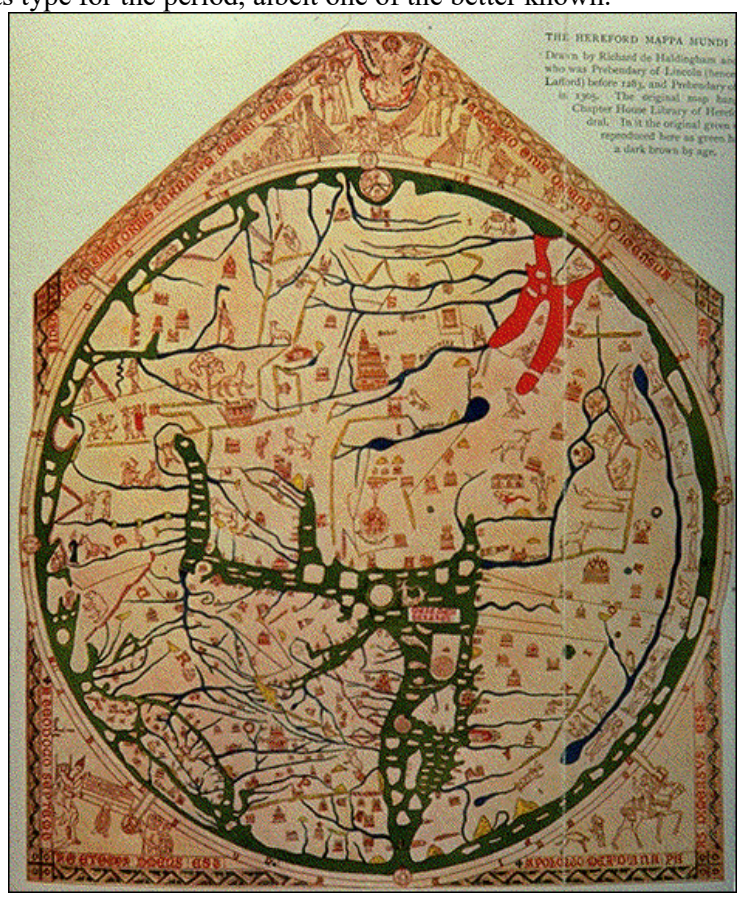


Fig 5.16 Hereford Mappa Mundi

The map at Hereford is one of the largest of the Mappa Mundi charts known to have been created, and one of the best preserved. There are many others in existence, but all have the same common basic design, no matter how good or bad the depiction.

They all show the Mediterranean and the Holy Land, with the centre of the world at Jerusalem, and as might be expected; those that have survived until today are located in religious institutions, such as Hereford Cathedral. But there is more to these charts than one would initially expect. Henry Davies describes the key features of the Hereford Mappa Mundi:

'This is the largest map of its kind to have survived intact and in good condition from such an early period of cartography. It has been preserved in Hereford Cathedral (England) for almost 700 years, and, besides its antiquity, it is notable for the quality of its workmanship and for the variety of the drawings that adorn it. For this map the entire skin of a calf had to be properly treated to make writing and colouring possible. Calfskin prepared in this manner is called vellum (from the Latin word vitulus, a calf). The vellum, measuring 1.65 x 1.35 m, is attached to a framework of oak, the actual map being set in a 1.32 m diameter circle'[38]

This is a large and very old vellum, which can be assumed to have stretched a little over the hundreds of years that it has been in its oak frame.

This needs to be remembered when the measurements above are examined in an Imperial context [where 1m = 3.280839895 feet].[39]

1.65 m = 5.413385827 feet
1.35 m = 4.429133858 feet
1.32 m = 4.330126614 feet

Given the close correlation of the dimensions seen above, it is a reasonable assumption that the original intention was for a rectangular velum of 4.4 x 5.4 feet, which would give an area of 23.76 square feet. [*2376* is another factor related to the measurement system in use in the ancient world].

The circular map has a hidden reference to the Michell's Earth circumference in use in the ancient world and there are three items to take into account here when evaluating the dimensions of this map.

- 4.330126614 feet is almost exactly 4.32 feet [within 0.121519368 of an inch, or fractionally over 3 millimetres, well within the measurement tolerance of +/- 5mm which we need apply to such materials]. *432* is factor which occurs and re-occurs in the world of ancient symbolic numerical values, for example it was seen in Chapter 4 that the stade of Dicearchus was 432 long Greek feet in length.
- One commonly utilised ancient value for π in antiquity was 3.1418181818r [which we note is more accurate than the other value frequently in use in ancient times of 22/7] Another value in common use in the ancient world was 0.968 feet or 11.616 inches.
- If we take the diameter of the map as 4.32 feet and use the above value of π, the circumference of this map would be calculated at 13.572654545 feet and by using the 968 x 10^4 as a multiplication factor we see that :

13.572654545 feet x 9,680,000 = 131,383,296 feet = 24,883.2 British miles -Michell's circumference of the Earth.

Given the closeness of the fine numerical evaluations to the published figures, it appears that this famous map, despite not being of any great cartographical value, has correlations with the anciently understood measurements of the Earth. This is possibly not surprising when one takes into consideration what Davies has to say about St. Isidore's knowledge of the Earth's dimensions:

'As to size, Isidore accepts Eratosthenes' estimate (via Macrobius) of 252,000 stadia for the circumference of the earth…'

However, Davies continues:

'One stadia equalled 625 feet in Isidore's calculations, but by employing the more usual reckoning of 8 stadia to the mile and 87.5 miles to the degree, he obtained the grossly exaggerated figure of 31,500 miles for the circumference, vice 25,000 miles…' [40]

The above again indicates the somewhat garbled understanding of the knowledge handed down from the Classical world.

However, the Hereford Mappa Mundi is far from being the only such depiction that exhibits knowledge at this period of the ancient value of the circumference of the Earth. Another example of the Mappa Mundi type of chart is the 1364-1372AD map from the Chronicles of St. Denis, drawn by an unknown artist [Figure 5.17]. Henry Davies comments on the St. Dennis Mappa Mundi:

'This world map exemplifies the type of medieval map so often criticized by historians and cartographic scholars of the past for its lack of both geographical knowledge and of a scientific approach to mapmaking. …
This type of map would be used to illustrate the retardation of the science of mapmaking and of geographical knowledge during Europe's Dark Ages…
A product of the late 14th century, it does not demonstrate any acquaintance with the travels of Marco Polo, the Arab trading activities in the Far East, the Catalan mapmakers' portolano style with the accurate coastlines and rhumb lines, etc. However, it is this type map that also exemplifies the attraction of the maps from this period…
… this type of map should not be evaluated on the same basis as one would a true cartographic effort. The creator of this map did not have as his intention to portray the entire oikoumene, or known world; nor did he intend this map for navigational purposes or even to locate well known places for his readers. Instead this map was intended to illustrate a treatise and to convey a conceptual view of the world. These maps are artistically and aesthetically attractive, and their lack of accuracy only adds to their quaint naivete that in itself is appealing. [41]

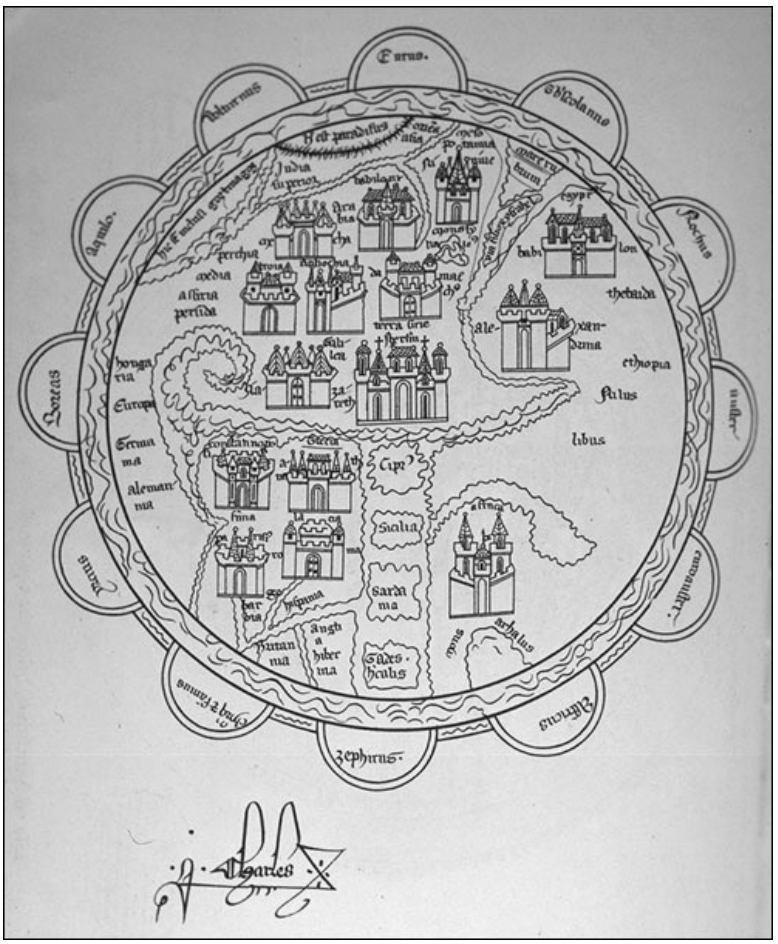


Fig. 5.17 World Map from the Chronicles of St. Dennis 1364 -1372 (Santarem facsimile) (orientated with East at the top)

What is therefore seen here in the *Mappa Mundi* charts is a worldview little different to that of Homer's and others of the type also indicate the dimensions of Earth in a similar manner to the Hereford map. These charts, nevertheless, were soon to be mainly supplanted in the Renaissance by a new form of chart with quite a different layout – the so-called *Portolano* chart.

5..5 The Portolano Chart

The word *Portolan* derives from the word *portolani*, which translates into English as *pilots* or as *rutters*. The Portolano had two forms, the first being a written text and the second consisting of an annotated map. The written form is less well known, it being a text that lists places, with the distances and directions to reach them. The James Ford Bell Library at the University of Minnesota [USA] has a fourteenth century Italian book *Portolano del Adriatico e Mediterra* which is an example of the written form of chart, it giving sailing directions from Constantinople to Lisbon. The library also has the first printed book on navigation, *Portolano per tutti I navichanti*. This was printed in Venice by Bernardino Rizus on 6 November 1490AD. The colophon of the book states that it was:

Composed by a Venetian gentleman for the use of all navigators who wish to travel safely.[42]

No maps or illustrations appear in either the manuscript or the book, and some consider this an advantage as texts can give detailed information about dangers on the seas, ports, safe anchorages, and about conditions at sea and on shore**,** which cannot be put on maps.

The second form of Portolan is the *Portolano chart*, and they predate the printed books mentioned above. The *chart* element of a *Portolano chart* makes it clear that what is being referred to is a map complete in itself, not a map illuminating a text. The word chart derives from the Latin *carta* meaning napkin or tablecloth. Features that usually appear on Portolano charts include: a network of lines made within a circle, coastlines of lands, place-names, scales of distance, a compass showing cardinal directions, and indications of shoals, reefs, and islands along coastlines.

Genoa and Venice in Italy were the first known centres of Portalono chart production with Catalan mapmakers, particularly in Majorca, following this technique later.

The earliest surviving Portolan chart is from the late 13th century, about 1290AD and is now located in the *Bibliothèque Nationale* in Paris. Called the *Carte Pisane* because it was owned by a Pisan family, its maker is not known. The map's birthplace is uncertain, but most scholars believe it was made in Genoa. The writing on this chart is in several languages, which is not unusual for the time, and this is one reason why the origin of many Portolano charts is difficult to determine. The Carte Pisane holds an unusual distinction in the history of mapping - although it is the earliest Portolan chart known, the Carte Pisane has all of the same physical and intellectual characteristics of the Portolan charts that come after it. This unusual feature of the history of the Portolano chart has long puzzled scholars such as Peter Whitfield, [43] as the Carte Pisane has the grid pattern based on circles and compass directions that later Portolano charts have, and its portrayal of the Mediterranean is startling in its accuracy. Scholars often ask the question – 'Where are the earlier charts showing the development of this form of mapping?'

If we look at the date of the first known Portolano chart noted above and the developments in mediaeval geographic knowledge and Islamic science then it is not hard to see the probable link, although the precise point of contact is not known. The later

Islamic/Ptolemy - style map [Figure 5.14] used as an example of the prowess of the mapmakers in the mediaeval Middle East also just predates the first Mercator map [discussed later].

The conclusion is clear – the explosion in map-making capabilities at the end of the 13th century was due to the Arabic amplification of the knowledge of Ptolemy over a thousand years before. We shall reinforce this assertion later when we look at the scales of some famous charts.

On Portolano charts prior to 1500AD, distance, direction, and coastal features were provided for navigators, with information to enable them to calculate and measure the progress and direction during a voyage [although mariners still had to rely on their experience]. Modern sea charts have many of the characteristics of the early Portolano charts – scale, compass, details of coastlines and harbours, and little detail in the interior. The precise definition of the Portolano as a sea-chart however is difficult.

This is because the assertion that these charts were made for use at sea alone has its weaknesses, since some of the charts were clearly made for the use of viewers who never left land. In considering this aspect of Portolano charts, Peter Whitfield concluded that:

'*Perhaps all we can say to define the sea-chart is the most obvious fact that the chart is centred on the sea, and the land is on the margins, rather than vice versa'* [44] [Note: Whitfield is discussing sea-charts from very early times to the present, not just early Portolano charts]

One important fact about Portolano charts should be stressed: they appeared at the same time that Europeans began using the magnetic compass, which, as far as can be ascertained, was a Chinese invention, probably appearing during the Qin dynasty [221-206 BC],[45] but seemingly not used for navigation by the Chinese until about 850-1050AD. Whilst there is some evidence that the compass was used for navigation in Europe in the late 12th century, it did not see general use until much later, in the late 14th century.

The Portolano charts have a different projection method to the latitude/longitude system with which we are familiar, as they utilise an eight or sixteen point *wind rose* system [see Figure 5.18]. This was probably devised by mariners, and allowed for the practical application of the compass bearing, as well as giving reference to various star-sighting points.

The famous *Piri Reis chart* [examined later] is of the Portolano type and the accuracy of this chart, irrespective of general criticisms, is really quite good considering the available technology. Applying the Eight Wind system to the Piri Reis chart, it can be seen that it does link up well with the chart as a whole, but additionally ties in with a similar equidistant projection of modern times. Figure 5.19 is a section of a United States Air Force map showing a section of an equidistant projection centred on Memphis in Egypt. Utilising this method, the distortion of the coastline of the Eastern United States on the map, is almost exactly that of the Piri Reis chart. It appears that a convention of dividing the geographical and cartographical circle by 16, has continued into modern times for the above link between the points on the circle and the Portolano projection points to coincide.

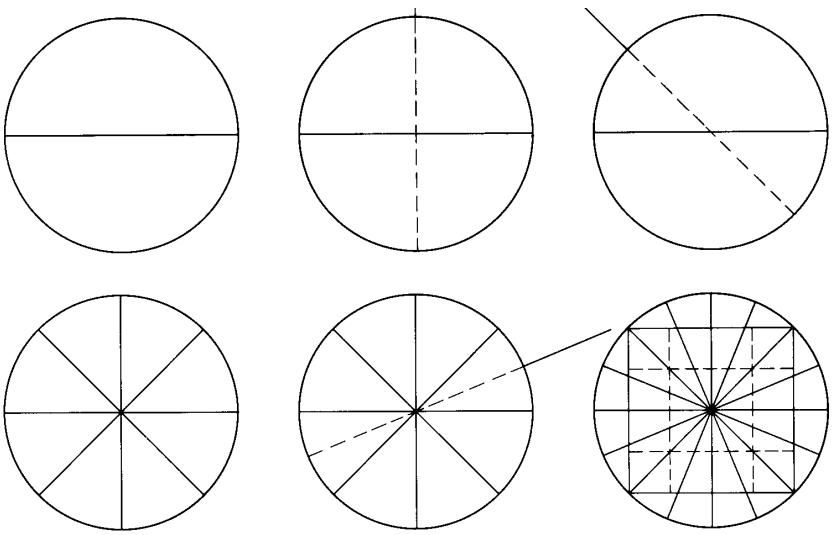


Fig. 5.18 The Eight wind System used on Portolan Charts

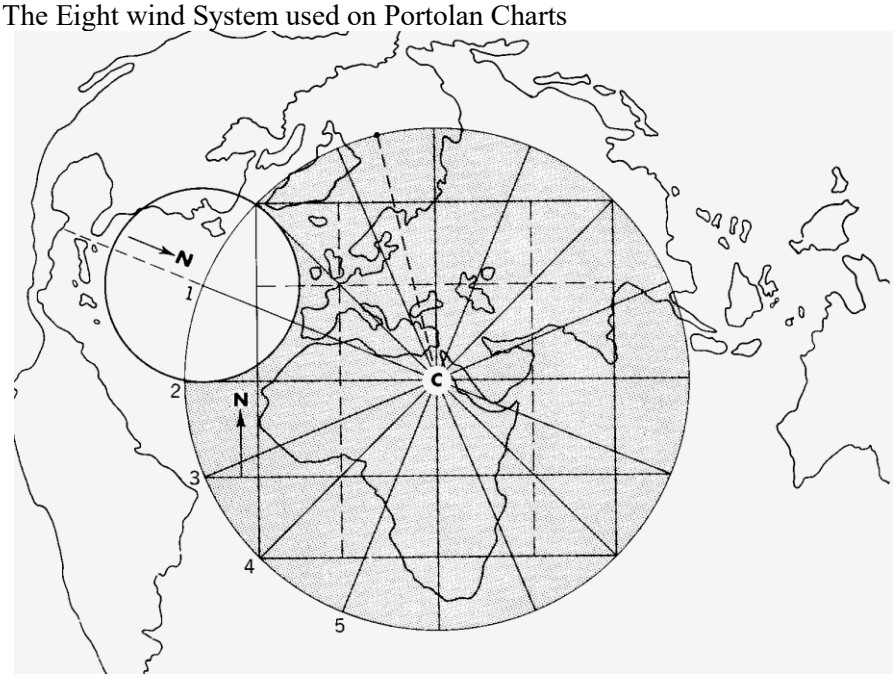


Fig. 5.19 Piri Reis Portolano Projection [after Charles Hapgood] imposed upon an Equidistant Projection of the world centred on Cairo. The numbers on the outside of the larger circle correspond to the projection points of the Portolan Projection

Fig. 5.20 Oliver Francisus Portolano Chart of 1650 AD

As a late version of an excellent Portolano chart we include a Mediterranean map dated to 1650AD**.** This chart [Fig. 5.20] is by Oliva Franciscus, and again demonstrates the techniques of the Portolano construction. Another example by Albino de Canepa, a Genoese cartographer, demonstrates the slightly different Italian style [Fig 5.21]. Further examples can be found at the United States Library of Congress.[46]

Fig. 5.21 Canepa Potolan Chart of 1489AD

5.6 Christopher Columbus

We have all been thought that Christopher Columbus was the first modern European to discover the American continent in 1492AD. What is not so well known is what Columbus knew of the geography and geodetic nature of the Earth prior to his voyage. This is exacerbated by some incorrect notions of the historic belief of a flat Earth, which, for example, is still taught in many elementary schools in the United States. As a result of this erroneous teaching, a large proportion of the general public hold the view that people of mediaeval times thought the world was flat. This is demonstrated by a recent study of students and adults by an American educational institution, which found that 90 percent of both groups believe that people in Columbus' era thought the Earth was flat. Where this perception comes from is still a matter of debate, particularly as it ignores the question of - if Columbus was planning to sail to the Orient why was he sailing to the West? [47]

As regards the flat Earth idea, nowhere in the historical records is it discussed. In addition, considering the amount of pointers available to anyone [particularly navigators], such as the often quoted 'boats going over horizon' example, there can be little doubt that Columbus thought the world was spherical [and so, in contrast to the absurdity taught later in places of education, did virtually everybody else].

As a teenager, Christopher Columbus learned the arts of navigation and seamanship. He was also an avid reader of the scholarly texts that were available to him at that time, and in 1476AD set up a mapmaking business with his brother in Genoa, Italy. He eventually tired of being land bound however, and returned to seafaring where his theory of a direct, trans-oceanic route to Asia was developed. One might assume that others drew the chart that Columbus was said to have utilised on his voyage [see outline in Figure 5.22 and detail in Figure 5.23] as he was *apparently* not much of a navigator. This was possibly seen, if we take note of Admiral Morrison's comment on the errors of Columbus's first voyage,

...we have only three latitudes (all wrong), and no longitude for the whole voyage.[48]

Having spent a number of years at sea and having a map-making business with his brother, he would be a sound navigator, making. Morrison's comments sound more like a case of sour grapes than constructive criticism.

Marianne Mahn-Lot comments in her book *Columbus* concurs with our view:

'Columbus was one of the best navigators of all time. His dead-reckoning navigation was incomparable, but his theoretical knowledge was weak. We cannot, however, reproach him for not using celestial navigation, for at the time this was not one of the tools learned by apprentice-pilots; it was used only after landfall "to determine the latitude of the regions discovered in order to map them."' [49]

Fig. 5.22 Anonymous Genoese Chart (C.Columbus?) circa 1490AD. Outline drawing of circular Portolano world map orientated with north at the top.

Fig. 5.23 Portolano detail of Figure 5.22

While Columbus may well have had authentic, reasonably accurate charts aboard when he undertook his transatlantic voyage, it appears that his knowledge of the Earth's geography was no better than any of his contemporaries. On the source of this geographical knowledge [which transpires to be basically that of Ptolemy] Marianne Mahn-Lot has this to say:

'[Columbus']basic ideas of what the world was like came from charts in Ptolemy's "Geography" (though as we have seen he followed the calculations of Marinus of Tyre and thus thought that Asia stretched even farther eastward). Since the time of Ptolemy, navigation charts had shown no territory farther east than a place referred to as Cattigara...Maps of Asia stopped there, and farther to the south a long arc of a circle was drawn, linking Asia and South Africa, and bearing the legend "Terra Incognita"--Unknown Land. Columbus believed that he had entered these environs: in [a] letter he says very clearly that he has discovered "a new hemisphere, unknown to the ancients." This is an important statement, for it is not too different from the one for which Amerigo Vespucci is renowned: "Ptolemy and other sages who described the world said that it was spherical, like the hemisphere in which they lived...But there is another half of the world of which they had no knowledge."' [50]

What is reasonably certain is that he did not know that North and South America existed, as they do not feature on his map, *and indeed do not feature on any known Portolano map prior to 1492AD*. However Columbus may not have been oblivious to all of the geography of the Americas.

It should be recalled at this point that North America had been visited several times by Europeans before 1492AD:

'Greenland was discovered in the 10th century by a Northman, Eric the Red, who sailed from Iceland; that a colony and a bishopric were established there; that Leif, the son of Eric (as has apparently been proven today), explored Newfoundland, Labrador, and a mysterious "Vinland" (currently identified as the region in the United States around Cape Cod.) The Scandinavian settlements in "Green Land" declined in the 12th century, but the memory of them was not dead, for at the end of the 14th century the Zeno brothers, who had settled in the Faroe Islands, sailed there and found traces of Christianity. (Their extraordinary adventures were not known, however, until the 16th century.) And in the year just past--1476--the King of Denmark had sent an expedition to Green-land with a certain John Scolvus as chief pilot.' [51]

It does not appear however, that any of the above was known in late 15th century Portugal. Even so, Marianne Mahn-Lot comments that Columbus may have been aware of ideas of a new continent being aired in Lisbon and elsewhere:

'Recent Portuguese historians...even believe that there were people in Lisbon who already suspected--or were certain of--the existence of the continent of South America. The testimony of Columbus himself on this point still puzzles us: during his third voyage to the New

World in 1498 he sailed very far south, to the latitude of Sierra Leone, before setting a course westward, "in order to verify," he writes, "what Dom Joo maintains: namely, that there lies toward the west a very large mainland." (Columbus did indeed find such a mainland, along the delta of the Orinoco.)' [52]

Gavin Menzies asserts that Columbus had seen a Portugese Mappa Mundi chart that showed some of the islands of the Caribbean, one that was produced by the Portuguese school of Henry *the Navigator* who is known for sponsoring the discovery of the Azores, amongst many other trading and colonisation missions.[53] There is also a possible linguistic back-up to this idea regarding the etymology of *Antilla* [the islands in the Caribbean]. Georgeos Diaz-Montexano has this to say about the Berber tribes' usage of the name and its root:

'...the Antilles Islands in old Portuguese (Anti-illa) means the 'island that is ahead' or 'the island facing'. Diaz goes on to quote the UNESCO academic Cortesao for more detail: …

..."The origin and meaning of the word Antilia has been the subject of much controversy. In fact Antilia is composed of two Portuguese words: before or anti and ilha, an archaic form of the Portuguese ilha, i.e. island. It is, therefore a purely Portuguese word and was meant to designate an island discovered perhaps at the beginning of the 15th century by some unknown navigators, probably Portuguese – lying before the continent which at first might have been thought to be Asia or opposite the European Continent (Corttesao 1954, p106)" ' [54]

Menzies also more sensationally asserts that this information that the above map was based on came from China, whose navigators apparently circumnavigated the world in a series of voyages in 1421-1423AD. Menzies' *1421*, the product of 15 years research, [56] has challenged accepted views of the history of world exploration. While much of the content of *1421* has been highly disputed by academics, his ideas about this Chinese expedition in the context of this chapter could answer many unsolved questions, as seen a little later.

To summarise, Columbus was possibly aware of islands that existed to the west of the Canaries [from whence he travelled westwards on the 28th parallel]. In addition, he may have heard that a previously unknown continent existed somewhere in the western ocean. However, it is well documented that he was actually convinced that he had got to the eastern edges of Asia on his early voyages, hence the 'West Indies' designation for the islands of the Caribbean that he employed.

Some authors also assert that Columbus was convinced the world was much smaller than it really is. For example, in her paper on Mahn-Lot's work, Janet L. Dotterer discusses what was understood as the circumference of the Earth in the late 15th century:

'In the late 1400s there was much debate as to the actual circumference of the earth. All geographers agreed the earth was round and divided into 360 degrees. But how long is a degree?...

... In 200 B.C. Eratosthenes calculated it to be 59.5 nautical miles, it is actually 60 (51 contemporary miles). Al-Farghani calculated it to be 56.66 Arabic miles or 66.2 nautical miles (approximately 56.2 contemporary miles), but Columbus assumed the Arabic mile equalled the Roman or Italian mile of 1480 meters or 45 nautical miles (38.22 contemporary miles). With these calculations Columbus's earth was 25 percent smaller than Eratosthenes had calculated. [56]

The statements above have probably never been examined in a metrological context. That omission is rectified here by making the following comments:

i) As seen in Chapter 4, Eratosthenes was correct in that his stade value of 24883.2/252000 miles x10 gave his mile of 0.9874285714 British miles. The Nautical mile is $1^1/_6$ conventional miles and when applied to Eratosthenes unit gives a unit of 1.152 British miles. This is equivalent to Michell's minute of arc and so if this is multiplied by 60, the result is 69.12 British miles or a degree of arc. Hence there are 70 of Eratosthenes miles to the degree. So Dotterer's assertion that Eratosthenes calculated a degree of arc to be 59.5 nautical miles is not far off the mark, just half a mile and much closer than that quoted by many other Classical historians.

ii) We will pass on the 'Arabic' miles of Al-Farghani as they do not seem to fit into the measurement system of antiquity as we term it in any discernible way.

iii) The Roman Mile was actually 1483.1714m [*Long* version] which should be compared to the quote of 1480m above and making 75 to the degree, or 1474.74432 m [*Short* version].

iv) The whole idea that Columbus thought the world was 25% smaller than it really was, is clearly nonsense - as a trained navigator he would have known that a minute of arc was about 60-70 miles in length and like all those involved with mathematics and related skills would have been aware of differing mile values and their connecting factors. However, if we look at this 45miles = 1degree assertion in a different way we find that there is no excuse for thinking he saw the world as smaller than it really was. If we use the *Piemonte* or 'Italian'mile of 1.536 British Miles [as noted in Chapter 6] as the mile in use [not an unreasonable assertion] then we arrive at 69.12 British miles – the correct value. 45 x 1.536 = 69.12.

5.7 Maps: Secrecy and Survival

Fewer than 100 Portolano charts created before 1500AD survive, and there are a number of reasons for this situation. Possibly the principal explanation was their value. For example in Spain, along with the efforts of their mathematicians to produce accurate astronomical tables for navigational purposes, there was a desire to maintain secrecy regarding new trade routes. Charts therefore were of the highest value to the state and to the merchants who worked closely with it. Indeed, upon completion of any voyage, the pilot was obliged to hand over his manuscript notes to controllers in the Casa da India in Lisbon or at Casa de

Contratacion de las Indias in Seville [both founded in 1504AD]. As Lloyd Brown, in his *The Story of Maps*, noted:

'At the outset, sea charts, by their very nature, were destined to be removed from the academic realm and from general circulation. They were much more than an aid to navigation; they were, in effect, the key to empire, the way to wealth. As such, their development in the early stages was shrouded in mystery, for the way to wealth is seldom shared' [57]

It is understandable therefore, that for the reason of secrecy alone, few Portolano charts have survived. However, there were many other reasons that mitigated against their survival.

Portolano charts were used at sea, and they went down with ships; they got wet and were damaged; they became outdated and were discarded. Another problem is the material from which they are made - vellum, which is animal skin prepared for writing. Vellum was expensive and was not wasted. Sir Thomas Phillips, the nineteenth-century collector of all the manuscripts he could get his hands on, found that his competition included:

'goldbeaters, glue makers and tailors, all of whom derived some advantage from the destruction of vellum manuscripts' [58]

Bookbinders used vellum in binding new books and it seems that the combination of reuse, damage, the discarding of outdated Portolano charts and the utilization of vellum in other ways help to explain their rarity.

5.8 A Historical Anomaly - The Waldseemuller Chart of 1507AD

Fig. 5.24 The Waldseemuller Map of 1507AD (aggregated version)

Waldseemuller, a German priest, was commissioned to produce a revised edition of Ptolemy's 2nd-century AD 'atlas of the world' in the early 16th century.

The Waldseemuller map of 1507AD, on 12 sheets, one of several he produced, is the earliest document known to contain the word America and indeed it is sometimes called 'America's birth certificate'. It is the first map to feature two major oceans, not just one [see Figure 5.24]. It depicts the west coast of America, specifically that of Chile and Peru, quite well. The method of projection is a little misleading and leads to distortion, but as numerous commentators have noted, when this distortion is allowed for, it produces a reasonably accurate depiction of the Pacific coast. There is an apparent anomaly however, as it seems that there may be a sea passage drawn in the region of Panama.

The first European to see the West coast of America and the Pacific Ocean was Vasco Nunez de Balboa in late September of 1513AD, after leading an expedition of 200 Spaniards and 1,000 native Indians across the Isthmus of Panama. [However it was Ferdinand Magellan a few years later who coined the name *Pacific* after its 'calm waters']. [59]

As the Waldseemuller chart is dated to 1507AD and it is believed that Balboa was the first to see the Pacific coast in 1513AD, two obvious questions are raised:

i) Was Balboa's depiction of the coastline an educated guess, [which is unlikely as it was initially commonly believed that this was the continent of Asia]?
ii) Had someone else charted the West coast of Chile and Peru prior to Balbao's visit, and Waldseemuller had obtained this information?

The answers to these related questions are not known – Waldseemuller's life history is sketchy, and we do not have any clear idea of what access to any earlier charts he had. However we can envisage that some unknown chart that depicted this coastline existed, one that had been previously ignored, or thought to be in error, because America had not been discovered.

This 'unknown' chart need not have had a European origin – it is possible to use the coastal navigation system discussed earlier in Chapter 3 to get from the Far-East to America's Western coastline and it may be that the information was derived from a Far Eastern source, itself perhaps notated by the navigators on the voyagers described by Menzies in *1421* as mentioned earlier.

5.9 The Mercator Projection – The Dawn of Modern Mapmaking

A Mercator projection is a mathematical method of showing a map of the globe on a flat surface, and was developed in 1568AD by Gerhardus Mercator [1512–1594AD]. Before this time, navigation charts used by sailors did not correctly account for the [then known] fact that the Earth was spherical. This type of projection is the basis of modern map-making, as noted earlier. Mercator's projection preserved exactly what sailors needed - shapes and directions; they were willing to accept the size distortion, which is more evident at high latitudes, and as we noted earlier all projections sacrifice some aspect of accuracy in portraying their graphical view of a roughly spherical Earth. After displaying an interest in the

mathematics of Aristotle as a young man, one that led to an interest in geography and also got him into trouble with the religious authorities in later life, Mercator created his first terrestrial model of the Earth in 1535AD.

The first map of the world to be produced by Mercator used a projection thought to be ascribed to *Oronce Fine* and appeared in 1538AD.

Mercator's first world-map is notable for being the first to represent America as stretching from the top of Northern hemisphere to the tip of South America, and for giving North America that name. In the next thirty years he produced many excellent maps and globes notably a celestial globe of the same size as his terrestrial globe of 1541AD, which he completed in 1551AD [the positions of the stars being corrected to their positions in 1550AD using Copernicus's model of the universe]. In the last three years of this work he was assisted by Dr. John Dee, a somewhat controversial and mysterious historical character, who is said to have introduced much of the science of the Renaissance into Britain.

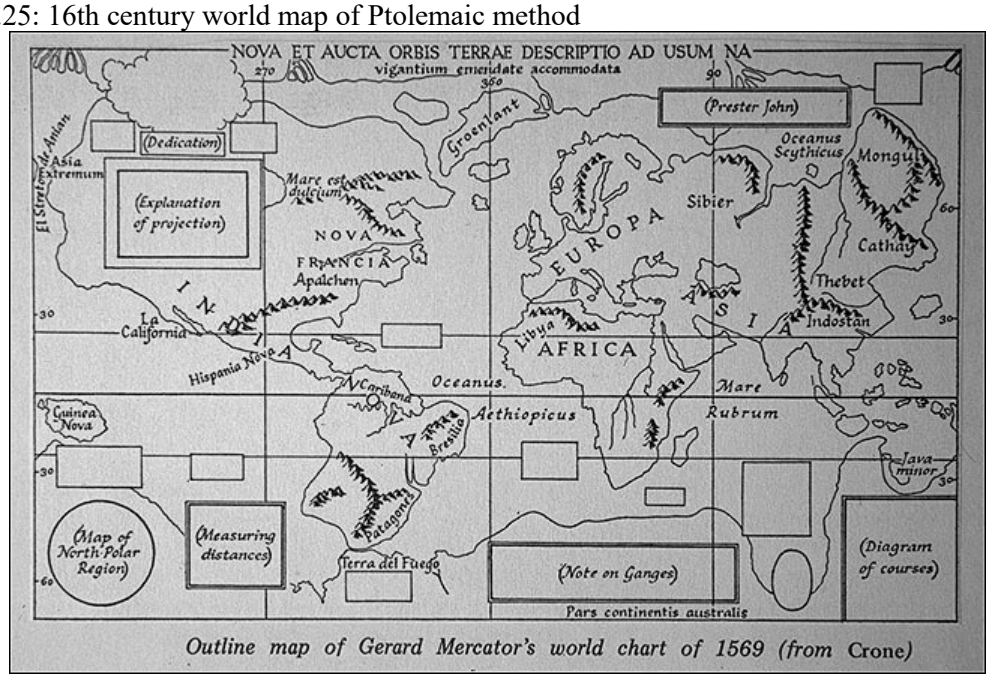
Mercator was appointed Court Cosmographer to Duke Wilhelm of Cleve, in 1564 and during his tenure he began to perfect a new map projection for which he is best remembered - the *Mercator Projection,* which he first used in 1569AD for a wall map of the world on 18 separate sheets entitled: *New and more complete representation of the terrestrial globe properly adapted for its use in navigation.* [60] He first used the term Atlas to describe a collection of maps [named *to honour the Titan, Atlas, King of Mauritania, a learned philosopher, mathematician, and astronomer*) and brought out the first version of his Atlas in 1578AD.

Mercator published, corrected and updated versions of Ptolemy's maps in this collection and also included some earlier Portolano maps such as the *Oronteus Finaeus* map [discussed later]. He also spent many years collecting ancient maps, and is also said to have visited Giza and the Great Pyramid in 1563AD as, much like Newton, Mercator was reportedly,

… indefatigable in searching out...the learning of long ago... [61]

It is from Ptolemy that Mercator got much of the inspiration for his work, as we can see when contrasting examples of maps from them both in Figures 5.25 and Figure 5.26. Mercator finally closed the gap between Ptolemy and the modern world of cartography and ends this examination of the purely map-making side of this transmission of the geographical knowledge of the Classical Greeks to the modern world.

Fig 5.25: 16th century world map of Ptolemaic method



Outline map of Gerard Mercator's world chart of 1569 (from Crone)

Fig.5.26: Outline of Mercator's Famous World Map of 1569.

Before we leave the work of Mercator, we noted earlier that he collaborated with Doctor John Dee for some years. One late eventual output from that work was the polar map seen in Figure 5.27 below [modelled on a Mercator map of 1569AD].

While most map researchers focus on the northern detail of the continents of North America and Asia, [62] it is the centre of this map that caught our eyes– it seems that it may show a depiction of a mountain at the North Pole surrounded by four rivers. This is obviously not a representation of a real geographical feature. There is no recorded explanation of how this representation came about, but given Dee's mystical interests it led us to suspect that it had a cosmological nature.

Fig. 5.27 Polar Map Dr. John Dee 1582AD

The companion work to this volume, titled *Deluge,* demonstrates that the ancient system of measurement discussed here is intimately related to the Great Flood mythologies of Europe and Asia. In the later stages of research it became evident that mountains, or more

specifically one particular mountain was also closely involved with this mythology and it is this mountain that appears to be represented on Dee's map. It is surprising where links between concepts arise, from myth to mapmaking…

5.10 Antarctica and Ancient Maps

The Discovery of Antarctica

Before examining Professor Charles Hapgood's thoughts regarding ancient charts and Antarctica, a concept propounded in his '*Maps of the Ancient Sea Kings'* and followed up by numerous writers since, we shall undertake a review of the history and climatic record of this vast wilderness, that which is depicted in the satellite photograph in Figure 5.28. An understanding of the same gives a different insight into some of the issues relating to these charts.

It has been just over 100 years since humans first occupied the continent of Antarctica [1899AD], and a mere 180 years since seafarers first saw the islands of the Antarctic Peninsula [1819AD]. Yet even before they laid eyes on it, most early explorers were convinced a large, Southern continent existed. As noted earlier regarding Columbus, they called it *Terra Australis Incognita* - the Unknown Southern Land. The idea went as far back to the Classical Greeks, who had a fondness for symmetry and balance.

In 1520AD, after he had sailed through the Strait in South America that now bears his name, Magellan speculated that the land to his South, now *Tierra del Fuego*, might mark the northern edge of a great continent. Fifty-eight years later, in 1578AD, Sir Francis Drake sailed his Golden Hind through Magellan's Strait. He encountered severe weather on the Pacific side and was blown to the south of Tierra del Fuego, then East around Cape Horn. It became obvious that Magellan's so-called continent was merely a series of islands at the tip of South America. If there was indeed a Southern continent, it had to be further south, and it was the severe weather that characterises the South Atlantic that was a key factor in the discovery of Antarctica, as repeatedly sailors blown off course by these storms discovered new land.

For example, while attempting to navigate around Cape Horn in 1619AD, the Spaniards Bartoleme and Gonzalo Garcia de Nodal were blown off course, only to discover the tiny islands they named *Islas Diego Ramirez*. This would be the most southerly-recorded land for another 156 years. In 1622AD, the Dutch pilot Dirck Gerritsz reported being driven by the weather to 64 degrees south.

He supposedly discovered a land with snow-covered mountains, a land similar in appearance to Norway. The accuracy of his latitude calculation is suspect, but it is possible that he sighted the *South Shetland Islands.* In 1675AD, the British merchant Anthony de la Roch was blown far to the East and South of the Straits of Magellan, to a latitude of 55°S, where he found shelter in an unnamed bay on what was almost certainly *South Georgia Island*.

The first systematic search for a southern continent didn't come until the start of the 18th century. In September of 1699AD, the scientist Edmund Halley [of Halley's comet fame, as noted in Chapter 3] left England aboard the *Pink Paramour* to establish the true longitude of

ports in South America and Africa, measure magnetic variations, and search for the mysterious *Terra Australis Incognita*. By January, he had crossed the Antarctic Convergence and on February 1, 1700AD at 52°24' South, Halley made the first recorded sighting of tabular icebergs. Several French expeditions followed in the early part of the 18th century, but it was not until Captain Cook's voyages in the late 18th century that any idea of the possible size and location of Antarctica was estimable. On one of his later voyages at the end of February, 1775AD, Cook crossed his track of 1772AD, thereby completing the first circumnavigation of Antarctica and proving once and for all that the Southern continent, if one existed, was neither as large nor as habitable as once thought.

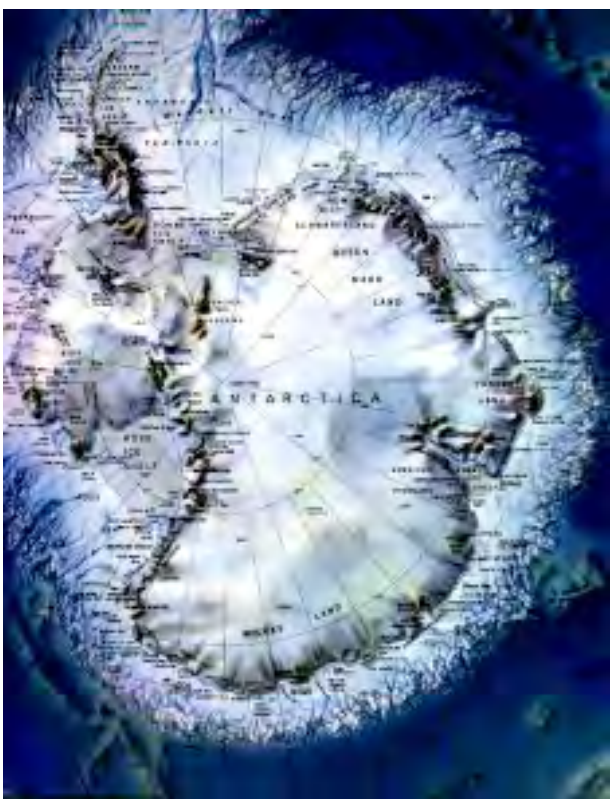


Fig.5.28 Satellite view of Antarctica

Cook is thought to believe there was a southern land mass, but that it was of little use to anyone. The main visitors to the area for the next 40 years were seal hunters who hunted [or rather over-hunted] the large stocks on the island below the Antarctic Circle. It was not until 1820AD that one of the few official expeditions led by Captain Thaddeus von Bellingshausen from Russia first sighted Antarctica proper.[63]

The above history suggests that *nobody* from Europe ever charted Antarctica in the Middle Ages when the Portolano charts were being produced, and provides no evidence to support any theory that the Antarctic continent was mapped either prior to, or during, that time.

There is a second issue we need to address regarding Antarctica before looking at the work of Professor Hapgood – its climatic history. There is an abundance of evidence indicating that Antarctica was covered by a fully developed ice cap between 38,000BC to 4,000BC, the specific era when according to the report in Hapgood's work, it was ice free.

For example there is ice core data, notably from the Vostok project, cores that are over 3km deep and cover the last 220,000 years,[64,65] cores from the Ross Sea,[66] palaeoclimatological data from the tip of South America[67] and numerous radiocarbon dates from glacio-lacustrine deposits and deltas[68]. These and other studies even show that a maximum development of the ice cap and Ross Ice Shelf occurred during the period, 19,000 to 14,000BC,[69] clearly indicating that the climate of Antarctica was completely the opposite of Hapgood's statements regarding the epoch in question. In fact, it is now well known that the last time that Antarctica was ice-free was in the region of 14 million years ago.

Having said the above, some of the Portolano charts still in existence pose some puzzles. Those that show a representation of a Southern continent are usually more accurate in their depiction of Antarctica if they are early examples [such as the Mercator maps of 1538AD and 1569AD, the Oronteus Finius map of 1531AD and the Schoner Globe of 1523-24AD].

This is all the more surprising as some of those of the later period tended to include Australia and even New Zealand, which is in itself a puzzle, as even the later maps predate the normally accepted dates of the discovery of these lands by Captain Cook in 1770AD and 1769AD respectively. However the actual history of the discovery of Australia and New Zealand is not as clear-cut as it appears.

For example, it is not even known for sure even how the name New Zealand originated. Abel Tasman actually landed on New Zealand in 1642AD although he thought he had landed on the Southern Continent for which he had been searching. He named this land *Staten Landt*, which refers to the *Land of the (Dutch) States-General*, although he never returned, due to problems at home with the Portugese.

There also was previous knowledge of New Zealand in the Western Pacific, due to information disseminated by the Polynesians who arrived [and then settled] there in their twin hulled or outrigger canoes around 950-1150AD, after using their exceptional navigational skills to cross the Pacific. Maori oral canoe tradition tells us of this voyage - *Kupe*, one of the great Polynesian navigators, who set sail from the mythical *Hawaiiki* [perhaps near either Hawaii or Tahiti] in his *waka* [pirogue] *Mata-hou-rua* arriving at New Zealand, or *Aotearoa - Land of the Long White Cloud.* [70]

The early history of the exploration of Australia is similarly murky. The first modern human inhabitants of the continent of Australia, the ancestors of the Aboriginal peoples, migrated from somewhere in Asia to Australia about 50,000 to 60,000 years ago by walking across land bridges, and sailing between the islands of South-East Asia. At that time the sea levels were much lower than they are today. These hunter-gatherers quickly colonised the whole continent, and were the only inhabitants of Australia for over 50,000 years, numbering

some 300,000 to 750,000 at the time of the first European settlement in Botany Bay in 1788AD.

In the first millennium AD, The Chinese, Malays, Hindu and Buddhist colonists of the islands of Southeast Asia suspected the existence of a *Great Southland*. Its image was even found on many maps. Later, Muslims and Bugis trepang fishers also knew of Australia, otherwise known as the *North Coast*. It was much later that Europeans first learnt of the continent of Australia, but precisely when that was is difficult to identify. A series of maps from France between 1536-1567AD, based on Portuguese originals, show a large landmass named *Java la Granda* which many scholars claim is proof of the Portuguese discovery of Australia, but they are independent of any actual voyage. There is also a questionable account of a supposed discovery of Australia by a French navigator by the name of De Gonneville in 1504AD.

The first European whose claim to having sighted and landed on Australia can be substantiated was Dutch sea captain who set sail under the command of the Dutch East India Company to explore the South coast of New Guinea. *Willem Janszoon* captained *The Duyfken,* which went 220 miles along the previously undiscovered [by Europeans] part of New Guinea, then into the Torres Strait. They then continued to head south, and in 1606AD Janszoon and his crew sailed beyond Papua New Guinea and encountered the Cape York Peninsula of Australia, sailing along the coastline for some 200miles. Willem Janszoon was the first European to record his voyages to Australia and because of his discovery, Australia was first known as *New Holland*.[71]

Whilst there may have been knowledge of Australia and / or New Zealand in the Western Pacific region in the early 2nd millennium AD or even earlier, this would not answer any questions regarding the early Portolano charts and Antarctica. Even if we accept that pre-Renaissance sea-farers had charted Antarctica, we have to ask how they were able to do it when, as was seen above, the early European explorers found the waters of the Southern Ocean so treacherous.

In *1421*, Menzies possibly solves the first part of the puzzle, if his assertion that Chinese sea-farers circumnavigated Antarctica in 1421-3AD is correct.[72] Climatic evidence may give the answer to the second part of the problem. Between the 10th and 14th centuries AD the average global temperature was about 1 degree Centigrade warmer than it is today, whilst between the 16th and 19th centuries it was between 1-2 degrees colder, a period that some climatologists call the *Little Ice Age*. In the 15th century, between these two periods, the average global temperature was similar to today.[73]

A degree or two variation in the global average temperature may not sound much, but this amount of change can have major ramifications, as we see today with the projected effects of global warming. Any change in the average temperature is amplified by the weather systems driven by the world's oceanic currents, which affect some parts of the world more than others. In the case of Antarctica, a 1-2 degree fall in average temperature would have produced a much greater number of violent storms in the 17th – 19th centuries, than in the preceding 5 or 6 centuries. Due to the thermal inertia of the Southern Ocean, the average temperature of Antarctica in the early 15th century may not have been much different to that of the 14th century,

the end of the previous warmer period, making navigation around the continent no more difficult than of recent years.

This may explain how Menzies' Chinese seafarers were able to circumnavigate Antarctica relatively easily. Through contacts with the Islamic world, and the reports of travellers, any Chinese knowledge of Antarctica may well have filtered through to 14th/15th century Europe, and gives an explanation for its early representation on Portolano charts. There may then be an answer for the mysteries of the Portolano charts from Menzies work. However, in the years since *1421* was published Menzies claims have been much criticised by scholars. If, as claimed by many academics, Menzies ideas are incorrect, then there must be some other answer to the knowledge contained in these charts, but academia has, as yet, singularly failed to supply this missing information.

Charles Hapgood and Portolano Charts

Perhaps the name most commonly associated with research into the mediaeval period of cartographic development is Professor Charles Hapgood. It is most unfortunate that Hapgood became engrossed with the notion that the Portolano charts were generally pieced together from remnants of much older works. Hapgood additionally was convinced that some of these charts showed Antarctica prior to it being frozen over, an impossibility as we have seen, as the Antarctic ice cap predates even the ancestors of modern humanity by 12 million years.

His work *Maps of the Ancient Sea Kings,* first published in 1966 and reissued in 1979, has been, and still is, consistently mentioned in the context of map research, predominantly by the so-called fringe brigade. It is a pity that more serious researchers have additionally been drawn into the web of self-deceit that Hapgood created. Let us very briefly examine Hapgood's thoughts regarding the *Piri Reis* Chart [Figures 5.29 and 5.30]:

'Piri Ibn Haji Memmed was a Turkish admiral or Re'is, who produced, or at least, utilised and put his name to, a number of charts. He has in modern times become known as Piri Re'is. One of his charts, now commonly known as the Piri Re'is chart has been credited with an importance that is out of proportion to its real value. Although it shows the coastline of America and parts of Africa reasonably accurately, for its time, it is also thought to portray part of the coastline of Antarctica.' [74]

Piri Reis was born sometime between 1465AD and 1470AD in Gallipoli, a town on the strait linking the Marmara Sea to the Aegean, where the inhabitants had been seafarers for many generations. He owed his own place in Ottoman nautical history to his uncle Kemal Reis, a famous Turkish corsair and admiral who was feared throughout the Mediterranean during the last quarter of the 15th century.

Until 1492AD, Piri Reis served with his uncle on his pirating expeditions along the coasts of Spain in the western Mediterranean. At the request of Sultan Beyazid II [1481-1512AD], they abandoned piracy to become naval commanders, and after the death of his uncle

in 1510AD, Piri Reis returned to Gelibolu, where he began work on his *Book of Navigation*. He completed his world map in 1513AD, and his book of maps in 1528AD [with an addition on North America in 1528AD], which was presented to the Sultans of the day, the latter book being notably presented to *Suleiman the Magnificent*.[75]

Fig. 5.29 The Piri Reis Chart of 1513AD

Fig.5.30 Part of South America from Piri Reis Chart of 1513AD

Halil Edhem Eldem, the director of National Museums, discovered Piri Reis's world map at Topkapi Palace in 1929AD. The map was examined by the German orientalist, Professor Paul Kahle, who was engaged in research in Istanbul at the time. Kahle reported on the map to the eighteenth Congress of Oriental Studies in Leiden in 1931. Meanwhile, the map was taken to Ankara, where other historians examined it, and Atatürk ordered a facsimile reproduction of the map to be printed.

As is seen in Figures 5.29 and 5.30, the map is drawn on camel skin, with illustrations in nine different colours. It is 86 cm long, 61 cm wide at the upper edge, and 41 cm wide at the

lower edge. Close examinations shows that the right-hand section of the map has been torn away, although the discrepancy in width between the upper and lower edges is due to the natural shape of the skin. The surviving half of the map shows the East and West coasts of the Atlantic Ocean. The coastlines of North and South America, the Antilles, Northwest Africa, Spain and France correspond closely to modern maps.

The map is a typical Portolano chart, with 5 compass roses and lines showing direction in place of lines of latitude and longitude.

It is decorated with mythical and realistic pictures, including a number of ships and place names, and is annotated with dates of discovery, legends about the places shown and explanations of how the map was compiled. It is also centred at the intersection of the Alexandrian meridian, 30 degrees east, and 30th parallel. Giza, a little to the south, at 29 degrees 45 minutes north and 30 degrees 57 minutes east is merely 59.5 miles away.

The map was re-plotted by Hapgood and his students on four separate grids. Two of these were parallel, although offset by a few degrees and were, rather strangely, drawn on different scales. A third grid is turned clockwise almost 79 degrees from these two, while the fourth grid is twisted counter-clockwise nearly 40 degrees, and additionally drawn at approximately half the scale of the main grid. There are five different equators on the map due to insertions into the various grids and the venerable professor made the following assumptions:

- A loss of 4.5 degrees of longitude on the North coast of South America.
- A loss of about 900 miles on the east coast of South America.
- Omission of the Drake Passage between South America and the Palmer Peninsula, amounting to 9 degrees of latitude.

The Amazon River, however, for some unknown reason is drawn twice. The Queen Maudland coast of Antarctica, for all Hapgood's claims of accuracy, and those of his associates, is in the region of 10 degrees too far to the West. One would imagine that all this moving around of elements of the chart would be sufficient to confuse any researcher but even after this, or perhaps because of it, Hapgood still claims to reveal errors of as much as 12 degrees longitude and 18.5 degrees latitude. Geographer Sean Mcwhinney was not confused:

'Nor is this all. Not far inland from the east coast of South America, the mapmaker has drawn a stylized mountain range. The space to the left of it is filled with inscriptions. Hapgood identifies these mountains as the Andes. He asks, "...what is the probability that a cartographer, by pure invention, would place an enormous range of mountains on the western side of South America, where one actually exists?"... If this is the western side of the continent, one might ask why it appears to be over a thousand miles too far to the east, and why, near the southern end of this mountain range, a river arises on the western side and curves around it to flow eastward. In fact, the west coast is not shown anywhere on the map, and Hapgood could have dispensed with one of his four grids. The smooth brown line beneath the mountain range

is not a coast. All the coasts are outlined in black ink, in jagged lines representing the inlets and promontories. The accuracy of this map resides entirely in Hapgood's imagination. [76]

As the four resultant map sections [drawn on different grids], were made to conform to modern maps, it was assumed by Hapgood that this must have been the structure of the original maps that formed the basis from which the Piri Reis chart was originally copied. The Erastothenes school of Alexandria was thought by Hapgood to have been the source of *some* of the material, as the Turkish Admiral, relating to maps, had himself claimed in the notes to his *Book of Navigation*:

'eight dating from the time of Alexander the Great, an Arab map of India, four Portuguese maps of the Indian Ocean and China and a map said to be by Columbus of the Western area ' [77]

[Note: We are not surprised that Piri Reis makes an oblique reference to the *Great Library of Alexandria* and the *House of Wisdom*, given earlier descriptions in this chapter relating to the roles of these institutions in the development of mathematics and cartography].

It is another chart that explains why Hapgood initially became so convinced that the continent of Antarctica had been explored. This is the *Orontius Finaeus Delphinus* [1494-1555AD], map of 1531AD [Figure 5.31].

The Orontius Finaeus Delphinus Chart, like those of Mercator [which is why he included it in his Atlas] utilised a latitude/longitude system, not the more common at the time, Portolano methodology. It is this map that convinced Hapgood that Antarctica had been charted under ice-free conditions. It can be seen by comparing it to Figure 5.28 that there is a likeness to Antarctica, but it is only a superficial one.

The shape drawn is relatively close to the real shape of Antarctica, but somewhat askew. Nevertheless, the South Pole is seen close to the correct location in relation to the landmass. Hapgood was won over by this depiction of the continent; when he first viewed it at the Library of Congress:

'I had the instant conviction that I had found here a truly authentic map of the real Antarctica' [78]

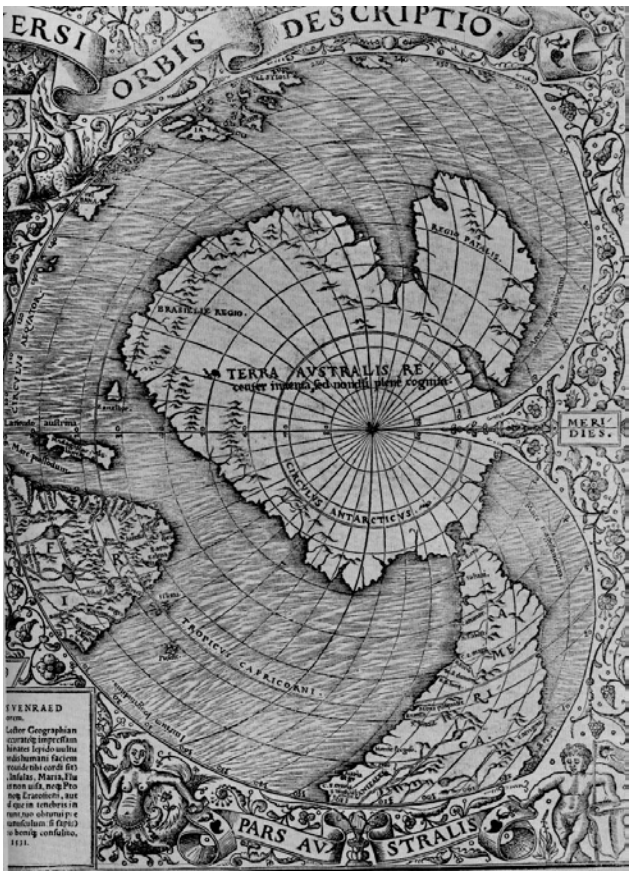


Fig. 5.31 Orontius Finaeus Delphinus Chart (Southern Extremities) of 1532AD

According to Hapgood and those who still believe in his ideas, such as Rand Flem-Ath, this chart shows the continent of Antarctica at the correct scale, with the Weddell and Ross Seas, Queen Maud Land, Wilkes Land and Marie Byrd Land in their correct longitudes. However, to show that Orontius's *Terra Australis* [as he named the continent] corresponds to the outline of Antarctica, Hapgood, of necessity, had to rotate the depiction of the land by about twenty degrees. He then moved the South Pole by 7½ degrees or 1,600 km and even altered the scale, because Orontius's *Terra Australis* is about 230% the size of Antarctica.[79]

To reinforce his argument of the continent being ice-free during a relatively recent period, Hapgood utilised the results of sea bottom cores taken from the Ross Sea in 1949. The cores from the seabed were removed during the Byrd Antarctic Expeditions and subsequently were examined by nuclear physicist Dr. W.D. Urry of the Carnegie Institution in Washington D.C. According to the results of this now outdated research, the analytical interpretation of these cores indicated that the *latest date* for surveying Antarctica with its flowing rivers and ice free hinterland seen on some of the maps, had to have been in the region of 6,000 years ago. [80] This interpretation was in fact incorrect, and today would be an isolated one anyway, against a

mass of contrary data as noted earlier. However, there was no real need to look for scientific data to back up his ideas. Hapgood had not realised that the map was actually a figment of its creator's imagination *as was actually stated on the chart*! This is because the map-maker's notes were in *French*, [81] and Hapgood had not had them translated. Many others then followed Hapgood's lead, thereby perpetuating the myth of an ice – free Antarctica in antiquity.

In summary, we find that there is no evidence in the map examined, or in the physical world to support Hapgood's assertions regarding Antarctica. However several of the charts have a link to a more ancient past – *in their scales.*

5.11 Measurements and Scales

It appears that Hapgood did not check his figures. He *assumed* that the chart, following the Eratosthenes dimension of Earth, would be scaled from a dimension that was 4.5% oversize as erroneously portrayed by some academics. Further to this, he worked with an inaccurate circumference for earth, 24,800 miles. At the time of writing his first version of his book more accurate assessments of the Earth's circumference were available for comparison, such as Michell's, as indeed has been demonstrated. However, one of his assertions, which is almost certainly correct, was that the chart was centred at the Alexandrian meridian and on the 30th parallel, in other words, almost exactly at Giza. [Note the Portolano comparison to the equidistant projection seen earlier in Figure 5.19 earlier] Would this be coincidence? We consider this to be very doubtful and it certainly appears to confirm the association with Egypt and the Great Library of Alexandria, which agrees with the writings of Piri Re'is.

It is shown below that the most famous of the Piri Re′is charts, appears to comply with Michell's interpretation of the dimensions of the Earth. This conclusion was based initially upon the work of B. Beale, cited in Hapgood's *Maps of the Ancient Sea Kings.* Beale attempted to discover the measures and scales involved on the Piri Reis chart seen in Figure 5.29. Her researches were based upon distances between the points indicated on the scales which Piri Re′is had drawn, and then comparing them to true air miles between the marked locations. These averaged, Beale claimed, to an approximation of 48.82 British miles, or 40 *Portuguese miles* of 6,758.7 British feet, or 88 *Turkish nautical miles* of 3,000 feet.[82] If one looks at these assertions, and expresses them as British feet, it can be seen they are at odds with each other:

- 48.82 British miles = 257,769.6 feet
- 40 Portugese miles of 6,758.7 feet = 270,348 feet
- 88 Turkish nautical miles of 3,000 feet = 264,000 feet

Additional analysis using the values above reveals that:

- 264,000 feet = 50 British miles
- 264,000 feet = 39.06076612 Portuguese miles
- 48.82 British miles = 85.9232 Turkish nautical miles

It is abundantly clear that the mathematics of Beale's assertions were not checked prior to publication. Further investigation however, reveals that there are connections with the geodetic knowledge of the Greeks:

- 270,336 feet [within 12 feet of the 40 Portuguese miles of 6,758.7 feet of Beale's *estimation*] represents 40 miles at 6758.4 British feet. This value, on Beale's count, has to be the true value of the *Portuguese mile*.
- This results in a Portuguese foot value [6758.4 feet/5000) of 1.35168 feet
- The mile here is a count of 1.28 British miles. [Note the value 128 as it occurs in an important position later in this work.] 1.28 x 1.2 = 1.536 = *Piemonte* or 'Italian'mile. Hence this 'Portuguese' mile is compatible with other major values and as such can be seen as correct.
- The foot value of Posidonius / Ptolemy, which was calculated in Chapter 4 was a unit of 1.216512 feet. If we increase this value by a factor of 0.111111111 or 1/9 we get 1.35168 feet, the Portuguese foot. The 40 mile distance is then 270336 feet or 51.2 British miles.

Turkish academic Professor Afetinan studied the work of Piri Re′is for many years and noted that on another, entirely separate chart, that the space between two sections on a scale was 50 miles, with the distance between two dots being 10 miles.

'There are also scales of miles on it, each with twenty divisions. From the notes beside them we gather that the distance between the divisions stand for 50 miles, and that between two dots for 10 miles. The scales here are bigger than in the previous one.' [83]

Assuming that the same scale value of 270,336 feet was in use as a standardised unit, a measure can now be discovered that is a reduction in mile length from that deduced from the work of Beale by a factor of 1.25 (i.e. we divide by the scale value by 50 rather than 40)

- 270,336 feet / 50 = 5406.72 feet
- 270,336 feet / 40 = 6758.4 feet
- 6758.4 feet /1.25 = 5406.72 feet

We can also note here that 6082.56 feet [a minute of arc of Michell's Earth's circumference as seen in Chapter 4] deducted from 6758.4 feet [the scale deduced from Beale's scale] results in 675.84 feet or 1/9 [0.111111] of a minute of arc. The mile value deduced from the Afetinan scale has a similar relationship with Michell's minute of arc: 6082.56 feet less 675.84 feet is 5406.72 feet. In summary the two different maps reveal the following relationships:

- Minute of arc = 6082.56 feet [Michel]
- Minute of arc plus 1/9 = 6758.4 feet [Beale]
- Minute of arc less 1/9 = 5406.72 feet [Afetinan]

Hence there can be seen a continuity of the use of ancient measures in these maps with scales related to a minute of arc of Earth's circumference as anciently accepted.

A further example of scale manipulation is seen in the Catalan Atlas, mentioned in Chapter 4, which is a map made up of sections and while the East and West extremities are detailed the North and South are cut off, as Henry Davis states,

'This may well be associated with the son of Peter of Aragon, known as Infant John, demanding a map " ...well executed and drawn with its East and West' [84]

The sections are recorded as being 49 cm by 69 cm and the total width is stated to be 3.9 metres, giving a measurement tolerance again of +/- 5mm. If we convert these figures to Imperial units and take into account these measurement tolerances we can estimate what was the intended dimensions:

49 cm = 1.607611549 feet. This we assess as 1.6 feet, a difference of 0.091338588ins. or 2.3 mm, well within the measurement tolerance above.
69 cm = 2.263779528 feet. This is assessed as 2.25 feet, a difference of 0.165354336ins. or 4.2 mm , again, within the tolerance used in measuring the chart.
3.9 metres = 12.79527559 feet, and this is seen here as 12.8 feet, a difference of 0.05669292 inches or 1.44 mm. This gives a better guide to the true dimensions of the chart, as measurement tolerances of the sections are beginning to average out.

Here there is another connection with the mile of Ptolemy, Michell's minute of arc, the measure of a minute of arc of the Earth's circumference that was used in the ancient world. 12.8 feet divides into the mile of Ptolemy, exactly 475.2 times - 6082.56 feet / 12.8 feet = 475.2. We therefore have a world map [North and South regions excepted], which is scaled to 1/475.2 of a Ptolemy mile. Obviously 4752 and 128, as numbers, are an inherent part of the measurement system.

Another example relating to scales is the 1411-1415AD map by *Albertinus de Virga* [see Figure 5.32].

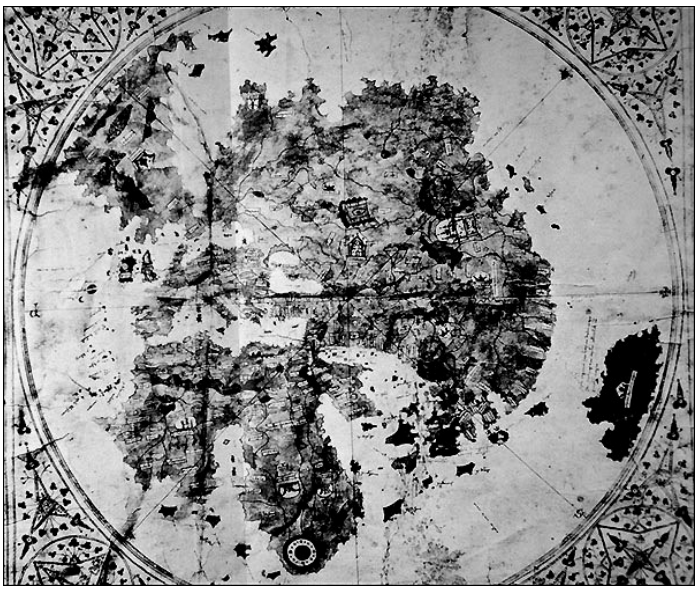


Fig. 5.32 1411-1415AD World Map by *Albertinus de Virga*

This is a circular map with a diameter stated to be 41 cm. Again, it is noticeable that the dimensions related in the various works consulted in our research always seem to be in centimetres, giving a tolerance of +/- 5mm.

Reverting to British measure again to estimate the intended dimension: 41 cm = 1.345144357 feet. This has been assessed this as 1.35168 feet, a difference of 0.078427716 inches or 1.9 mm. The reader who has been following the numbers carefully in this section will note this value is the foot of the Ptolemy mile increased by a factor of $^{1}/_{9}$. In effect this is the same foot measure as that derived from the Portuguese mile denoted by Beale relating to the Piri Reis map.

We shall mention one further example to reinforce the argument – another mediaeval chart, in this case a circular world map by *Vesconte.* This is quoted as being 35 cm in diameter. As 35 cm is within 1.1129 mm [or less than 5/100 of an inch] of 1.152 British feet, it is safe to assume that here we have a more realistic figure. The suggested replacement dimension is actually the long Egyptian foot which, when multiplied by the number of feet in a British mile, 5,280, results in the now familiar 6082.56 feet of a minute of arc of the Earth's circumference, the Ptolemy mile.

5.12 The Message of the Maps

It can be seen now that cartographers of the medieval period were constructing maps by utilising scales that were related to fractions of a minute of arc of the Earth's circumference, as defined by Michell, as understood from ancient times.

Indeed, as seen in Chapter 4, given that Aristotle, Dicearchus, Eratosthenes, Ptolemy, and Microbius gave accurate assessments of the planet's dimensions based upon the same unit, we can also see now that the medieval mapmakers were simply restating the values known a millennium and more earlier. In addition, from a historical viewpoint it can now also see now how this happened – via the brilliant Islamic scientists of the Middle East.

It has already been suggested that the Eratosthenes school of cartography may well have been the source for the cartographic advances we see that Ptolemy is supposed to have made some 400 years later. The fact that the *Prime Meridian* of these maps went through Alexandria lends support to this assertion.

As stated earlier, the source of the Classical Greek's accurate knowledge of the dimensions of the Earth almost certainly came from Egypt, although given the collection of material in the Library of Alexandria, Egypt almost certainly learnt from others. The obvious route to travel in a search for the source, if it could be found therefore, would be to next examine Egypt.

We have already seen that Earth measurement and mathematics were not such problems to the peoples of the ancient world as is generally thought. If we accept that, and note that ancient Earth geodesy, astronomy, mathematics and map-making seem to go hand in hand where there is a need for it, then we can see that the world could well have been charted long before the Classical Greek era. However, given the monetary, military and political value of any such charts they would have been carefully guarded, and possibly destroyed rather than fall into the wrong hands. We also have the *learning by rote* issue raising its head again, as seen earlier. In this instance copies of such charts may have been very few in number - the information may have been kept inside navigator's heads.

We believe that the chances of finding any *accurate* charts older than the ones examined above are very slim, due to the numbers of positively destructive reasons noted above, as well as the normal archaeological artefact survival issues. However, there is always the possibility that some of the *Portolano* charts are based upon fragments, or even whole, ancient charts. One of these charts [see Figure 5.33], a chart by Jorge Reinel [which was examined by Hapgood] is currently undergoing an in depth scrutiny and comparison to up the minute charts derived from computer simulations of ancient shorelines.

This map, apparently depicts a map of India,[85] but not with its modern coastline – this particular *Reinel Chart supposedly quite accurately* depicts the coastline, not as it is today, or even 6,000 years ago, but as it appeared 11,500 years ago. The modern development of computer simulated ancient shorelines mentioned above is from the University of Durham.

Graham Hancock has utilised this map and computer simulations in his work to reinforce his arguments regarding a 'lost civilisation'. In our companion work *Deluge* similar material is used combined with other information from Indian textual sources that confirm in part at least that there has been flooding of great areas caused by sea level increase.

However, the detail on the Reinel chart is not sufficiently clear to enable us to make any decision regarding its content and depiction of the coastline of India, nonetheless, the region of South Malaysia certainly appears on the map as it would prior to flooding. It would consequently come as no great surprise to us if an enhancement revealed that indeed this chart did indicate the same coastal outline as that of the computer analysis of the period.

Fig. 5.33 Jorge Reinel chart c1519AD (India is towards the top-right)

In the next chapter we review Michell's and Neal's work into metrology and reveal a different approach to the relationships between unit measures. However we shall conclude this chapter on a different note.

We have briefly examined the concept of Chinese explorers narrating their experiences while in America. We cannot state that this did happen but can say that this is the only description of past events that allows for the transference of this knowledge to the Americas. The dating of the earliest narrative is correct for the pre classic era of MesoAmerica and also fits with the spread of such learning across Asia, which logically would have been accepted and utilised in China before this time. The descriptions contained within the narratives are accurate as are the distances between the locations described. Hence we see no reason to doubt the idea of the Chinese explorers being inAmerica millennia before any European. After all, they only had to follow the coast around…the Aleutian Islands make the circumnavigation of the polar region relatively easy as the longest distance between islands is around 200 miles and most others are in sight of each other. So let us, for the sake of argument accept that this is the case and we have the Chinese spreading learning to America.

It is this learning transference that is intriguing, not the Chinese in America but the idea of the Meso American gods doing the same and returning later as the Chinese appear to have done. So is there a connection? Was the original Virachocha a Chinese sailor? After all he is

said to have educated the people in his region after emerging from Lake Titicaca and then going away across the Pacific…walking on the water the legend states…

Similar ideas arise when discussing Quetzalcoatl and if we take note of the known history such ideas were part of the records put together after the invasion of the region by the Spanish and Portugese. However, it is clear that much is fiction, invented by the chroniclers of the day possibly there was an expectation of a return of the Chinese but the Axtecs would have quickly realised that these were a different people to those who had been there in the past. It is said that the Axtec leader involved, Moctezuma gave up his throne for Cortez the Conquistador leader what is not explained is that this was the behaviour of an Aztec leader as it should be. This is no more than a suitable mannerism, the equivalent of a washing of the travellers feet in Arabic countries. Yet much was made of this and while the records give no evidence showing that the Axtecs claimed that Cortez was a returning Quetzalcoatl they most certainly made that claim in their later documentation of the meeting.

Likewise they claim that the Axtecs saw their god Quetzalcoatl as being pale with a beard which was completely untrue; there is no reference to this character being white in the annals of the Axtecs. It is clear that there has been much invention regarding the peoples of Meso America and it all started with the invasions of the Spanish and Portugese. There was no expectation of a returning Quetzalcoatl or Viracocha that was documented in the regions where these characters were gods. This is an invention by those who conquered the region.

So in this case there is no evidence for a group sailing the world and educating people wherever they made landfall. But a similar legend arises in the Middle East.

Berossus wrote of the half fish, half man god Oannes who came out of the Persian Gulf during the day to educate people. He was said to move on when satisfied and keep educating folk. This is yet another of those 'fishy' tales. Berossus was making his claims in the third century BC but his Oannes equates with the Semitic god Dagon. Oannes is now known to be derived from the Babylonian name for one of their pantheon of deities, Uanna which in the Library of Ashurbanipal equates with Adapa, who, according to the texts was a son of the god of wisdom Ea, the Sumerian Enki from the city of Eridu. This takes us back to the 14th century BC where Adapa was seen as the first of the Seven Sages. Adapa was portrayed as half fish half man to denote his abilities as a fisherman. Some Mesopotamian literature describes the sages as fish…pure *paradu* fish. The Greeks have a version of this character called Cecrops. Hence the concept was quite widespread in the Middle East. The difference here is that Cecrops was a reigning king after the king Ogyges who was on the throne at the time of an early flood. However, the half fish idea remains, not that dissimilar to the centaur, half man half horse. This idea is almost certainly related to the much earlier story of Manu and the fish Matsya from India and the Oannes myth will also transpire to be related.

So legends of people travelling the world educating people are meaningless in effect...except that of the Chinese in America and in that there is no claim that such teaching activities took place. Rather there is commentary on what is seen and understood, it was the Chinese who appeared to be learning. Yet we can accept that there was some reciprocal passing of information because the familiar units of measure arrived in America at around the era claimed for the early Chinese travels and there is no other such contact recorded anywhere that is known to history. There can be but one conclusion, the Chinese did explore America.

CHAPTER 6

The Roots of Metrology

The fact is that metrology is so central to ancient thought that its study tends to expand in all directions.

Livio Stechinni A History of Measures…Why Study Metrology?

Metrology is linked to science and trade. As soon as a culture needs or uses quantitative description of itself, its parts or its surroundings, measurements are performed, any measurement requires a unit, and metrology is established - it may not be on a strict scientific basis at first, but the basic concepts are there.

Dalle [physicist and contributor to Wikipedia]

6.1 Metrology: A True Science

'*There are many approaches in the branch of historic metrology which must be qualified as pseudoscience. Resistance against the metric system also seems to have played an important role. Interest seems to have been triggered by interest around the Megalithic culture and the Great Pyramid of Giza..'* [1]

Of course, while we wouldn't argue with the statement from Dalle seen as a quote above, we do not agree with the above statement from Wikipedia regarding historic metrology as pseudoscience. While some approaches to the subject such as the God given 'pyramid inch' of Piazzi Smyth that denoted a God given timeline within the Great Pyramid are indeed, to put it very mildly, highly suspect, most research into the subject is far more intelligent. However, while the number of serious researchers into the subject of ancient measurement is few, the majority are making, or have made, genuine logical attempts to unravel the complexities of the measurement systems that were in use in past eras. Indeed, one of these systems has carried on until the present day in our metric and SI-driven world – the British Imperial system, as seen in Chapter 3.

We have already commented on Stechinni and Michell's inputs into what has been an under-studied *science*. John Neal has perhaps taken this study into a new phase with his analysis of the work of those who 'went before' but even then he has allowed himself to be led astray by what is an apparently obvious error. Here we mean the circumference of the Earth to which the measurement values in question link. Neal, Michell and others all claim that the old Greek and Roman references to the Earth's circumference are to the polar diameter or meridian circumference when in earlier chapters we have shown this assertion clearly is impossible. As

shown in these earlier chapters, the extant textual references all refer to an Earth that was believed to be globular.

Unfortunately, this polar direction of thinking has led Neal to make further errors, not in his numerical evaluations of the units of measurement, we cannot fault his immaculate maths, but as we shall reveal, in his reasoning for the lengths of a specific structure.

In this chapter we shall delve a little deeper into the complexities of what we term the 'measurement system of antiquity'. As will become apparent, this appears to be at once both a simplistic study and a complex one in that while figures are interrelated, there appear to be too many of them. But in this type of study there are answers that are logical and do not rely upon 'accepted' history or a belief system relating that the ancients knew the meridian circumference of Earth. As Stechinni discovered,

'In this field one can rely on evidence more reliable than that usually available in ancient scholarship, and as a result there is substantial agreement among specialists about all essential points; but other scholars refuse to accept the conclusions drawn from the evidence because these do not suit their way of thinking.'[2]

All is far from straightforward nonetheless, and early in this chapter we shall deal with some of the more complex aspects of the system, just to 'get it out of the way' as it were. Here the work of both John Michell and John Neal is the initial focus of our examination.

6.2 Some Numerical Relationships

Re-iterating what said in Chapters 1-4, here we follow Michell in that each unit, foot, cubit, step, reed or whatever had both a 'long' and a 'short' value connected via the factors 175/176. Various sets of values were in existence which Michell termed, simply for identification purposes [they had no national affinity with the countries] as Greek, Roman and Egyptian. There of course are more sets of units but these, along with divisions of the Polar axis of Earth are the prime units denoted by Michell.

The 'short' Egyptian units were used in the construction of the Great Pyramid, and they have gained the appendage of 'Royal'not because of their association with Giza but because the rods upon which these have been found inscribed were preserved within inscriptions of dedication to royalty. Actually this is meaningless as all the main sets of measurement values were utilised over a very wide area and would have existed before such termed the common cubit however and this is explained later in the chapter.

Given that Michell utilised two values, the long and short with the short version being the 'royal' we shall continue with his terminology with reference to the 'royal' title.

These 'dimension sets' that include the directly interrelated feet and cubits etc themselves were interconnected by other factors such as 0.96 [or 24 / 25] which, for example, took one from the Greek dimension sets to the Roman. The *Long Egyptian* units, although not mentioned by Michell, connected to the *Short Greek* values via 8/7. Hence the *Long Egyptian*

foot of 1.152 British feet / 8 and then x 7 = 1.008 feet which is the *Short* Greek foot. From here the 175 / 176 factor takes the value to the *Long Greek* foot.

Complex? This is simple compared to John Neal's evaluations of the connections between units. Below we shall examine some of his sets of connections that numerically are correct but we have to admit doubt as to whether many of these values were in common use. However, Neal does clearly demonstrate the mathematical connection to the singular familiar British foot of 12 inches which certainly was in use in the ancient world. He [Neal] refers in places to stone cubit rods discovered in Egypt and to cubit marks on plinths of statues and suchlike objects, mainly in Rome and Greece, but as he states, to evaluate an accurate value from a mark by a mason's chisel is somewhat along the line of wishful thinking. Yet Neal took note of a find in Rome in1736 by Folkes of:

'A fair stone of white marble of the length 8 feet 5 inches English and of the breadth 1 foot and 9 inches and a half; upon which are inscribed the standards of several measures with their respective inscriptions.' [3]

Here we have measurement units denoted by the masons chisel and they transpired to be approximations of some Neal's *projected* measures, units that according to his theory should exist. The 'measures', although whether these names were part of the original inscription [doubtful] or added by Folkes we cannot say, but were listed by Neal as,

Table 6.1 Measures found in Rome 1736 [in British feet]

Roman foot	0.9658333
Braccio de mere	2.7875
Greek	1.005833
Staiolo	4.2166
Braccio de tela	2.086666
Architect's cana	7.325

Yet a basic investigation reveals that there are different interpretations to be found. We would claim that the Braccio de mere at 2.7875 is incorrect and in fact would be step measure of 2.78784 with a foot measure of 1.115136 British feet. [1056 x 1056 = 1115136 and the 5280 of the modern British mile squared =27878400.] The importance of the value 1056 will emerge later in the chapter.

According to another line of research 69.57 cm was the *Braccio da tela di Pavullo* with subdivisions of 12 *ounces* [inches]; with one *oncia* having 12 *points*.[4] Therefore the unit of 69.57 cm or 27.38976378 British inches was divided into 144 smaller units of 0.19021 British inches. This unit of 2.282480315 feet does not appear to reflect the measurement values denoted by Neal. Further variation in different Italian regions denoted 63.31 centimetres [2.077099738 feet.] for the same unit of a *Braccio*

More of the old Italian units of measurement are to be found among the pages of:-

The Elementary Treaty of Arithmetic to use of the Course of Technical, Ginnasiali, Liceali and of Military schools, Published for the cure of A.C. and Approved of from the Higher council of Public education 26th July 1849, 26th edition
1880 Near G.B. Paravia and Compagnia

An extract from this reads as follows.

"For Piemonte we mean the ancient ones province of Turin, Susa, Pinerolo, Ivrea, Connecting rod, Saluzzo, Wedge, Mondovì, Dawn, Asti and Vercelli; in the which solos uniformità of weights existed and measures, established from Carl Emanuele with editto 5 june the 1612 foot liprando.... formed the base of all then the measures which were in use until 1818. In that year the Room of Conti on seeming of the Academy of Sciences of Turin determined to lengthen the foot liprando of 124 one hundred thousandth [...]. *The formed measures therefore were in use in the aforesaid ones province until the introduction of the system decimate them* (*1850*)*."*

The measures from Piemonte in question are listed in Table 6.2 below.

Table 6.2 Piemonte measures			
Lungh.	Foot = 12 ounces (6 feet = the trabucco) Ounce = 12 points of 12 atoms Roso = 14 ounces of the foot Mile of 45 to the degree	met. » Cm	0,514403 0,600137 2,469136
Super.	Day = 100 tables of 4 trabucchi quad.	it plows	38,1039
Capac.	Emina Brenta = 36 pinte Pinta = 2 boccali of 2 quatrains	lit. »	23,05 49,3069
Weight	Pound = 12 ounces Ounce = 8 eighth of 3 money	Cg	0,36888
Coins	Ancient Lira = 20 moneies of 12 money	Liras it.	1,180

We shall refrain from including further direct examples from these pages here or confusion will arise, but suffice to say, there is more to this than meets the eye. Certainly, given that these units stem from 1612AD one is inclined to ponder on the possibility that some finds of 'ancient' inscriptions are not quite as ancient as believed. For those who wish to investigate further, a number of units from an additional 12 Italian regions can be found at the same web source, *Ancient Italian units of measure.* [5]

There are some interesting elements here however. Firstly the metre value that emerges from the information in this table when we take the old accepted circumference for a globular Earth as the basis for calculation [Michell's circumference]. This Earth measurement is 24,883.2 British miles with a consequent degree length of 69.12 miles.

The mile value noted in the table is 1/45 of this or 1.536 British miles which as seen, is said to be divided into 2,469,136 centimetres. This metric assessment is in error, and in reality the notation should be for millimetres whereupon we find a value of 0.039414986 inches to the millimetre which should be seen against the modern version calculated from the values in Chambers Dictionary, the modern internationally accepted millimetre, of 0.039370079 inches. The metre, as seen in this calculation should therefore be seen as 3.284582167 feet against 3.2845824 feet derived by Neal from Michell's meridian circumference calculation. There is a difference here to Neal's evaluation of a tiny 0.000002796 of an inch or a mere *30.612 feet* in the theoretical circumference of Earth. In other words, allowing for this minor discrepancy, only revealed via the use of extended decimals, the anciently accepted circumference of Earth, that evaluated by Michell and irrevocably linked to the measures seen throughout this work, was in use in Italy when these values were recorded. The modern metre is seen as 3.280839895 feet.

The measures seen in the above table connect to the Greek units when the mile is divided by 5000 to find the foot value. 1.536 British miles [see analysis of Janet L. Dotterer's comments regarding Columbus in Chapter5], equate as 8110.08 feet and consequently the required foot value that is associated with these Italian measures would be 8110.08 / 5000 or 1.622016 British feet. In effect, the foot value here is the *Long Greek* foot x 1.6. Put another way the connection between the *Piemonte* units and the Long Greek as denoted by Michell is a factor of 8:5. i.e [1.622016 / 8] x 5 = 1.01376. Conversely 1.01376 / 0.625 takes us to 1.622016. If the calculation is altered to a division by 8 and multiplication by 3 the result is 0.608256 where one minute of arc of the Earth's circumference as seen before metrication and indeed since, was 6082.56 British feet. This is also the nautical mile, later adjusted by 1.2 inches to 6082.66 feet.

The cubit related to the above mile value emerges as 2.433024feet [in fact a double cubit of 1.216512 feet which is the Posidonius foot that equals 1/5000 of a minute of arc of Earths circumference as seen in Chapter 5] with its associated reed measure at 14.4 *Long Greek* feet of 1.01376feet or 14.598144 feet. Hence 10 reeds associated with the *Piemonte* measures equate with 144 *Long Greek* feet which is 1/900,000 of the Earth's circumference as accepted prior to metrication. The *trabucco* mentioned in the table is the *Long Greek* foot x 9.6. From here the remainder of the system connects via 24 / 25 [0.96] etc. So as the *Long Greek* measures are related to the British units with the associated foot of 1.056 feet via the 24 / 25 factor [0.96] we have a connection via 1.6 x 0.96 between the *Piemonte* measures to British. 1.6 x 0.96 = 1.536, the length of the *Piemonte* mile in terms of British miles. The *Piemonte* foot of 1.622016feet / 1.536 = 1.056.

In themselves these evaluations are important direct confirmations of the use of the same anciently accepted circumference for Earth [as calculated by Michell] in mediaeval times as was in use in the ancient epochs. [These measures, as noted above, were *officially* recorded in 1612AD.] The *Piemonte* measures which do not feature in the work of either Neal or Michell confirm Michell's evaluation of the Earth's circumference, that which embodies the ancient measures with the units being an inherent part of the whole system. As the British mile has not altered in length but only in division from 5000 to 5280, it is also clearly apparent,

given the connections to ancient units that this most English of measures stems from long before its historical attestation.

Of course, the question of what is meant by accurate arises here and Neal has worked to a lesser, albeit extensive count of decimal places than has been utilised in the research for this work. Extended fractions are deemed necessary for mathematical exactitude as a very small fraction can only accumulate when counted many times as seen above. Because small fractions are involved this must be taken into account, both when conducting theoretical work as has been done by Neal and when evaluating the results of on-site surveys.

Another point of note seemingly missed by other commentators is that frequently craftsmen have to devise their own units and / or scales when dividing a given distance, usually of an opening, into equal spaces. For example, an opening which appears to be close to three feet may well in reality be the thickness of a timber bead on each side less. Hence the dividing may be of two feet eleven inches. There may well be a spacing of this divided by, for example, four or six and as an example of six divisions the unit spacing here would be 5.8333r inches, close to a division of three feet at six inches but just that little bit less and not related to any of the more usual units of measure. Such oddities do occur and hence the surveyor has to be aware of the possibility of such findings. A number of such diverse craftsman devised scales were discovered when damaged wall panelling was removed after the fire at Windsor Castle in England.[6]

Intricate work on gold decorations, specifically, for example, those involved with the burials of pharaohs may well call for such divisions and not a recognised unitary value. In such a scenario, given that the arrived at unit of length will in any case be very close to another, we here come back to the case of 'the mason's chisel,' or even a fine scribe and the question of from where in the width of the so formed groove does one measure to make an assessment of the *intended* value. Divisions of an overall length can help ascertain whether or not the unit is a purposely devised measure for that particular job. Ultimately the value of the measure can only be arrived at by careful mathematical comparison and evaluation, not only of the distance between adjacent points but of regular parallel lines and patterns…and comparison to known measures. Hence the tables Neal has devised are, by definition, along the lines of a hypothetical mathematical construct which according to his theory is correct. But as we have seen, and indeed, as Neal admits, the investigation is far from over, there is much yet to learn and Neal has failed to investigate such values and concepts as those described above.

However, as Neal took his initial lead from Michell, we shall firstly recap on the early connections made by Michell. Michell was fascinated by that masterpiece of early British masonry, Stonehenge. Having knowledge of the works of the earlier investigators into metrology he applied his knowledge to Petrie's survey of this enigmatic monument.

The inner diameter of the Sarsen Circle according to the meticulous work of this famed surveyor was 97.325 feet. The so called *Long* 'Greek' foot was derived from a survey by Penrose of the *Parthenon* in Athens, where the relevant value was seen to be 1.01379 British feet. This was amended by Michell to comply with the factors involved and to fit with other known measurement values. It has become established as 1.01376 feet. As we are aware, Michell's evaluation of the 'Greek' measure is 25 / 24 of the 'Roman' measure and therefore the *Long* 'Roman' foot measures 0.9732096 British feet. Hence 100 *Long* Roman feet =

97.32096 feet against Petrie's Stonehenge survey result of 97.325feet. There is a difference here of 0.00404 of a foot or 0.04848 inches [1.2 millimetres] in just under 100 feet and therefore it was safe to state that this diameter measures 100 *Long* Roman feet. [To reiterate the argument regarding names for these units, Stonehenge predates Roman or Greek development by millennia.] This equates with 96 *Long* Greek feet. The lintels have a width of a theoretical unit of 3.475748571 British feet which is the long Egyptian cubit doubled and increased by 175 /176, the factor between 'long' and 'short'or'royal' measures within the dimensions sets. This convoluted looking value divides exactly 37,800,000 times into the Earth circumference as denoted in the ancient past and when divided into the stade value utilised by Eratosthenes [discussed in Chapter 4] can be counted exactly 150 times. There is more detail of Stonehenge in Chapter 7 of this book.

The connections increased the more Michell examined the monument at Stonehenge and he then applied his techniques to the Great pyramid. The south side of the pyramid is believed by many to be the established accurate 'datum' side from which the others were worked.

This has the nearest measure to 756 feet and Michell took this to be what we term the 'target length' of 756 feet. Petrie's measurements [after Michell] are given in Table 6.3 for comparison.

Table 6.3 Measurements at the Great Pyramid [Petrie]

Face	Length [Inches]	Length [Feet]	Diff. to 756feet.
North	9069.4	755.7833r	2.6 inches
East	9067.7	755.6416r	4.3 inches
South	9069.5	755.7916r	2.5 inches
West	9068.6	755.716r	3.4 inches
Mean	9068.8	755.733r	3.2 inches

It is Neal's claim that the most accurate survey accomplished to date of the Great Pyramid is that of the engineer J.H.Cole in 1925 whose work, he claims, surpassed that of Petrie. Cole's dimensions for the side lengths [in feet after Michell] are given in Table 6.4.

Table 6.4 Measurements at the Great Pyramid [Cole]

Face	Length [Feet]	Length [Inches]	Diff. to 756 feet
North	755.425	9065.1	6.9 inches
East	755.875	9070.5	1.5 inches
South	756.083	9072.996	0.996 inches
West	755.766	9069.192	2.808 inches
Mean	755.785	9069.42	2.58 inches

Frankly, if this was meant to be square then Petrie's survey would be more likely to have reflected the finished object. Further, how can an objective judgement be made regarding

which was the more accurate survey of the two? With modern equipment an analysis could be made but that available in 1920 was no different to that in use by Petrie a few years earlier and to say that Cole's work was better than Petrie's is to state that Cole was a better surveyor than Petrie, a clearly preposterous idea. They were both first rate surveyors.

However, Taylor had previously erroneously reported that Herodotus claimed the length was 750 feet and Michell picked up on this; actually fortuitously, because he now discovered that this side length of 756 feet was exactly divisible 750 times by the value of 1.008 feet, which is the *Short* Greek foot. Michell's methods appeared to have been confirmed.

Moreover, Michell was also seemingly correct regarding the target or 'conceptual' length [to use Michell's terminology] of the finished pyramid below pavement level at the position of the outer corner 'sockets'. Petrie's drawing shows a dimension that has a mean of 24.825 inches from pyramid face at pavement to this line where the 2.16 feet denoted by Michell gives 25.92 inches. This means a target length [according to Michell] at that position of 760.32 feet or [756 / 175] x 176. In fact given the deviance in overall length seen in the lists above this is quite acceptable. Whether or not it was part of the design criterion we cannot say. However, the measure would certainly be appropriate via the 175/176 factor and the consequent change from the short cubit to the long via this factor. Pyramid base using the short or 'royal' version at 1.718181818 feet and the longer conceptual length denoted in the longer 1.728 foot units. This gives the theoretical target width from the finished pyramid to the outer casing line beneath the pavement level. The finished pavement, which was not level probably due to an ancient earthquake, did not in any case give this value as the socket dimensions were beneath the paving.

This then also complies with what Herodotus *did* say regarding the length of the structure. In his work *Histories* Herodotus relates that he was told that the length of the pyramid was 8 *plethra* or in other words, 800 feet. At the 756 feet of the structural masonry this results in a value of 0.945 feet which effectively relates to nothing. However, at 760.32 / 800 we find a very satisfactory 0.9504 feet, which is the foot value of a cubit of 1.4256 British feet known in Cambodia as a *hat* that was used in the construction of the famous temple of *Angkor Wat* and which replicates the count of 9.504 British feet in the reed associated with a foot value of 1.056 feet.

The measurement unit of 1.056 feet is the *Northern* or *German* foot as described in Encyclopaedia Britannica, that which was originally seen as the British foot. Hence, as 10.56 feet also happens to be *the measurement between the centres of the Sarsen uprights at Stonehenge* [see Chapter 7] we begin to see an international commonality among these units of measurement.

Michell's early work, as noted, has been greatly expanded by Neal and we now look to the complexities and of Neal's evaluations and ideas that initially were based upon not only the work of Michell but of Greaves, Stechini, Taylor and Berriman and upon commentaries in the classical works. He has evaluated a series of connections that all work in a logical manner although it has to be admitted that while the relationships are *mathematically* sound, any logical reasons for the necessity of such a variety of measures seem to have eluded Neal as much as for a long time they elude the principal researcher of this work.

The idea of measurement being related to specific degree lengths along the meridian line as espoused by both Michell and Neal we see as totally erroneous. Neal makes positive mathematical identification of units and names them with very little foundation; as we have stated, the measures were in use over a widespread area. Additional dimension sets can be constructed in a variety of fashions. There is ample evidence of this in mediaeval cathedrals and monasteries across Europe and one at the Great Pyramid [as seen above] of a count of inches in a foot replicating the count of feet in a larger measurement unit. This is not Neal's way however.

Another oddity arises here. Neal claims that each individual side of the Great Pyramid is deliberately designed, when calculated in conjunction with its height, to represent a specific degree length along the North / South direction of Egypt and the Nile. The northernmost part of Egypt is located at the latitude of 31 degrees. In 1907, Helmert calculated the length of the degree in a meridian direction at this location at 110,861 metres. In 1907, the metre in use, whether in France or Britain, would have been 3.28085 feet. [See Chapter 3.] Neal, however, insists on using a different evaluation of the metre, 3.2845824 feet, a unit based upon 1/40,000,000 of the anciently accepted measure of the circumference of Earth and has not examined the values in use when the survey was accomplished. Helmert's interpretation of this degree length would therefore be [110,861 x 3.28085 feet] = 363718.3119 feet.

Utilising Neal's erroneous metre Helmert's measurement, when translated into feet becomes, according to Neal, 364132.0894 feet which is 413.77755 feet different to the interpretation that Helmert would have recorded. Neal claims that,

'The 481. 0909 foot height of the pyramid multiplied by the 756 foot south base side is 363,704.72ff, thus, is within 13 feet of Helmert's measurement.'[7]

Yet as we have seen, when the correct metre value for the era is applied, this is untrue; the degree length, using the version of the metre that was in vogue in 1907 would have been denoted as 363718.3119 feet [110,861.3415 modern metres where a modern metre is 0.04491006 inches shorter than Neal's interpretation and 0.00012126 inches longer than the version in vogue when Helmert was surveying in Egypt. Neal's metre is 0.0447888 inches larger than that utilised by Helmert] Neal's evaluation is clearly a long way from being a mere 13 feet away from Helmert's measure, well over 400 feet away in fact. Similarly Neal looks at the remaining pyramid side lengths in conjunction with the pyramid height and with meridian degree lengths and continually makes the same sort of errors. The final side, the North side he associated with Thebes[8] as the degree length derived from his calculations indicated the latitude of Thebes. We find this more than a little strange as in addition to the metrological mistakes, there are other reasons of an historical nature that cast doubt on the validity of Neal's imaginative ascertains regarding the pyramid side lengths. It seems that Neal has completely ignored the fact that *Thebes did not rise to any prominence until the Middle Kingdom at the earliest*. During the Old Kingdom, that of the pyramid building era, Thebes was no more than a provincial town by the name of *Waset*.[9] Given such a historical fact why should the pyramid have been built to accommodate the geographical location of such an unimportant location? In

short, it was not and we revert to a side length of 440 cubits as the target dimension on all four sides.

We cannot argue with the calculations but the difference in metre lengths to which Neal appears to have paid no attention makes an appreciable difference. We therefore maintain that he is in error and that the differences at the pyramid sides were not deliberate but due to the almost impossible task of maintaining the phenomenal accuracy that he claims was the outcome of the pyramid builder's efforts. Many shorter distances within the structure are generally within 1/5 of an inch of their target length and this is highly accurate but to work over a distance of 756 feet to an accuracy of 1/3500 [2.58 inches into 756 feet] is such a brilliant achievement that like most other commentators, we doubt if the deviance was intended. Hence we maintain that 756 feet or 440 cubits of the royal variety that Michell terms *Short Egyptian* was the *target value* of the structural pyramid with the finished unit replete with polished limestone casing having a base length beneath the perimeter paving of 760.32 feet, a perimeter of 3041.28 feet, 1760 long Egyptian cubits. This measure, hidden beneath the paving, is 1/43200 or half a minute of arc of the Earth's circumference.

Logic raises questions regarding Neal's claims here in that if the South side were that utilised as a datum, why should the Northernmost extremity of the country be seen as worthy of such eminence as against the location of the structure itself? Why was not the supposedly-important South side constructed to suit the location of Giza?

There can be little doubt that the ability to measure the difference between various degree lengths on Earth existed and latitude on Earth was denoted by the height of the North Celestial Pole above the northern horizon [when a pole star was available].

However, there is *no evidence whatever* that has been uncovered in the course of this metrological research to indicate that such knowledge was utilised in the manner indicated by Neal. This idea is derived from the commentaries of others and not from available evidence. Since the inception of the ancient measurement system the Earth was regarded as being globular with all degree divisions being of the same length; even the Greeks, long after the pyramid building era in Egypt, stated this. However, Neal has ignored their statements and the measures that they applied to Earth.

The results of the research for this work clearly show that the ability to measure the skies to the level of a degree or better existed long before dynastic Egypt but we have to ask why it is that while all and sundry, including the Greeks who held Egyptian and other material in their great libraries, maintained the world was in fact globular and yet according to Neal, the Egyptians, contrary to everyone else in the ancient world during the pyramid building age, thought differently. As we have seen, the same measurement for Earth circumference has been in use right up to the surveys that were conducted specifically for the new metric system. Hence while we do not argue with Neal's tables of numerical values, they fit together very well and should be taken on board by students of metrology as it is clearly apparent that his mathematics work, it is unfortunate that in other regions there is much he has failed to research and analyse competently.

6.3 Complex Connections

The 175 / 176 factors according to Michell [who appears to have followed the earlier investigators in this line of thinking] denote the difference along the meridian of the degree length at 10 degrees latitude and 50 degrees latitude. The 50 degree latitude value coincidentally is that of the average degree length of the whole circumference. These 'short' and 'long' measures Michell termed 'Tropical' and 'Northern' and he says in *New View Over Atlantis*:

Hence this presupposes that the degree length had been calculated at a variety of latitudes in the distant past. [our emphasis]

Note the 'presuppose' that has been taken on board by others with no in depth investigation to verify the supposition. The word may well have been omitted from the statement as it has been generally accepted that indeed, Michell is correct. Michell also states in his works that it is of no use searching for the root source of the measurement units of antiquity. In fact, in tracing sources of measures into the distant past, what appears to have been the source has been revealed and toward the end of the book is described, along with the method it is suspected was utilised for the purpose of measuring the Earth and additionally, when and where this appears to have occurred. Neal claims that the 'true' length of the metre should be evaluated in relation to the deduced average degree length which would make it a unit of 3.2845824feet, and as he put it, *not as the French calculated, a metre of 3.2808427feet.*

[Note: As seen earlier we use a value derived from the 1963 British valuation found in the Chambers Dictionary, 3.280839895 feet. The technical description has since altered but the measure has not.] The factors seen on the right of Figure 6.1 are utilised as changeover factors between values and shortly we shall see more of how this works. Firstly however, we shall reveal a little more of Neal's mathematical construction, which as we have stated is undoubtedly correct, our worry is that there are too many units and most were not used. In other words, much of Neal's evaluation, while brilliant in itself, we see as pure hypothesis. Conversely, the units that we introduce can be proven to have been in use.

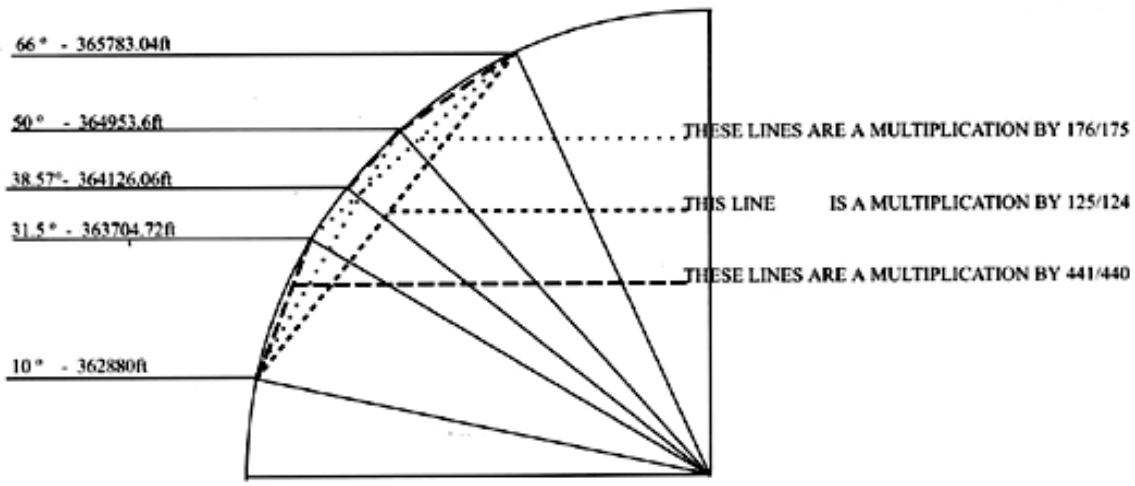


Fig 6.1 The Meridian Degree

There are other comments worth making here. The question arises of why should the latitude of 10 degrees be seen as a start point as against the equatorial position which would be far more logical. That the initial eight degrees adjacent to the equator show little change in length is accepted but there is a difference to the 10 degree point and hence why commence here? Furthermore, where is the factor change for the region between the 66-degree mark and the pole? As Neal states, 66 degrees is good rule of thumb for the Arctic Circle but we fail to understand of what relevance this is to the remainder of his arguments and in any case, 'rules of thumb' are based upon approximations, loose values that would not be suitable for the fine calculations that Neal has made. Further, who initially measured the degree length at the Arctic Circle and when? Historically this is a relatively recent event, much later than the Egyptian period of which Neal writes. It appears that as the measurement units connect via specific mathematical factors [as being numbers they simply have to] it is mere coincidence that the values fit the shape of Earth as they do.

We assert that the peoples of antiquity were unaware of the degree lengths at these locations, as far as they were able to tell the world was a globe, as recorded by the Greek geographers and accepted by those before them.

Further, the unit values only fit with the anciently accepted Earth measurement and hence Neal is completely incorrect when he states that the French were wrong in their assessment of the metre length. With a variance in length of a degree along the line of the meridian, there is no doubt that indeed the mean value is at 50-51 degrees latitude but why should the French, who now had more accurate measures of Earth and supposedly, according to history, knew nothing of the *dimension sets* discussed in this work, do as Neal states they should have done and have the metre conforming to a mean degree length at 50-51 degrees latitude, and complying to the ancient values? A more accurate assessment of Earth's dims

would imply that even if the mean degree was taken in this context, it still would not fit the ancient values as they had been superseded by a more accurate survey of the meridian length.

His claim that the metre should be 3.2845824 feet takes the Earth circumference back to the ancient 131383296 feet [40000000 x 3.2845824] against the 131234000 feet [40000000 x 3.28085] of the more accurate French survey which results in a difference of 149296 feet or 28.27575758 miles. Even this latter circumference measure is not strictly precise as can be seen when making comparison to the NASA values derived from satellite observations [See Chapter 3]. However, while Neal has seemingly been carried away on a wave of misguided enthusiasm, [much as he claims others have done] the calculations seen below are all logical and fit together beautifully. In fact the 'Egyptian' 'Greek' and 'Roman' units [among others] can be found utilised in mediaeval cathedrals and similar structures across Europe. In a later chapter some examples are given of this. Below we show the values as denoted by Michell [table derived from Neal in *All Done With Mirrors*]. As can be seen, they are extensive with the left hand column being related to the right hand by the 175 / 176 factor. We reiterate, however, that the names do not necessarily align any of these measures to specific localities. Where, for example, would we go to find a place called 'Sacred'? The Polar denotation is to the Polar Radius and as seen in an earlier chapter we do not accept that this value was known in the ancient world, other than as the radius of a globular Earth and then the value that did apply was far from that ascribed to it by Michell.

Table 6.5 [A-E] Measurement Unit Values according to Michell after Neal[10]

Table A

ROMAN	Tropical	Northern values
digit	0.06048	0060826
foot	0.96768	0.9732
remen (20 digits)	1.2096	1.216512
cubit	1.45152	1.459814
stade	483.84	486.6048
stade (600feet)	580.608	583.92576
furlong (625feet)	604.8	608.256
mile (5000feet)	4838.4	4866.048

Table B

GREEK	Tropical	Northern values
digit	0.063	0.06336
foot	1.008	1.01376
cubit	1.512	1.52064
stade(500feet)	504	5068.8
stade(600 feet)	604.8	608.256
furlong(625feet)	630	633.6
mile	5040	5068.8

Table C

EGYPTIAN	Tropical	Northern values
foot	1.1454545	1.152
cubit	1.7181818	1.728
stade(500 feet)	572.72727	576
stade(600feet)	687.27273	691.2
furlong	715.90909	720
mile	5727.2727	5760

Table D

POLAR	Tropical	Northern values
foot	0.9874285	0.993071
cubit	1.4811428	1.489607
stade(500 feet)	493.71429	496.53551
stade(600feet)	592.45714	595.84261
furlong	617.14286	620.66938

Table E

SACRED	Tropical	Northern values
foot	1.3824	1.390299
cubit	2.0736	2.085449

So here we find a complete list from Michell denoting the 'Tropical' [10 degree] and 'Northern' [50 degree] values or the 'long' and 'short' versions. But how can there be a 'Tropical' and 'Northern' dimension set[s] for the Polar radius? It is the curvature of the surface of the planet that dictates the variation in degree length and not the straight line of the radius.

Neal, in fairness, was meticulous in his checking of examples of Roman feet … *which are accepted as being 24 to 25 of the Greek feet…*

He very carefully compared values taken from 14 different bronze and bone rules discovered in various European locations and two standards engraved on the monument of Cossutius. There was very little variation between the examples and below is his report on the results of the investigation where values increase via the 175/176 and 440/441 factors.

'…the values of the Roman feet, which are accepted as being 24 to 25 of the Greek feet, are here listed in their ten potential values in two rows, separated by the fraction 440 to 441, as letters of the alphabet. The fraction between each measure across the two rows is 175-176'

175 / 176

440/441

a, 0.949122 b, 0.954545 c, 0.96 d, 0.965487 e, 0.971003

f,0.951279 g, 0.956714 h, 0.962181 i, 0.96768 j, 0.973209

Commenting on his results Neal states that:-

'This is very conclusive of both the accuracy of the measuring devices and of the general theory concerning the conventions that govern the differences... These comparisons are random, no selection process has discarded any non-conforming values. Analysis of the measurements from buildings, as accurately examined by surveyors, yield even closer values to those predicted.[11]

We can therefore be in little doubt of the veracity of the figures. That these are all of Roman origin however is another matter. The fact that these values were derived from scales and rules discovered in Roman occupied territory *implies* a Roman origination but is not proof. Rome occupied Britain but the units discovered at Stonehenge that have been termed Roman, the same values utilised by Neal and Michell are not related to Rome, they predate the rise of that Empire. We maintain that the measures were in use over a wide area and were not region

or nation specific. It is pure mathematical certitude that given the use of one value in association with a geometrical or numerical formation, another related value will appear.

Hence 100 Roman feet [The internal diameter at the Sarsen circle of Stonehenge] = 96 Greek feet. This is equivalent to:-

(1.728feet [Michell's *Long Egyptian* cubit] x 2) / 175 and multiplied by 176 [or 3.475748571feet.] x 28 = 80 x 1.216512feet. [A value associated with Posidonius as seen in Chapter 4 and according to Neal in the table below, is the geographic Roman *remen*, a value of 20 digits].

Neal's strength, nonetheless, is in his mathematical connections between values and we shall show more of his work before diverting into territory that he has utterly missed. He shows that the British foot of 12 of our familiar inches is the root of the system and while we would argue that was not an initial idea, we would agree that it certainly stems from a very early period when the system was under construction. Neal has devised tables that are somewhat more elaborate than and not as straightforward as those of Michell. He has added values that appear to comply with some of the discovered standards. We shall refrain from extended explanations here, these can be found in Neal's book *All Done With Mirrors,* [which we do recommend] but we shall include another table to reveal the values that arise and to show where further measurement units have been inserted. Firstly, we introduce an explanation by Neal upon the contents of Table 6.7.

'...but the final of these specific observations proves to be one of enormous importance. It is the fact that the Greek foot reduces to I.00227272feet. As a fraction, this length is exactly 441 to 440 of the English foot, this reduction is from a value of 1.008 feet which is 126 to 125 of an English foot... This precise compatibility, 1.008 being a compound of these two fractions of a 175th and a 440th would seem to indicate that the series of the three values starts from the value of the English foot... These numbers may then be viewed thus:
1.01376/176 x 175=1.008; 1.008/176x175=1.00227272; 1.00227272/441x440=1[12]

Below are the Greek measures as calculated by Neal. The other units follow in the same fashion as is seen in the lists from Michell. The same relationships to other units apply as above but here we observe four columns of values instead of three.

Table 6.6 Measurement Unit Values denoted in British feet according to Neal

ROOT	**STANDARD**	**CANONICAL**	**GEOGRAPHIC**
	[/440]x441	[/175]x176	[/175]x176
GREEK			
digit 0.0625	0.062642	0.063	0.06336
foot 1	**1.0022727**	**1.008**	**1.01376**
cubit 1.5	1.5034091	1.512	1.52064
stade (500feet)	501.1363636	504.0	506.88
stade (600feet)	601.3636364	604.8	608.256
furlong (625feet)	626.4204545	630	633.6
mile (5000feet)	5011.363636	5040	5068.8

'The first column is headed Root and is the base one from which all the other values are developed, the Greek geographic foot having been reduced by regular fractions to its origin in the English foot'[13]

So we arrive at a point where the basis of the measurement system as seen by Neal is explained. We also note that if the smallest version of the Egyptian foot of 1.1428571 were to be reduced via the 176/175 factor to 1.136363636, a value that converts Greek to Egyptian measure would be revealed. For example, 1.01376 x 1.136363636 = 1.152, it is seen that 1.136363636 is a constant factor between the Greek and Egyptian units.

However, we need to show further connections to the factor 1056. Here we shall find that time is of crucial importance as it is *time* that firstly denoted the factors for change and not the various angle measures of the meridian surface of Earth.

6.4 Cubit Values Correlation:- Egypt and Mesopotamia etc

In this section is demonstrated correlations between the cubit rods of Egypt and Mesopotamia and the measures widely cited in the books *Measurements of the Gods* and *Deluge: From Genesis to Atlantis*. There is also reference to the human proportions utilised by Vitruvius as elements of these appear in in the evaluations. Egypt had a different system of proportional representation of the human form but the results were the same.
For information on these applied Vitruvian proportions see
https://en.wikipedia.org/wiki/Vitruvian_Man
And for an Egyptian methodology http://www.pyramidofman.com/proportions.html

The cubit values.

Looking at the lists of dimensions applied to the various cubit rods that have been examined, predominantly from Egypt with the addition of one or two from Mesopotamia it is very clearly apparent that there is little consistency and that fixed units are not accurately described. There is considerable variation between interpretations of the dimensions marked on these rods or rules. These ancient measures are additionally almost always described in metric units.
The observation made by William Lane[2] *120 years ago must have been equally true in ancient times: "Of the measures and weights used in Egypt I am not able to give an exact account; for, after diligent search, I have not succeeded in finding any two specimens of the same denomination perfectly agreeing with each other."*[14]

People seem to forget that metric measures developed between 1700 and 1800AD following a suggestion in the 17th century and that with the ancient dimensions we are looking at measures that utilised a sexagesimal count, a system that had 6 or 60 as its base albeit with a decimal fractional system; in the case of Egypt this would have been in parallel to their own fractional system. That decimals were in use is apparent from the connections across the

whole system where the sa\me value can be represented in a small or large amount, for example from a tiny 0.036 to 36000. The same numerical connection applies. 9/250 has not the same connecting value as a replication of 36 although it is 0.036 in value.

The Nippur cubit rod is the first item seen here and from the information available we reveal the correct dimensions indicated by its markings. One would have thought that read a rule is a simple enough exercise but within small margins a number of diverse measures have been stated to be the definitive values set out on the rod. That applies to all of these rods and only by association with the values initially developed by Michell can we find the correct target value that was the original intention of the maker of the rod.

Fig 6.2 The Nippur rule

The Nippur rod is stated to be 1.1035 metres which is 43.44488189 inches in length. This equates with four of the relevant feet. The foot length here is divided into sixteen digits and there is a further division seen of 14 digits. In this shorter foot of 14 digits we see the accepted proportion of a human foot length in relation to height. [This as portrayed by Vitruvius and utilised by Da Vinci.] This 14 digit unit is the correct proportion of the height when that height is seven of these units. From that height is then revealed a cubit which is one quarter of the height. More conventionally we see the foot as being 2/3 of the cubit or as seen above 16 digits where there are 24 to the cubit. This short foot of 14 digits is therefore 7/8 of the longer 16 digit version.

43.44488189 / 4 = 10.86122047 inches = 16 digits at 0.67882628 [43.44488189/64] 14 digits = 9.50356792 = foot [human proportion from a count of seven of these feet as height].

If we use 9.504 inches here which number is seen in the 9.504 feet of the reed associated with the 1.584 foot cubit [*See in list below*] then we have an overall increase in length of the four foot rod of 0.050171655mm or five hundredths of a millimetre at 43.44685039 inches. The digit here becomes 0.678857143 [1.724297143cm] and 14 of these equate with 24.14016 cm. [*compare to the 24.15 on the table regarding this rod. This is within less than 1/10 of a millimetre.*]

This then reveals that the foot calculated [16 digits] = 10.86171429 inches. This is EXACTLY 6/7 of 12.672 inches or 1.056 feet [*see the 1.584 and 1.76 foot cubits in list below*]. In metric this is 27.5887543cm [*compare to the 27.58 on the table regarding this rod, again less than 1/10 of a millimetre difference*].

We assume that the Vitruvian concept of the foot being 1/7 of the height of a human is relevant here. Hence foot at 10.86171429 inches x 7 = 76.032 = [12.672 inches or 1.056 feet x 6 = 6.336 feet = 6 feet 4.032 inches]

This is now divided by four to obtain the cubit length as per Vitruvius

6.336 feet / 4 =1.584 = 19.008 inches

Handbreadth = 0.264 feet = 3.168 inches

Digit =0.066 feet = 0.792 inches. This is 1/12 [inch of the 14 digits at 0.678857143 inch or the human foot division].[0.792 x 12]/14 = 0.678857143

To clarify the methodology:-

To ascertain correct length the 14 digit value was calculated from available info. This gave a dimension that was very close to 9.504 inches which is a familiar count from other measures. This was taken to be the correct value for the 14 digits and the digit calculated accordingly.

The 16 digit foot was then calculated and this was seen to be 6/7 of 12.672 inches or 1.056 feet.

We then multiply by 7 for the overall height or length and this result was 6.336 feet [note that there are 63360 inches in the British mile]

Set of unit measures applied to the Nippur rod.[15]

Table 1. Measured values on models

	1/2 Yard (Arm's length) (cm)	1 foot (cm)	14 finger (cm)
Original	25,6	27,65	24,15
Photogrammetry	25,28	27,48	24,31
Laser scanner	25,32	27,58	24,06

This revision of the Nippur rod clearly indicate that the values calculated above in extension of the work of Michell are indeed valid. It also demonstrates the mathematical abilities of the artisans who devised the rods. Without the lengthy fraction attached to 10.86171429 this could not possibly work. These long fractions are essential for accuracy in calculation.

Regarding accuracy, the fine measures applied in calculation were simply impossible to mark accurately; they simply were too fine for the instruments in use, finer than the lines made to denote the measures. Hence we find the differences in opinion of their values. In the table we see three sets of results, the commonly accepted [original] value, one taken by photogrammetry which is thought to be the most accurate and that conducted by laser scanner, all of the same rod.

We have revealed an accurate measure that was within 1/10 of a millimetre of 27.58 centimetres and another unit that was again with 1/10 of a millimetre of 24.15 centimetres. It is not surprising that neither of these values are in the list of units derived from the latest photogrammetry scan but one is original and one from laser scan. Note the overall difference here between 24.31 and 24.06 which is 2.5 millimetres. This simply demonstrates the argument put forward above. Later in this work weights are examined and Petrie supplies a number of lists of weights all measures in grains [1/437.5 of an ounce]. In India a series of cuboid weights made from chert have been found which are again denoted diverse values and a lot of trial and error was applied until a set of values that connected all was derived. Again these link across nations and millennia.

In Egypt weights were made in a great diversity of shape and from nearly as wide a selection of materials. How much easier it would have been to make standardised cuboid weights. However if a weight of chert had been made to comply with a grain weight, its side length would be 4.01958 millimetres. Compare that dimension with the 2.5 millimetres variation in what was seen to be a definitive length on a cubit rod here. No way could a weight be constructed sufficiently accurately for the same reasons as the unit measures on a rod have been misunderstood. To evaluate these things one simply has use extended fractions for accuracy and the intended result will eventually be found as was the case with the measures revealed back in the 1970s by Michell.

The Nippur Rod also demonstrates that the Vitruvius proportions were in use although only the 1/7 of the height and the division by 14 makes his different from the system as seen in the tables below. What it shows is the height of the human at over 6 feet 4 inches with his foot including toes at 10.86171429 inches.

The length marked as a ½ yard [half Arsin] is the sum of the 14 and 16 digit foot lengths. This is seen on the rod in Turin Museum. Hence 30 digits. This is 30 digits at 0.678857143 [1.724297143cm] or 20.3657142 inches or 51.7289142 cm. This is 6/7 of 23.76 inches or 1.98 feet which is 30 x 0.792 inches. in other words the table above indicates what effectively is ½ of the ½ yard or ¼ of its length at 25.86445714 cm.

25.86445714 cm is 10.182857142 inches which is 15 digits. The overall length of four feet is 64 digits as seen on the rod in Turin Museum. This is an increase from the 30 x 2 digits of the full yard by a factor of 1/15 of the yard.

This length of 64 digits or 3.620571429 feet is 6/7 of 4.224 feet or 2.112 x2 where 21.12 inches equates with the cubit of 1.76 feet.

The yard of 60 digits or 3.3942857142 feet is 6/7 of 3.96 feet which is 3 x 15.84 inches or 1.32 feet with its cubit of 1.98 feet.

Hence it can be very clearly seen that the dimensions of the Nippur rod are based upon 6/7 of the values of a series of interconnected measures.

This is a somewhat intricate seat of units that interrelate well and some of the proportions of the male human physic are included. However, this does not mean that the linear lengths seen here were in use as a model for the human body, this only demonstrates the proportions and then only a small selection of those proportions.

The imperial values are correct in that they link EXACTLY to numerous others. I shall give a selection of connecting values. All these have been seen to have been used .
1.728 feet. This is EXACTLY 52.669644cm. This is within 0.3056 of millimetre of the cubit mentioned by Girard and indeed an approximation by Petrie which was in addition to his brilliant assessment of the 'royal' cubit at Giza.

P. S. Girard in his *"Mémoire sur le nilomètre de l'Île Éléphantine et les mesures égyptienn*es," and in "*Notice sur quelques étalons de l'ancienne coudée égyptienne récemment découverts,*" gave an average value of the length of the royal cubit of 52.7 cm (Girard, 1809, pp. 1–48; 1824,pp. 34–40).[16]

As already noted Michell termed this the 'short' Egyptian cubit but in reality the term 'royal' is that usually accepted as royalty featured on some rods showing this length.
We have additional confirmation from Petri. What is termed by Michell as the short Egyptian cubit is detailed here by Petrie in his work on the Giza Plateau *The Pyramids and Temples of Giza.*[17]

141. The values of the cubit and digit, found in use in the cases mentioned in this chapter, agree remarkably closely with what has been already worked out. For the cubit I had deduced (Inductive Metrology, p.50) from a quantity' of material, good, bad, and indifferent, 20.64 ± .02 as the best result that I could get; about a dozen of the actual cubit rods that are known yield 20.65 ± .01; and now from the earliest monuments we find that the cubit first used is 20.62, and the mean value from the seven buildings named is 20.63 ± .02. Here, then, by the earliest monument that is known to give the cubit, by the mean of the cubits in seven early monuments, by the mean of 28 examples of various dates and qualities, and by the mean of a dozen cubit rods, the result is always within 1/50 inch of 20.63. On the whole we may take 20.62 ± .0I as the original value, and reckon that it slightly increased on an average by repeated copyings in course of time.

Further to this a footnote [which refers to the 52.7cm unit of which Girard wrote] at the bottom the page of Petrie's analysis reads:-
On the façade of one of the tombs at Beni Hassan there is a scratch left by the workman at every cubit length. The cubit here is along variety of 20.7 to 20.8. [inches][18]

This results in the value Michell termed the 'long' Egyptian cubit which is derived from what he in this case termed the 'royal' cubit of 1.718181818 by:- [1.718181818 / 175] x 176 = 1.728 feet or 20.736 inches or 52.66944 cm.

At this point we add some further confirmations and show approximations from Petrie's *Ancient Weights and Measures* [19] page 41

Petrie claims that what he terms the 'Northern Foot' was 13.2 inches. This is directly associated with a unit measure found in Britain from whence it probably became popularised by the Saxon invaders it is 1.1 of the familiar British feet. It was in widespread use in many regions as is demonstrated elsewhere in this book and G.G. Joseph claims that this measure was widespread in India. Two of these feet are 2.2 British feet or 26.4 inches

Petrie lists 3 measures at 26.4 inches, 1 at 26.3 inches, 1 at 26.5, 1 one at 26.6 inches, 3 at 26.7 inches, 1 at 26.8 and 1 at 26.9 inches. Lower values are one at 26 inches, one at 26.1, and 1 at 26.3 inches.

Some of these are correct at 26.4 inches. This can be seen as 2 feet at 13.2 inches or 1.1 feet or represent the step of a 10.56 inch foot which is also seen as 0.88 of a British foot which results in a cubit of 1.32 feet. This was a common ploy where the count of inches and of feet exchanged places. Here a cubit of 1.32 feet and a foot of 13.2 inches.

2.5 of these 13.2 inch feet equate with 33 inches or 2.75 feet. This is a step value the foot of which is 1.1 British feet or the stated 13 .2 inches; this step has a name in India, the *gaz* while Joseph associated the 13.2 inch foot and its connected values with the measures of the Indus Valley.

Effectively this 13.2 inch foot is tthat which is directly associated with the English rod, pole or perch of 16.5 feet with its cubit value of 1.65 feet or 19.8 inches. The acre is seen as a rectangular area of 66 feet x 660 feet or 43560 square feet. In the associated foot value of 13.2 inches [1.1 feet] we have 60 x 600 feet or 36000 square feet of 1.21 [1.1squared] this against the 43560 British feet.

Hence we can immediately observe widespread connections. However, checking through the listings it is also apparent that there are numerous variants that are but poor imitation of accurate measuring rods or are inadequate interpretations of those rods. We have already seen some of the results of inaccurate interpretation and this will be no different. Petrie did not personally measure all of these examples but accepted existing information for some of his data.

I do not detect any definitive parallel to the remaining values in the list and all are judged as suspect. This is similar to the variations of a theme of accuracy seen with the cubit rods of Egypt and Mesopotamia. However there is a larger difference between the largest and smallest values here, half an inch or 12.7 mm.

While these are all seen by Petrie as 2 feet in length he makes an error because he still terms these as cubits. A cubit is 1.5 feet not two feet. 26. 4 inches or 2.2 feet is 1.1 x 2.
A mile derived from this foot will be 5500 British feet [5000 at 1.1]which can be reduced via the 24/25 factor [0.96] to the 5280 feet of the British mile. From here a further reduction reveals the long Greek miles of 5068.8 feet British which divided by 5000 shows the foot length of 1.01376 British feet. One more reduction takes us to the Roman mile [long version] which is 4866.048 British feet with the foot value here at 0.9732096 British feet. Short versions of the Greek and Roman measures are arrived at via the 175/176 factor one could include a short British value here at 5250 feet which gives a foot length of 1.05 British feet

[12.6 inches] a cubit of 1.575 feet [18.9 inches] reed of 9.45 feet [113.4 inches]and step of 2.625 feet[31.5 inches] but in fact these values are very rarely seen.

On page 40 of the same work Petrie records a limestone cubit rod of 26.8 inches. This does not relate to anything. However at 26.88 we have different tale, all due to that small addition of 8/100 of an inch. What now emerges is a cubit of 1.92 feet or 23.04 inches, increased via it's handbreadth to 2.24 feet. The handbreadth then complies at 3.84 inches to Petries 3.829 inches.

The cubit rods whether timber or other material are only as good as their manufacture and the measurement denotation lines are invariably much thicker than the unit value that the artisan is attempting to denote due to the impossibility of marking lines so very fine plus there needs be allowance for the movement due to temperature and humidity that effects the materials employed. Hence all such rods are deemed approximations only. Indeed for practical purposes they serve well but when we attempt to evaluate these to ascertain any connectivity and to reduce errors it is imperative to work as fine as possible and short decimal fractions, unless they are correct only lead to further errors.

The Egyptian 'royal' and 'short' or 'common' cubits

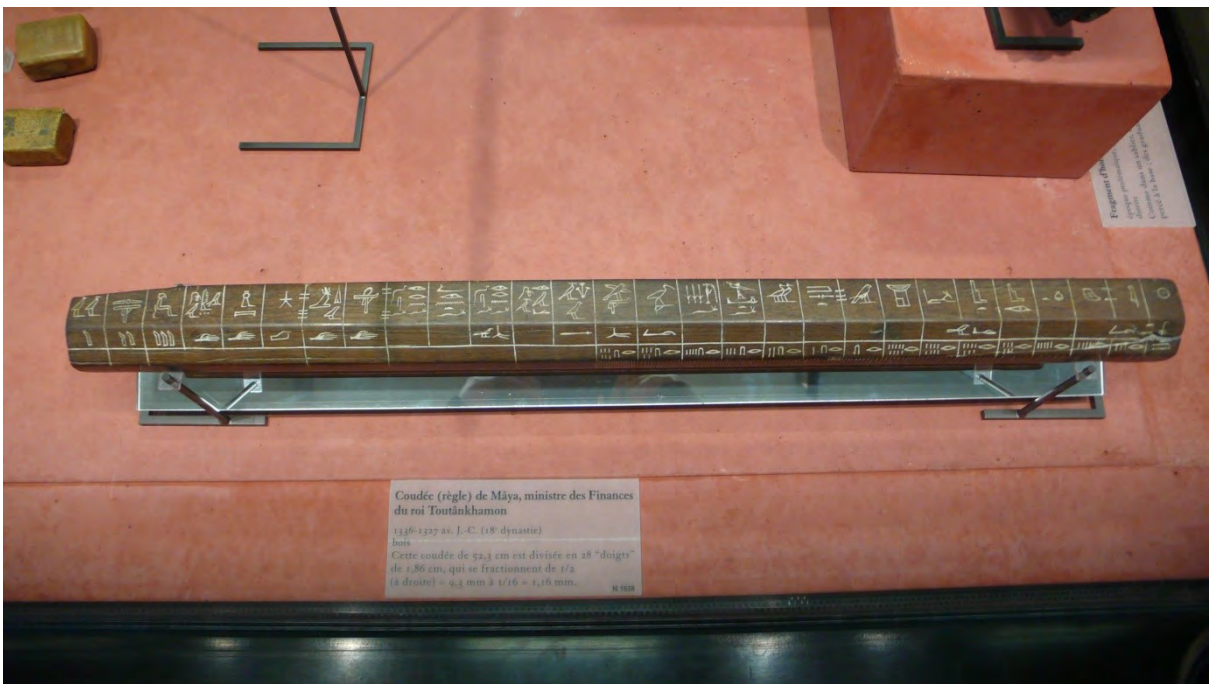
The value of 1.718181818 feet is 20.61818181 inches.
Petrie's 20.62 inches less 20.61818 etc leaves 0.001818 etc or 0.046 of a millimetre and hence is well within his tolerance of 0.1 of an inch which is 2.54 millimetres.

In metric 20.6181818 = 52.3701818 cm

Below is seen the measuring rod of Maya the financial minister of Tutankhamun and this again is denoted as being the same as the 'royal' unit, 52.3 cm in length. Other interpretations for the royal cubit range between 52 and circa 52.5 cm and the same applies to this rod. Once more note the disparate assessments of the measure.

There are a number of rods indicating a length very close to this but the reports are many and varied. The imperial calculation of Michell at 1.718181818 feet or 52.3701818 cm gives us the intended length. The cross correlation seen in the lists below which link to the values seen in this section will demonstrate the validity of this statement.

Marked on at least one of the rods is a length that approximates this 1.718181818 reduced via the 6/7 fraction and this is the length of 1.47272727 feet. This is EXACTLY 44.8887272 cm.



The cubit of 1.76 feet [see table below] has a foot of 1.1733333. The cubit of 1.728 feet [Girard see above] divided by 1.17333333 etc = 1.47272727 feet or 44.88877272 cm. This is precise whereas the 45cm commonly applied is an approximation derived from examination of the rods with their fine errors.

This length is termed the 'short' or ' common' cubit and is 6/7 of the 'royal' cubit of 1.718181818 feet. In essence then here we see a very similar scenario to that of the Nippur unite where the value described is 6/7 of an other than has links to a variety of further measures.

If the 1.4727272727 or 'common' cubit is divided into six handbreadths and 24 digits then the digit x 14 for the 'human foot' is seen to be 10.309090909 inches [9 of the relevant inches or half of the 'royal cubit'] and seven of these feet give an overall human height of 72.16363636 inches or 6.013636 feet or 1.832956362 m. or 3.5 'royal' cubits. The human foot length derived from this equates with 0.841558442 of foot or 10.0987013 inches.
If the 'royal' cubit is treated in exactly the same way we have a human at 7.0159090909 feet tall which is 213.84490909cm.

Dividing this by seven we have the 1.1454545 foot related to the royal cubit x 1.142857142 or one and one seventh.

Hence we divide the cubit by seven for the handbreadth instead of six.
1.718181818/7 = 0.245454545feet = 2.9454545inches
0.245454545 / 4 for digit = 0.061363636 =0. 736363636 inches

0.06136363636 x 14 = 0.859090909 feet = 10.309090909 inches
0.859090909 x7 = 6.01363636 feet = 72.16363636 inches = 3.5 'royal' cubits or 183.2956364cm

In other words both cubits have exactly the same result when the 6/7 proportion is applied as is expected because this is the difference between the cubits. It is pretty clear that here we have proportional differences in measure, effectively two related values that connect via a specific proportion of 6/7. The fact that we achieve the same height [which we term human after the 7 foot division into the four cubits of Vitruvius proportions is no more than coincidental, we applied the 6/7 factors and whatever we did after that, assuming the same was done to both cubits the same results for each cubit would result. There is no specific reference here to human measures other than proportional as is common to numerous units.
So assuming that Vitruvius concepts are applied here we either have an approximately 6 foot human derived from the 'short' or 'common cubit' and a seven foot specimen from the 'royal' cubit or we have two six footers…

The Amenemope circa 993 – 984 BC [21st dynasty] cubit rod [19]

This has the six handbreadth division of the same length as the 'royal' cubit and this has been termed the 'reformed' cubit. This gives us the 7 foot human. Here we have the 6 handbreadth instead of seven and 24 digits to the cubit. This pattern is as seen in the listing below of a variety of cubit values. It has been suggested that the six handbreadth standardisation took place at this time [circa 1000 BC] but in fact this is not the case and a wide variety of measures show differently to this dating as they predate this and have the six handbreadth to the cubit proportion. Both divisions have been used when seen as appropriate.

Samian cubit

"The Egyptian cubit being equal to the Samian." [20]

This quotation would be meaningless without a definition of the Samian cubit. The Ashmolean Museum in Oxford displays a life-size relief of Samian origin,[21]

This gives the length of the Samian cubit. According to the position given to the elbow when the arm is bent, the cubit length varies between 0.54 m (9 squares) and 0.525 m.[22]

What yet again emerges here is the disparity in assessment. There is difference between these measures of 0.59 of an inch or 1.5 cm. Hence we cannot depend upon the statements of length other than as approximations. On this basis no human development from inaccurate measures will have much validity.
In his *Gegen die Zahlenmystik an der großen Pyramide bei Gize* (Borchardt, 1922, pp. 8 ff)[23], remarked that the length of 0.525 metres of the royal cubit is seldom encountered and preferred a "standard" length of 63.5 cm.
At a length of 63.4822469 cm [within 0.1775mm of the 63.5 cm of Borchard] we find the 'short' or 'common' cubit of 1.47272727 feet increased via the factor 1.414213562 which is the square root of two. This is the hypotenuse of a right angled triangle with side lengths of 1.472727272 feet.

This is usually known as the remen. Any cubit or other measure of one side of a right angled triangle with two equal sides will have its length x the square root of two as the hypotenuse. Hence this value is unlikely to be used as a unit measure but will be applied as a factor for increase or decrease.

Why the 'Royal' terminology is applied to the cubit of 1.718181818 feet.
Here we explain just why the 'royal' cubit was deemed so important. It effectively, via 22/7 is related to all other values in use in a much closer way than the various factors for change such as 24/25 for example denote. These evaluations are confirmation of the importance of this cubit.

…….
The cubit value in imperial is 1.718181818etc British feet.
Multiplied by six this gives a reed value of 10.309090909etc feet
The foot is 1.145454545 etc feet
The step of 2.5 feet is 2.8636363636 etc
A circle with its circumference at the length of the reed, six cubits, or 10.3090909etc is divided by 22/7 or 3.142857142 etc
The diameter of that circle is now seen to be 3.28016529 [this is definitely NOT related to the metre although a similar looking number]
3.28016529 / 1.145454545 [foot value] = 2.8636363636 = step length.
Hence by the application of 22/7 to a circle with the circumference of the reed length we deduce the foot and the step lengths.
…….
We now do the same with other cubit values.
…….
Cubit at 1.584 feet
Foot at 1.056 feet
Step at 2.64 feet
Reed at 9.504 feet
9.504 feet / 3.142857142 = 3.024 feet
3.024 feet / 1.056 = 2.8636363636 = the step length of the royal cubit and divided by 2.5 gives the 1.14545445 foot length of that cubit.
……

Cubit at 1.65feet
Foot at 1.1feet
Step at 2.75 feet
Reed at 9.9 feet
9.9 feet / 3.142857142 = 3.15 feet
3.15 feet / 1.1 = 2.8636363636 = the step length of the royal cubit and divided by 2.5 gives the 1.14545445 foot length of that cubit.
…….
Cubit at 1.52064 feet
Foot at 1.01376feet
Step at 2.5344 feet
Reed at 9.12384 feet
9.12384 feet / 3.142857142 = 2.90304 feet
2.90304 feet / 1.01376 = 2.8636363636 = the step length of the royal cubit and divided by 2.5 gives the 1.14545445 foot length of that cubit.
……..
Cubit at 1.512feet
Foot at 1.008feet
Step at 2.52 feet
Reed at 9.072feet
9.072feet / 3.142857142 = 2.8865454545 feet
2.8865454545feet / 1.008 = 2.8636363636 = the step length of the royal cubit and divided by 2.5 gives the 1.14545445 foot length of that cubit.
……..
So let us create a super large version and utilise the circumference at the centreline of the lintels at Stonehenge at 316.8 feet as our circle; this we shall term the reed measure.
We need divide by 6 for the cubit which evaluates at 52.8 feet and divide by nine for the feet which results in a foot value of 35.2 feet.
316.8 / 3.142857142 = 100.8 feet
100.8 / 35.2 = 2.8636363636 = the step value of the royal cubit and divided by 2.5 gives the 1.14545445 foot length of that cubit.
…….
Hence from this it can be seen that the association of the values of the royal cubit dimension set via 22/7 emerge in conjunction with the remainder of the system. Obviously only a small sample is seen here but the principal remains. This discovery rightly gives this cubit with its feet, step and reed such a position as being the Royalty of measures as all others appear to be subjective to these values and proportions irrespective of other associations.

6.5Time-Based Changeover Factors

We noted in *Deluge* that factors derived from time values were almost certainly utilised in conjunction with the measures for changing between units. Here we discover the 175/176,441/440,24/25 that Neal is convinced are derived from the various degree lengths along the Earths meridian quadrant. This is also revealed in *Deluge* as explanations are required for understanding there as much as here.

As noted in Chapter 2, in antiquity the skies had been measured in terms of time [for example 15 degrees is equivalent to 1 hour]. In a later chapter is found an explanation of when, where and how the circumference of the Earth was probably first measured. That it was measured is a *certainty* or the measurement units as we know them, including the British Imperial values, would not have existed. The first and perhaps most important point to note here is that various month lengths were in use plus the lengthy period of the precession of the equinoxes. It was a long time before the various meridian degree lengths were understood and therefore to state that this was the factor that denoted the differences between measures is erroneous. Here is seen what did apply. The monthly periods were in terms of round figures but the same changeover factors as utilised by Michell also give extremely close correlations to the different values, but, as we state, in relation to time and not measures of specific degrees around the meridian.

Here are noted the month values.

The *sidereal month* is the time the Moon takes to complete one full revolution around the Earth with respect to the background stars. However, because the Earth is constantly moving along its orbit about the Sun, the Moon must travel slightly more than 360° to get from one New Moon to the next. Thus, the *synodic month*, or *lunar month*, is longer than the sidereal month. A sidereal month lasts 27.322 days, while a synodic month lasts 29.531 days. The mean of these values is 28.4265 days. Both 27 and 28 days counted without the fractions have been frequently used in calendar counts and while we have not uncovered any evidence for it, in all probability 29 was also utilised in similar fashion.

The sidereal month of 27.322 days, increased via the 25/24 factor, or the reciprocal of 0.96, which is 1.041666666 results in a value for the mean month of 28.460416666…within 48.84 minutes of the true value! Such fractional values, albeit perhaps only to a single decimal place, were long understood as we can see from the flood story as described in Genesis where Noah was afloat for 354 days or 12 months at 29.5 days, a synodic lunar year. Other texts from India, when examined in depth, indicate similar knowledge.

To calculate the lengthy period of the precession of equinoxes of 25920 years is not as difficult it sounds as the apparent movement equates with half a degree over 36 years. Half a degree may not sound much but that is the visual diameter of the moon or sun and hence is a definitive measurable distance. This lengthy period would have been calculated via the rising or setting of stars along the horizon and when, over a period of 36 years a star had ‘slipped back’ by a lunar diameter, it became apparent that a long cycle required understanding, at least in terms of its length.

So let us examine the divisions that were first put to the circumference of Earth. The measured circumference was initially divided by the 25920 years of the precessional period utilised as a divider which gave what Michell has termed the 'Greek' mile. In turn the value of 27000 relating to the 27 days of the sidereal month was also divided into this same circumference and resulted in the 'Roman' mile.

Hence, from an initial measurement of the circumference of the Earth and a division of that circumference by counts of time there emerged two measures that were established as being stable values. As we now understand, these were connected via the 24/25 factor. By an increase of 25/24 [divide by 0.96, or to reduce the value multiply by the same factor] from the 'Greek' value, the next unit was derived, which is that which we understand to be the British mile albeit at this point seen in terms of 5000 feet. The foot value would be 1.056 of the later, familiar and shorter version. [The 'Greek' foot of 1.01376 / 0.96 = 1.056 and 1.056 x 5000 = 5280 = British mile.] Possibly at this time the 'British' mile measure was also increased via the 25/24 factor to what later would be accepted as 5500 singular British feet and which gave us units common to India, Sumeria, Saxony and later to Britain. From this unit was derived the 'rod, pole or perch' of 16.5 feet and the acre.

[Note: It is important to remember that we are here counting in familiar British feet and that the original 'British' foot would have been 1.056 of the familiar shorter version that we are utilising. Initially the modern value of 5280 feet to the mile would not have existed. All miles had 5000 feet. Hence an increase from 1.056 via 0.96 would result in foot value of 1.1 and a mile of 5500 feet. In fact when these evaluations were initially made a totally different set of unit divisions would have existed and it was only after the mile lengths via divisions denoted by astronomical counts had been established that constant 5000 divisions gave the foot values. Hence the earliest 'British' foot was one of 1.056 feet or 12.672 inches and NOT Neal's 12 inches, the system could exist without the 5280 division of the mile. This came a short while later.]

Common counts in use for month values were 28 days, 27 days and 29 days which were added to by the 30 day month in association with the 360 day year. The values extended to time spans much greater than the month or year. For example there was the Saptarsi calendar of India which had a basic length of 2700 years emulating the 'round figure' sidereal month. This is well attested and has links to the birth of the Greek and Roman gods…

From the time of Father Liber [Roman Bacchus or Greek Dionysus] *to that of Alexander the Great,*[356 BC–323 BC, ascension in 336 BC] *one hundred and fifty-three kings of India are reckoned, extending over a period of six thousand four hundred and fifty one years and three months.*[14]

Here we have a date from the summer of 336 when Alexander ascended the throne. Effectively this can be seen as 335.5 BC to which we add the 6451.25 years mentioned by Pliny to arrive at a date of 6786.75 BC or the spring of 6787 BC, the vernal equinox. This approximates the beginning of the Age of Gemini. The onset of the new zodiacal age is gradual and either date, 6787 or 6676 derived from Indian calendar counts is equally viable from a visual perspective. Note that this is a *visual* dating when the Sun rose midway between Cancer

and Gemini as against the modern date of 6500 which is based upon a geometrical division of the sky. [see Figures 8.12 and 8.13 of *Deluge*]. If we accept a small variation in dates ascribed to this event such as the 111 years between the commencement of the Saptarisi Calendar and the date given by Pliny, which visually was barely noticeable, then we can accept that the beginning of the age of Gemini denoted not only the Saptarisi Calendar but also the birth of Dionysus. This raises questions regarding the beginnings of the culture that prevailed in that land so long after the onset of Gemini, why utilise a specific date so far back in time?

The period of 2700 years was altered in 3076BC to 3600 years, a yearly representation but counted from the original date of 6676BC. The Naksatras, which were the 27 divisions of the month denoted by asterisms associated with the constellations, are another example; these were later increased to 28 divisions.

27 / 0.96 [24/25] = 28.125 and 28 days was the generally accepted mean value of the month as is implied by the calendars mentioned above. [There are 13 of these months to 364 days.] If 28 is further increased by the same method, that seen by Michell, Neal and others as representing changes in the meridian circumference of Earth, the 25/24 factor, the result is 29.16666 where the true value of the synodic month is 29.53 so again it is acceptable as it gives us the anciently used approximation of 29 days. In round figures, representing days, [27 + 29] / 2 = 28, the generally accepted mean value. It was also discovered that a number which repeatedly appears in India, that of 1.08 slots into place here as 27 x 1.08 = 29.16 and hence both methods were in use, although the 0.96 value more generally applied to the increase or decrease in measurement values.

While approximations could be used for time, more accurate values such as 28.4 days for the mean month, which self-evidently reveals knowledge of 27.3 and 29.5 days for the sidereal and synodic months were known in India at a time before dynastic Egypt, as we demonstrate in *Deluge*. Linear measures, however, had to be exact even though time approximations were utilised as factors to change one value to another.

So to recap: The Earth circumference derived from the early surveys was initially divided by the 25920 [years of the precessional period] and this gave what Michell terms the 'Greek' mile of 5068.8 British feet which connects to the 'Roman' version via the factor 25/24 or 1.04166666 [the reciprocal of 0.96]. It was the 27 days of the sidereal month that gave the so called 'Roman' mile in terms of 1/27000 of the Earth circumference. The 'Roman' mile is a distance of 4866.048 British feet. The 'British' mile is an increase by 25/24 from the 'Greek' mile with the 5500 foot 'Sumerian' or 'Saxon' mile being a further increase via the same factor from the British unit.

At this point therefore, we have not only the Greek and Roman miles but the British and that which Neal terms Saxon but for argument's sake [and evidence seen in *Deluge*] we shall name Sumerian. This is all from evaluating the connections between counts of time. It is clear that here is the original source of these factors. As we shall later show, the Earth was initially measured via the use of observations of the skies. The movements of the lights in the sky were the only static factors in the life of anyone in those far off days.

6.6 The 360-Day Year

Where Egypt eventually took a predominantly solar / star based calendar India maintained the ages old lunar / star based version, which had solar correspondences. The 360-day year seemingly has a curious origination in India. It can be seen as a lunar / solar count and not as in Egypt a convenience [or so the Egyptologists would have us believe]. While there is almost certainly a more simple explanation, we show firstly how this may have been derived from accurate observations of the heavens. To devise the 360-day year with its 30 day month precise astronomical measurement was required. According to Professor Subhash Kak in his 2003 essay Babylonian and Indian Astronomy: Early Connections:-

The wheel of time was defined to have a period of 360 parts. This number seems to have been chosen as the average of 354 days of the lunar year and the 366 days for the solar year.[15]

The solar year is fractionally over 365 days, as we know; if it were not we would not require a leap year every four years and hence it appears that the year for this count was seen to complete during the *366th day*.

The explanation, utilising modern knowledge, runs thus: the length of the lunar year is 354.36708 days. [29.53059 days x 12 *Chambers Science and Technology Dictionary*] We shall allow this to be known as 354 days, [12 synodic months] which is the value required for the calculation that may have been made to determine the 360 day year and which denotes the 29.5 day month. The solar year is a little different in that the *sidereal* day length is less than our conventional and convenient 24-hour day which was initially developed in Egypt. The sidereal day is that which is defined by the passing of a point on an imaginary line between the centre of the Earth and the centre of the sun, hence it defines a single rotation of the Earth. This period is, as recorded in *Chambers Science and Technology Dictionary*, 23 hours 56 minutes and 4.091 seconds, which in terms of decimal values is seen as 23.93446972 hours. It is 0.065530278 hours short of our conventional 24 hours. In the *tropical year*, which is defined by successive passages through the vernal equinox, there are 365.242194 days. Taking the sidereal day of 23.93446972 hours and multiplying by 366 we find a count of 8760.015918 hours. Divided by 24 the result is 365.0006632.

Hence, allowing 24 hours for a day with a count of 365 days means that there are 366 revolutions of Earth to the year. Possibly, it was initially thought that a year ended within the confines of the 366th day as such accurate counts did not arise until a much later period with the Babylonians but nevertheless, it is striking that Indian concepts absorbed this idea.

Again, using modern assessments, taking an accurate measurement of 29.53059 days for the lunar month giving 354.36708 days per lunar year and 365.242194 days for the tropical year, we have a mean value for the year of 359.804637 days, which could be approximated to 360 days. However the value came into being as a count of time, this was the Indian civil year.

Every 5 years an intercalary month was added to comply with this count, which kept the solar and lunar counts in line. For example, 354.36708 x 5 + 29.53059 = 1801.36599 and 359.804637 [seen as 360] x 5.006511325 has the same result. In round figures, as would have been utilised, this arrangement can be seen as (354 + 366) / 2 = 360 and (360 x 5) + 30 = 1830

whereas 366 x 5 = 1830. This five year 'Yuga' [which loosely means a joining of measures of time] is mentioned in a number of Indian works including the *Rig Veda*, the composition of which is now dated to 3500BC -3800BC by Dr. Nicholas Kazanas of Omilos Melton, Athens. [See the discussion and references in Chapter 8 of *Deluge*.] In fact other Indian works contain astronomical and climatic information long predating this date strengthening the idea of information being handed down orally in story format. Some has been missed by the experts as is seen in Chapter 9 of *Deluge* which is devoted to an explanation of the lengthier yugas which *traditionally* extend into many millions of years. What is therefore seen here is an effective combination calendar comprised of an accurate count of lunation in units of 62, a civil 360-day year and a count of 365 days combined with the annual count of Earth revolutions of 366. This type of counting was also in use in Europe as we shall see in a later chapter.

However, there is a more prosaic explanation.

The Indian *Surya Siddhanta* states [1:10] that real time is different from calculated time implying that other factors and values come into play.

Lokanam antarkt kalah kalonyah kalanatmakah
Sa dvidha sthulasuksmatvan murtas ca amurta uccyate.
An English translation reads:-

The time which destroys is the real time the other kind of time is
for the purpose of computations. They are of two kinds, the gross one is
used for real time use and the firm one for the purpose of computations.

It is apparent that much of the 'symbolic' use of numerical values is that seen here related to 'firm' values and time. Hence as the numerical system revolved around the values 6, 12 and 10 we see that 360 is a value that encompasses all, to which most of the numerical counts related. Here is seen the 'firm time' noted in the extract above and the development of a calendar count that is easily constructed without the need for precise observation and calculation. This, almost certainly, is the origin of the 360 day year that spread across a number of cultures and was widely utilised in the Bible.

Note that only recently is the true antiquity of the astronomy and the mathematical abilities of the seers of this nation being recognized. Much false history has been written about India such as the 'Aryan Invasion' that in fact did not happen and was invented by Europeans during the early years of colonization. The Europeans could not accept that the Indians could have had the ability to compose long texts and build the structures that were uncovered and hence a suitable European based history had to be invented.

As noted above the Bible also utilised a 360 day year where lunar months are not implicitly mentioned and frequently uses the concept of 'a year for day' where a count of days can mean years or vice versa.

Note:-See Ezekiel 4:4-6, Numbers 14: 33-34 for the 'year for day' description. See also 2 Peter 3:8 where the concept of a thousand years equating with a day can be seen. This implies multiplication in values of tens and in the Bible and similar writings it is the numbers that give answers and the extensions into thousands confirm vastness. In the Indian annals it is

shown that a day [of the creator god Brahma] equates with a human year, hence a day for a year or vice versa as seen in the Bible.

The concept of a day for a year emanates from the north polar skies as is implied by Lokamanya Bâl Gangâdhar Tilak in his 1903 work *The Arctic Home of the Vedas*.[16]

Tilack argues and we agree, that it was noted that a day for those away from Arctic regions is one rise and set of the sun, something that happens, in round canonical figures, 360 times per year, whereas in the Polar areas, this happens but once a year.

It was a vision of the circumpolar stars that did not set but remained in their elevated positions '*the imperishable ones*' that kick started this concept into being, an idea repeated in Egypt.

Examples of time periods relating to this count, invariably utilising the 360 day year, are found in India, Mesopotamia and Egypt and even the American Maya utilized associated canonical values.

The year [13 months at 28 days] of 364 days / 175 = 2.08, which, when then multiplied by 176, [the 175/176 conversion factor of Michell] gives us the 366 day year [see above] at 366.08 days; again, [366.08 /441] x 440 = 365.2498, almost exactly the true solar year length. Both long and short versions as with the measures are seen here in a time count. It now therefore appears that the 'long and short' measurement idea may be derived from a long or short annual or monthly count of time.

In conclusion, therefore, it can be seen that these divisions and factors of the various measures originated in approximations of counts of time and not the degree lengths along the meridian line which were simply not known in those far off days when it was accepted that the Earth was a globe. The initial mile values were themselves obtained from counts of time associated with the Earth's circumference. Other values associated with the diameter and hence the 'square of the Earth' came only after two values for π had been calculated.

Looking again to time values it can be seen that the 28.4 days of the mean month can be increased thus:- [28.4 / 125] x 132 = 29.9904 or 30.

So now we have a further connection, a link to the important canonical 30 day month, 1/12 of the 360 day symbolic year from the mean month. But there is more. The 360 day year effectively embodies, via the factorial changes, the elements of the other year lengths and indeed, and perhaps more importantly, the 30 day month also has this quality and so this seemed to be an important value not only from a symbolic point of view but also a practical one as 360 and 30 fit the counting system that was in use. Here we have all the sixes, twelves and tens coinciding in a beautiful harmony, the Indian 'firm time'. This took predominance over other measures for the year and month, for the extensive periods in India known as the Yugas, in fact for all except practical astronomy which required accurate calendar counts. The values associated with this symbolic system, 30 and 360 became of the highest importance. This was fixed, it was a mathematical certitude, it was *firm time*.

The circumference of Earth had already been denoted in terms of the precessional period and the 27 day month; the 30 day month, that which denoted the canonical values was allotted to the British measure. Here we see the emergence of the values of 1056 and 31680. Importantly here we have the factors 132/125 associated with the increase from the mean monthly value of 28.4 to the canonical count of 30 days. An evaluation of 132/125 = 1.056 or

put another way, the canonical month / 1.056 = the mean month [30/1.056 = 28.4090909]. Hence it appears that 1.056 was seen as important to this evaluation.

The 30 day month was therefore multiplied by 1056 for a final result of 31680 and each 1056 represented a day. The month has four quarters and 31680 / 4 = 7920 the long accepted diameter of Earth in British miles. This value has only been ousted since the onset of decimalisation by the French authorities. It is ironic that this quite accurate dimension for Earth's diameter was a by- product of time counts associated with Earth's circumference.

6.7The Square of the Earth

It is most intriguing that the number 33 in terms of 'Gods' occurs often in religious lore as with the 33000 Gods or to be more accurate, 'aspects of the Lord', in India. The source of this value is obscure, perhaps 1188000/36 = 33000 where 11.88 years represents the orbit of Jupiter, a movement that was understood millennia before dynastic Egypt as clearly seen in the Indian Mahabharata [Book Three Section 189 in van Buitenan's translation]. Here there is an astronomical description that *only fits* a specific day and date that is two days after the spring or Vernal equinox with the same day being the new moon of the relative month in 6681 BC. Central to this description is the position of Jupiter.

In conjunction with the above calculation we should repeat a Biblical extract that explains in part the extended value seen above for Jupiter.

2 Peter 3.8 reads:

But do not forget this one thing, dear friends: With the Lord a day is like a thousand years, and a thousand years are like a day.

The Book of Ezekial, Chapter 4:4,5 and 6 detail, as does The Book of Numbers, 14:33 and 34 the concept of 'a year for a day' and /or 'a day for a year'. These strange by modern standards ideas are clearly written in the Bible and were applied to the numerical values therein. Commonly, only the numerical value without any decimal place indicated what was intended and hence 1188 would imply the orbit of Jupiter. By utilising the thousand years as a day as a multiplier concept this then becomes 1188000. If the 1188000 are seen as days and divided by 36 representing the 360 days of the year the result is as seen above, the number of aspects of the Lord in India, 33000.

What is certain is that 33000 x 0.96 or $^{24}/_{25}$ of 33000 = 31680 and we have seen the repeated use of 0.96 in the earliest evaluations that occurred after the initial measuring of Earth. So here we have a link between the number of aspects of the Lord and the value of 31680 which was a month counted at 1056 per day. The Moon has always been of very great importance, not least due to its clearly apparent four phases every month. As the Moon is implied in the time factors for change seen above we shall look once more in that direction. The 31680 was divided into four for a result of 7920. This was then associated with the mile units that were $^{25}/_{24}$ of the Greek values, those we term British. We now have the perimeter of a circuit of the space around Earth divided into four sections which was utilised as a square, a square representing the Earth, as seen in numerous locations in a count of British miles. Each

side of this square was known to be 7920 miles [British] in length with a total perimeter of 31680 of the same miles.

This square can be utilised also in circular format as indeed it was at Stonehenge scaled to British feet at 316.8. The full size diameter of the circle [using 22/7] measures 10080 miles, which is 2160 miles greater than Earth. Here once more we see a lunar representation. 2160 years is the period of the 'precessional month' which again, quite coincidentally is also the count of British miles in the Moon's diameter. Hence on this esoteric basis, when set out in a circular format, the centre of the Moon is symbolically1080 miles from the surface of Earth and the surfaces of the two planets are touching. The commonest representation for this however is in square format as seen at the Great Pyramid where the perimeter was 31680 Egyptian inches.

In support of the idea of this being common knowledge in the past we can quote some Egyptian material at this point.

There is a reference to Earth's diameter and the square in the slightly oddly named: *Papyrus of Nu*, *The Chapter Of Making The Transformation Into Ptah, Of Eating Cakes And Of Becoming A Living Being In Annu* [Heliopolis].

The subject of this papyrus chapter revolves around the deceased taking up residence among the Gods and verses 9 and 10 read thus:

[9] *My head is like unto that of Ra and when my members are gathered together I am like unto Tem; the four sides of the domain of Ra*

[10] *and the width of the earth four times…*[17]

6.8 Pi evaluations

Again, contrary to conventional teaching it would be relatively easy to evaluate 22/7 from the practical method of inscribing a circle and measuring its circumference [relatively easily accomplished with rope around pegs with no space between them with the outside of the pegs being the circle circumference] and then dividing the circumference by the radius used to discover the involved factor. The result is 2pi or $6^2/_7$. For the diameter relationship the singular value of pi or $3^1/_7$ [22/7] would appear. We are not looking at historical mathematical theories regarding polygons but at stark practicality. If maths had not developed as we have been suggesting, from a practical base, then the measurement systems that allowed the buildings of India and a later dynastic Egypt to be erected would not have existed and quite simply the Great Pyramid would not be a wonder of the world as it would not have been built.

The second value of π was understood long before the building of the Great Pyramid or the square of the Earth with its value of 31680 would have no place there, it would not have been devised in the form that it appears. Each side of the 'square of the Earth' has a length of 7920 miles British or 8250 miles Greek. Dividing 22/7 into the known circumference of the planet does not produce either of these values, merely an odd number that is relatively close. Hence the diameter as derived from the 'square of the Earth' was divided into the known circumference.

In Greek measure	25920 / 8250	= 3.1418181818
In British measure	24883.2 / 7920	= 3.1418181818

Therefore there was now a correlation between the 'square of the Earth' and the known circumference. Ironically, this diameter, developed from a symbolic 'square of the Earth' has proved to be extraordinarily accurate and the π value is more exact than 22/7. In fact a mean circumference value taking in the equator and meridian measures from NASA is 24880.20958 miles against Michell's 24883.2, a difference of a mere 2.99042 miles. Dividing this mean measure by 7920 we find a value for pi of 3.141440604. Modern pi = 3.141592654.

6.9 1056 and 1.0

So why the finer division and alteration to produce the familiar 12 inch British foot, that demonstrated by Neal as being the root of the system? It would appear that this value came about as a result of experimentation with canonical values associated with 1056 and the month. Effectively 1056 was now seen to represent a day, it was an increase from the 1.01376 feet of the 'Greek' foot by 25/24 to 1.056 feet of the early 'British' but while this was the case a singular count of 1 was possibly also required for that single day. This would give the 360 days of the year. If this was the case then it was almost certainly at this point that the singular British foot emerged, a unit that divided 1.056 times into the pre-existing foot value and of course this then fitted into the numerical Greek scheme of values.

Naturally there also had to be a base notation for trade where all and sundry recognised counts in the common denominator value. It would have been easy to have a base of 1 that interrelated to all systems via easily recognisable factors. We can therefore see the British measure would have been utilised far and wide as a base for counting, via the Greek values, [as denoted by Neal] which we have stated would have been the initial prime units from which a value of 1.0 emerges and to which all else relates.

Various other measures as described would have been the primary everyday values but all had to have a base at some point and that base was one British foot, a small 'Greek' unit. The derived mile was that seen in conjunction with a count of 7920 as Earth's diameter. Neal's evaluation we accept as being basically correct although the use of the values and reasons for their derivation, other than mathematical, he apparently fails to realise. Regarding dating however, we firmly state that it would predate dynastic Egypt by at least a few hundred years and as later evidence will reveal, almost certainly stems back to the seventh millennium BC or possibly even much earlier.

So eventually, a number of different mile values [from which numerous other units evolved] and two versions of π were devised from the initial measurement of the Earth, all intimately related to the movements of the Moon, Sun and as is later demonstrated, a very specific star, Capella. As the canonical calendar was based upon the mean value of the month, as seen in the monthly count of the Indian Yugas, [fully explained in *Deluge*] it was what we understand as the British mile that came to the fore. However, the Earth circumference would have been understood initially at least in terms of the 25920 of Michell's 'Greek' mile and the operative foot that complied with the standard 5000 divisions of the British mile was that of 1.056 British feet or 12.672 inches and not the basic foot as we have known it for hundreds of years. The singular value of 1.0 for the foot was calculated shortly after the system was set up.

We do not know when or why the mile value was divided into 5000 to create a foot; the nearest guess appears to be that the average step divided into the average mile 2000 times and hence this gave 2.5 feet to the step. This fitted the size of the average foot and with this revelation came the slotting in of the vastly aged lengths of forearm, width of hand and fingers to give the remaining units. The reed probably was derived from an adaptation of a weapon to suit the then developed measuring system. To maintain these units there would probably have been elite groups of individuals who were guardians of what were the 'state's' measuring rods, and these people made precise replicas for localised leaders. Perhaps even, the units, being derived from stellar and Earth correlations *were* seen as 'sacred', *Measurements of the Gods* indeed.

In the next chapter we explore a completely different usage of the factor *1056* and indeed of our 'Measurements of the Gods' in general, one that has been missed by all other researchers into metrology. It is where the connections between metrology and astronomy extend into *mythology* and modern religions with a particular focus on the widely-found ancient mythology of a 'Great Flood.' We reveal just a little more of what is to be found in the companion work to this book, *Deluge* and then move to Stonehenge for more about 1056 and calendars.

CHAPTER 7

The Ark, the Great Pyramid, Stonehenge and Silbury Hill

Num-Khufu, the builder of the Great Pyramid, dreamed of a coming deluge and built the pyramid as his Ark of safety. He then 'made his abode in the maritime pyramid along with Noah.'

Murtadi, Arab writer (1584AD) (Cited by Massey in *Ancient Egypt: The Light of the World*. 1907)

7.1 The Monuments of the mid 3rd Millennium BC

We remain focussed on the time around 2500BC in this chapter and unashamedly borrow some text from our work *Deluge* as we view this section as being important to the current study. Not only was the greatest of all the pyramids built during this era in Egypt but elsewhere around the world other great monuments and structures were constructed for reasons that archaeologists consider revolve around state formation. Possibly this is the case, but taking in the results of our investigation into Great Flood mythology into account, we believe there may be more to this massive expenditure of effort at this particular time than mere political statements.

However, to demonstrate the links to Great Flood mythology and the inter-linking of monumental constructions we shall focus on some connections here between two of them. Firstly though, we need to explain how the metrology seen in earlier chapters is also connected with the Biblical story of a Great Flood.

7.2 1056 and Noah's Ark

We have seen how the value 1056 relates to a single day of the 30 day month. The flood hero of Genesis, Noah, was afloat for a lunar year and his Indian counterpart, Manu, as seen in the companion volume *Deluge*, is also associated with the month. Time was of great importance; time was the creator and destroyer. To discover where the metrologically-important factor 1056 which was explained as a unit derived from time in Chapter 6, fits in to 'Great Flood' mythology it is necessary to look to the Bible. In the book of Genesis this is found to be the birth date after creation of the most famous mariner of all time, Noah.

Why this specific value is utilised here is revealed in detail in the companion work to this volume, *Deluge* and the actual answer to this question is far from what it initially it appears to be [a relationship to the length of the Ark of Noah].

In summary, Great Flood numerology basically relates to an astronomical calendar that describes a cycle of *Celestial Floods.* It is clear in Genesis 1:6, 7 and 8 that there were 'waters'

above the heavens. This calendar, nonetheless, was prompted into existence by a coincidental connection to real flooding events long before the 5000-6000 years ago that most researchers into the subject appear to assume was the case. Like much Great-Flood related lore, the factor of 1056 was added into the early Old Testament texts which were amalgamated by Hebrew scholars around 800BC [although there are other, later additions]. Celestial references abound in the story. Again, when the period of the Flood is evaluated we find that a lunar year is implied, a total of 354 days or 12 synodic lunar months of 29.5 days. Even the 40 days and nights of rain are a reference to the loss of view of the Pleiades at around 2300BC. [1] We see reference to this on the ground in Britain in a later chapter.

So, it seems that here we are leaning back towards a concept that is becoming familiar. These mythical tales revolve around astronomical counts of time and inserted into the tales are elements of measurement units, whose values are again associated with counts of time. Here we see Noah afloat for a lunar year but we should note the Biblical rule seen at Ezekiel 4:4-6 and at Numbers 14:33, 34 where the concept of a 'day for a year' is seen. Hence the implication is that the year afloat in reality could mean a day. We have revealed in Chapter 6 that the canonical month of 30 days gives a value for a day of 1056 and here we have Noah born in the year 1056. This is far too much of a coincidence, while the description gives a period afloat of 354 days, this is merely to show that we should be looking at a lunar concept, the 1056 attached to Noah gives us, via the Bible's own ruling, the 360 day canonical year and the 30 day month.

What does Genesis say about the Ark? If we assume that 10.56 is to be seen as a six cubit reed value then the cubit in use for the overall length of the vessel was 1.76 feet giving a total length of 1/10 of a mile or 528 feet. [Note: This whole subject, including Plato's interpretation of it which is wrapped up in a story of the lost *Atlantis*, is analysed in great depth in *Deluge*, the companion volume to this book.][2]

However, the Ark was more than just a mythological construct. Something in antiquity had to be physically seen as the Ark, or the landing place of the same to give the story the force that it has. So where was this place supposed to be?

According to legend the Ark landed upon the *Mountains of Ararat* and here the plural should be noted, it most definitely was *not* Mount Ararat.

The actual mountain was that of *Mahsa Dhagi* which was known otherwise in ancient times as *Mount Nisir* [see flood story in the *Epic of Gilgamesh*]. This has more recently taken the name of *Durupinar* after the name of the Turkish flier who spotted what transpired to be that which for thousands of years was believed to be the Ark, in the location that the ancient texts claimed. In fact, this 'Ark' was actually a geological anomaly that looked like the remains of a giant ship. A modern survey of the Durupinar geological anomaly showed that the overall length of this 'vessel' was 528 feet. As described in *Deluge*, the 'Ark' on the mountains of Ararat was surveyed no later that the start of the 4th Dynasty in ancient Egypt [about 2600BC] and the same figures were derived from it. In addition, the development of the luni-solar calendar and the ancient Indic flood epic involving the Indic Noah, *Manu*, is dated by us as the late 4th millennium BC [with which certain scholars of the subject are in agreement – dating of the ancient Indic texts is discussed in Deluge]. So, to summarise what we do not

explicitly state in *Deluge*, as it becomes obvious throughout its 15 chapters, another coincidence seems to be at work here.

Just as the factor 1056 appears to be of key importance in celestial events, a structure is discovered that appears to be a direct sub-multiple of it. Not only that, it is in the shape of a *boat* and the religious concept of a fish towing a Solar boat was a key one in Old Kingdom Egypt and also in ancient India whose religious ideas were probably the pre-cursor to those of Egypt. It seems that an important connection was made in the minds of the ancient priesthoods of India, Egypt and Mesopotamian lands. The Durupinar geological formation must truly have been seen as the 'Boat of the Gods'. [Note: With regard to the 'fish' that tows the solar boat we believe that again this is a reference to time. The 'boat of the Sun' was believed to move through a *Celestial Ocean* so it is fitting that it was said to be towed by a fish. As noted above, Genesis clearly states that such a sea existed.]

The length of vessel in Genesis was given as 300 cubits which in fact relates a measure of 528 feet, the beam given was 50 cubits or 88 feet, which has led many religious scholars [including Martin Luther] and artists from mediaeval times to assume that the Ark was a barge in a 6:1 ratio. The cubit value was derived from a reed [six cubits] at 10.56 feet and therefore is 1.76 feet. However, other representations in mediaeval art also show a boat-shaped structure. What all that refers to is revealed in *Deluge*, but the key issue here is that a boat-shaped representation is seen. Now, if the *Golden Section* [often a feature of ancient boat designs] is applied to this figure of 88 feet it is found that another element of the mathematical world gives the actual beam width found on site at Durupinar, 142.3869909 feet or 43.39955483 metres, [a theoretical value but virtually exactly the on site measure], which is the length of the funeral boat of Pharaoh Khufu.

Given all these different inputs, it is easy to see that the 'Ark' at Durupinar became important in religious thinking in the early 3rd millennium BC. In fact this importance carried on into much later times when pilgrims visited the location, as related by the Babylonian scribe Berossus among others. In addition, the *Epic of Gilgamesh* depicts this *exact* location [Mount Nisir] as the landing site. [The flood tale in the Epic of Gilgamesh is effectively an addition of earlier material into the narrative; the deluge story in fact predates the Epic of Gilgamesh as is seen in *Deluge*.]

7.3 The Golden Section

Before we examine the relationship between the strange geological anomaly at Durupinar and the Great Pyramid, a mathematical construct known as the *Golden Section* needs to be considered. For those not familiar with this concept we include here a brief discussion on the construct.

The Golden Section, sometimes called, in the first case wrongly, the *Golden Ratio* or *Golden Number*, is an *irrational number* or one that cannot be expressed as a simple ratio or a fraction and it has two closely related values that are normally termed by mathematicians as *phi* and *Phi*.

The two values are closely related to each other in the equation: $Phi = 1 + phi$.

phi is 0.618033988 whereas Phi is this plus 1 hence Phi =1.618033988

therefore Phi – phi = 1, as can be deduced from the first expression. Both these values are closely related to the so-called *Fibonacci Numbers.* The Fibonacci numbers are a sequence of integer values where the next number in the sequence is the sum of the previous two. In this example, beginning at zero, its commencing point, the sequence operates as follows: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55 ... etc. As the sequence extends, the ratio between a number in the sequence and the previous one eventually converges towards Phi, which to 10 significant figures, equals 1.618033988.

If we take Phi at 1.618033988 and multiply by phi at 0.618033988 the result is 1.0 [to within 10 places of decimals]. The full value here [calculated from 10 places of decimals] is 0.999999998323184144 which is pretty close to 1.0, but:-

the value of Phi can be set out algebraically and here we find that Phi =
[1+ square root of 5] / 2
= 1.618033988749894848204586834365 6
and:-
1.618033988749894848204586834365 6
x 0.618033988749894848204586834365 6
= 1.0

The Fibonacci numbers and the Golden Section are closely associated with growth and are therefore widely seen in nature. The latter is to be found in numerous places in the natural environment, including the theoretical shape of the perfect wave, the formation of seeds in the flower head of a sunflower, the spiral of snail's shells and indeed the shape of numerous galaxies. However, as far as *generally accepted* mathematical history is concerned it is *not* clear that the Golden Section was known in the third millennium BC, at least not in numerical form seen here.

Whilst some have suggested the Golden Section was a factor in the design of the Great Pyramid or the Giza complex in general, it is more generally thought that its primary relationship there was with pi, expressed as the ratio 22/7. This idea seems to be backed up by the Egyptian *Rhind Papyrus* of about 1650 BC, which was written by the scribe *Ahmes* in about 1650BC and who claimed that he was copying a document that was 200 years older. It is accepted that the document is one of the oldest mathematical works in existence and includes the solutions to some problems relating to the pyramid form but it does not mention anything about the Golden Section. This is not evidence that the value was unknown however, as one of the tenets of archaeology stresses - *absence of evidence is far from being evidence of absence*.

It will be seen below that it appears that the Golden Section *was known* in Old Kingdom Egypt and if one considers the geometrical diagram in Figure 7.2 it is easy to see how this value could be constructed geometrically.

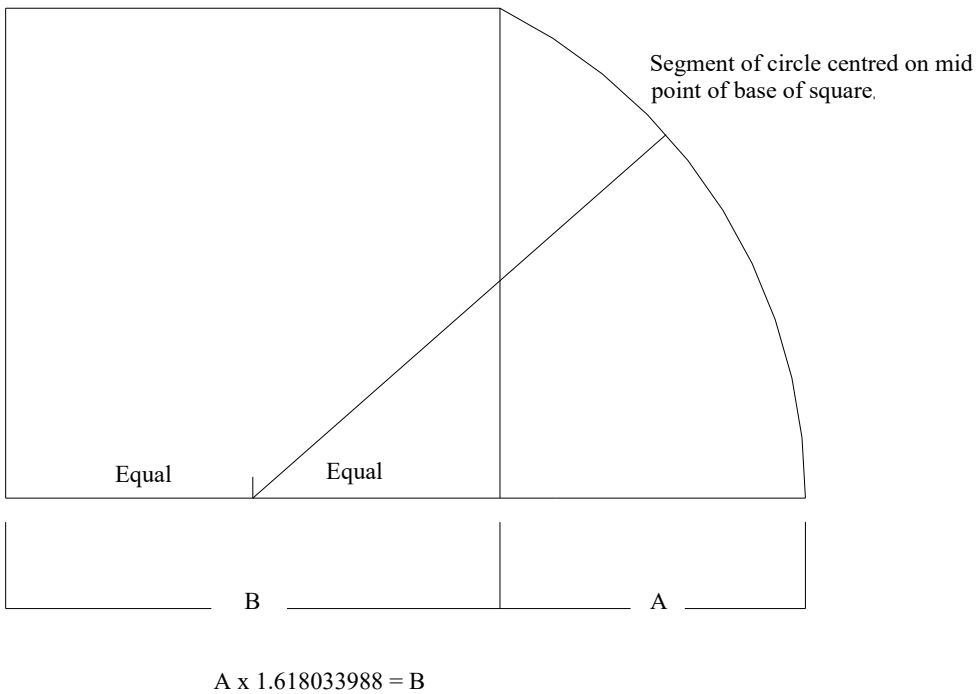


Fig. 7.1 Simple Geometrical creation of Golden Section

It is apparent from this simple construction that the geometrical value and uses of the Golden Section would have been understood and utilised but it is doubtful if the values as outlined above would have been understood. In reality such refinement would not have been necessary as here we are looking at practicality.

7.4 The Ark and the Pyramid

In Chapter 6 we discussed the assertions by Michell and Neal regarding the external dimensions of the Great Pyramid and found that while Michell's ideas we believe are correct, Neal's extension of them are not. However, while some investigators have had what can only be described as 'off the wall' ideas regarding pyramid passage lengths no researcher into metrology has apparently detected the messages that the Great Pyramid carries in its internal passages relating to the worldview of the mid-3rd millennium BC. While most famously Piazzi Smyth and more recently Peter Lemesurier have related ideas regarding Biblical dating from these passages, all totally meaningless of course, there in fact is one specific passage with an odd configuration that until now has baffled all.

In addition, few if any modern Egyptologists seem to be aware of Gerald Massey's early 20th century view that the Great Pyramid is related to 'Great Flood' mythology [although this may not be surprising as his work was not easily available until recently].

Deluge explains in depth how the aforesaid Great Flood mythology applies to the Great Pyramid and other monuments on the Giza plateau and how that knowledge probably filtered into Egypt. We reprise some of the revelations regarding the Great Pyramid below in order to indicate the importance of this mythology and associated metrology at the time these monuments were built.

It appears that the *Grand Gallery* of the Great Pyramid [seen in Figure 7.2] is a representative inversion of the Ark of Noah – how this is so is explained below.

The Grand Gallery has seven recesses, each effectively an inward corbel on each sidewall, each being 0.24feet in thickness. 0.24 feet multiplied by 7 = 1.68feet and 1.68feet multiplied by 10 gives 16.8feet. If that value is then multiplied by one instance of the *Golden Section, Phi* [1.618033988] we get 27.18297100feet. This corresponds to the increase in the half beam [port or starboard] of Noah's Ark from its 'raft base' upward, as shown below [*working to target values of 10 significant figures again*].

The total increase on Ark beam is calculated as 142.3869909 less 88 feet [50 cubits], which is 54.38699094feet. If we divide this value in two for the port and starboard dimensional increases, we get 27.19349547feet, within 0.126 inches or 3.2 mm of the above value of 27.18 feet, confirming the value of using refined fractions in these calculations.

To illustrate the correlation between the two values, if we divide 27.19349547 feet by Phi, 1.618033988, this results in exactly 16.80650448 feet., which is within 0.078 [less than 2 mm] of an inch of 10 x 1.68feet. When this is further divided for each individual corbel, the comparison between Genesis / Ark and Pyramid measurements results in a difference of 0.018 of an inch, [less than 0.5 mm] per corbel.

In effect, the Grand Gallery is very accurately emulating at a scale of 1:10, in an inverted form, the increase from the Genesis configuration to the onsite beam measurement of what was thought to be the Ark, via the utilisation of *Phi.* This appears to initially confirm that *Phi* was understood in the Old Kingdom of ancient Egypt.

Nonetheless, this Noahic modelling in the Grand Gallery, is more of a composite picture where the overall height of the walls above the Ark raft, 25.344 feet, [for full details see *Deluge*],are seen in the overall height of the gallery, *square to the baseline.* [All surveys examined give a plumb measure to a floor that it is admitted by the surveyors to be very uneven in this passage.] The calculated draught of the vessel is seen in the 23.76 feet measure from the shoulder line [one cubit at 1.584feet above floor line] and the soffit. The associated step value to this cubit [2.5 x 1.056feet] is seen in the 2.64feet height of each corbel**.**

The shoulder depth of 1.584feet indicates the cubit value used to assess water depth of the 'Great Flood', 15 cubits at 1.584feet is 23.76feet. [1.584 =1.056 x 1.5] The mythical vessel's freeboard was 1.98feet or 23.76 inches. Here, at raft top level, the beam has widened out to the full width and the 'walls' [as against hull] rise a further 25.344feet [16 x 1.584 feet] with the roof light above being 1.716feet high. The overall height is then 30 cubits at 1.76 feet or 52.8 feet. As the length of the Ark was 528feet and the pyramid appears to be lofted or set out to the value 22/7 we have a very fitting 1.68 foot inset each side of the Grand Gallery. This

is seen as being a fitting measure because the length of the Ark [528feet] / 3.142857142 [22/7] = 168feet. Using the dimensions specified in Genesis and the cubit of 1.76feet, again as implied in that text via the use of 1056 for the year of birth of Noah, the perimeter in plan of the Ark would have been 1,232feet. The measure 1.232feet is seen as a foot value in the Grand Gallery, it is counted 15 times in the height from first corbel to soffit of 18.48 feet. [The related cubit is 1.848 feet.]

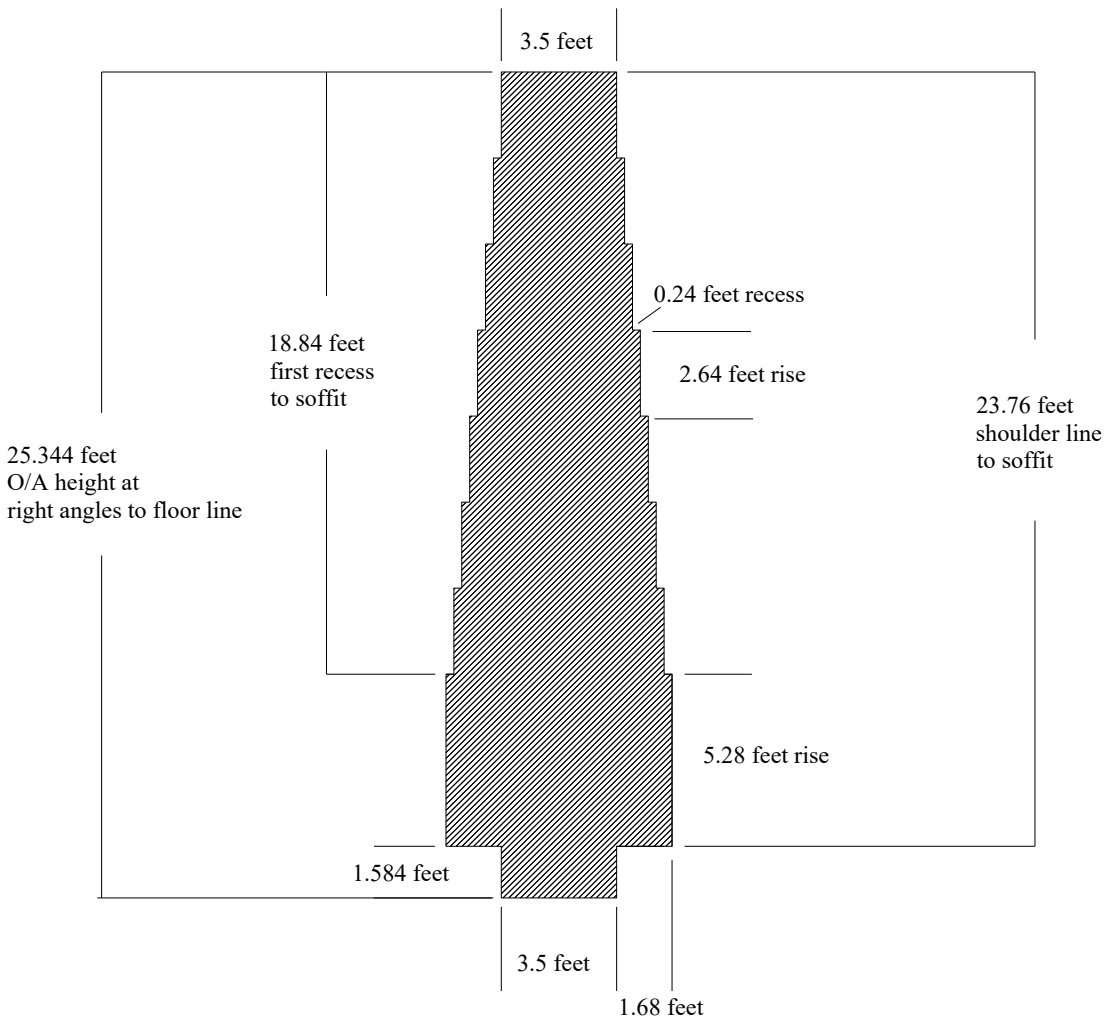
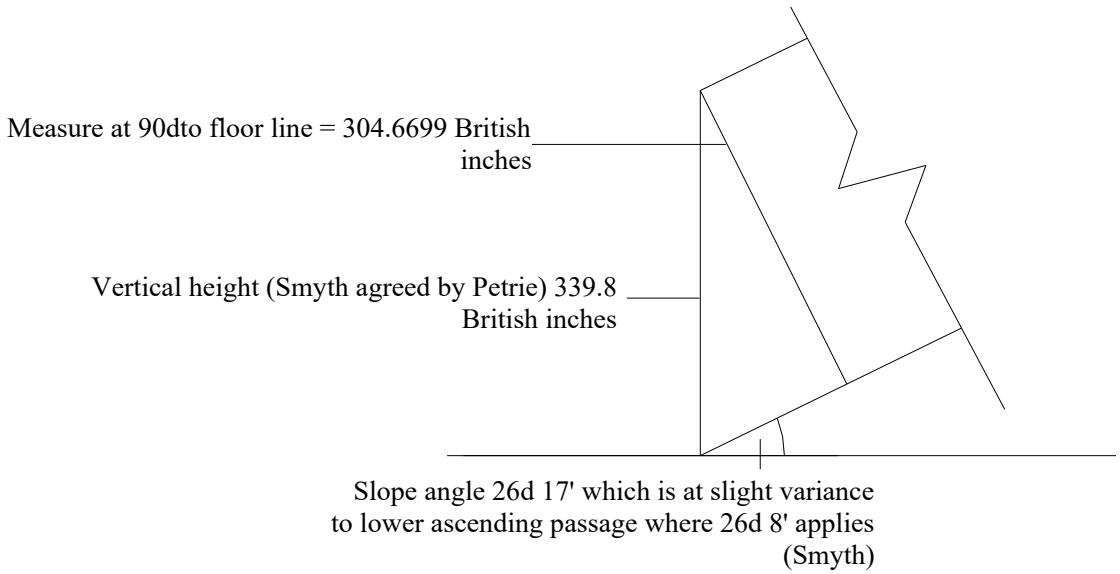


Fig.7.2 Grand Gallery Cross Section at 90 degrees to floor line



Height square to baseline is based upon the mean of measures to a floor that is not perfectly flat. The target dimesion at 90 d to floorline is 304.128 British inches which then complies with the 25.344 ft seen on the Ark and with the 3041.28 ft of the perimeter of the pyramid measured around the socket lines. Smyth and Petrie made the vertical height 339.8 inches which makes the measure at 90d to the floor line 304.6699 inches. The difference between this value and the target measure is 0.5419 of an inch.

Fig 7.3Grand Gallery Height explained

If the floor area of the King's Chamber is divided into the ground plan area of the Great Pyramid of 756 British feet per side, the result is exactly 968. 0.968 feet = 11.616 ins and the elevation perimeter of Noah's Ark was 1161.6 feet. [Using the 1.76 foot cubit defined earlier.] 116.16ins is also the length of the Anti-Chamber leading to the entrance passage of the Kings Chamber. The Queen's chamber treated in a similar manner is also revealing in that its floor area divides into the ground plan of the pyramid, as defined above, 756 feet per side, exactly 1,760 times, indicating again the relevance of the factor 176 to the Great Pyramid's design. As noted by Michell, the difference between the structural and finished base side lengths, 756 and 760.32 feet can be seen [756 / 175] x 176 = 760.32 feet.

Hence we have revealed the use of the value 10.56 and its cubit, here seen in relation to Noah in a place that would surprise many. One cannot simply utilise mathematical tables alone to evaluate these measurement units. As has been seen, astronomical time counts are a major part of the make up and the 'gods' were the lights in the sky that were observed and gave the counts that in turn indicated how to divide the measure of the circumference of Earth. There was no 'Royal' measure, this is merely a tag devised by archaeologists and the names that others have dreamed up are of little value other than as a means of identification.

Other pyramids in the region also indicate metrological connection to the numerical elements of 'Noah's Ark'. In *Deluge* however, we do not confine ourselves to metrology although it was a major key to the deciphering of the mystery, we also look to the various aspects of the flood story in different regions and their commonalities. This revealed much that confirmed that the same concepts existed in India, Mesopotamia and Egypt.

We have effectively utilised this background as an introduction to the use of the now familiar numerical value 1056 in a setting much closer to home, Stonehenge. Here we reveal that same measure was in use in Britain even before the Great Pyramid was built.

7.5 Stonehenge: Archaeological Background

The ancient megaliths and associated earthworks at Stonehenge comprise a structure, whose design, and longevity of usage, is unique. The dimensions for this monument were originally taken from Michell's interpretation but since those early days in this investigation, much more cross checking and further evaluation has been achieved…confirming at least a large part of Michell's thesis regarding the dimensions of the site. Not surprisingly, this is a World Heritage site, and the subject of much study and conservation work. Activity at the Stonehenge site extended right back from the start of the British Mesolithic some 10,000 years ago, until the end of the Early Bronze Age at around 2000BC. Later on, as evidenced by the survival of the main structure of the monument, there was an obvious reverence and re-use of it, even until the Iron Age, as is demonstrated in Figure 7.5 below.

Fig 7.4 View of Stonehenge

Fig. 7.5 Iron Age activity is indicated by a burial of a young adult male into the terminal of the palisade ditch. This skeleton has been dated to 780-410 cal BC.

The Mesolithic activity at the Stonehenge site consists of number of postholes in what is now the car park, holes that seem to have held large Birch posts, which archaeologists have speculated were possibly used as a sort of British *totem pole.* These postholes are dated to two periods of the early Mesolithic *8500-7650 cal BC* and *7500-6700 cal BC.* [Note: In this section all dates are calibrated radio-carbon dates and come from English Heritage].[3] The construction of Stonehenge proper began with the *Main Ditch* which was dug in a series of segments, at the base of which were deposited large numbers of antlers, many of which had been used as picks or rakes and showed heavy wear. This large number of artefacts available for examination enables the ditch to be reliably dated to 3020-*2910 cal BC.*

The next period of activity at Stonehenge was the creation of the so-called *Aubrey* holes that ring the monument. However, these can only be dated to being constructed sometime after the construction of the Ditch and before the building of the Sarsen circle.

The *Sarsen Trilithons* appear to be stratigraphically earlier than the *Bluestone Oval/Horseshoe.* Both, from limited recovered organic samples, have been radiocarbon dated to the so-called Stonehenge Phase 3 - *2440-2100 cal BC* for the Sarsens, and for the Bluestone Circle, *2280-2030 cal BC.* The construction of the Bluestone Horseshoe is thought to be the latest major construction at *2270-1930 cal BC.*

There is something which is perhaps astounding about the archaeology of Stonehenge. This is where the Bluestone Circle stones are supposed to have been derived. Rather surprisingly archaeologists since 1991 [after geologists from the Open University] have suggested that the stones came from the Preseli Hills in west Wales, not a new idea but one that was put forward circa 100 years ago, now proven by modern methodology. However, how human endeavour transported these stones, as appears to be still believed by many eminent archaeologists, to the Stonehenge site has never been satisfactorily explained. [A recent emulation of the transportation of a Bluestone by boat ended in abject failure.] Another idea forwarded in the past has recently been revisited and reported in the *Oxford Journal of Archaeology.* This idea is that the stones were ripped from the ground and moved by glaciers during the Ice Age. The recent work was conducted by a team headed by Professor Olwen Williams-Thorpe [again of the Open University]. The team used geochemical analysis to trace the origins of axe heads found at Stonehenge and this backed up the original work by concluding that the small numbers of axes that are actually bluestone derive from several different outcrops within the Preseli Hills. In fact the 'bluestones' of Stonehenge were originally derived from 15 locations in the Preseli region of South West Wales [there are circa 15 different variations of stone types among the so called 'bluestones'] and other areas not as yet identified hence the singular Preseli location for the bluestones is meaningless. This is not a new theory, having been aired few times in the past, but this matter of the human transport of the bluestones of Stonehenge is a good example of a fascinating story getting in the way of factual history.

That the bluestone axes and some of the stones of Stonehenge appear to have arrived at the site from the Preseli Mountains is no longer in doubt, but some archaeologists, professional people who should be above such fantasy; still maintain that early man moved the large, heavy stones manually. In fact man utilised material that was available for stone circles and we do not even find complete circles built specifically of 'bluestone' material in Pembrokeshire where the majority of the stones originated. An excellent review of the evidence to date is in *The Bluestone Enigma* by Brian John published by Greencroft Books.

However, in 2009 we saw the final dig at Durrington Walls, adjacent to Stonehenge on British television and even after the purely scientific investigations by geologists, the same old fiction regarding the stones was trotted out to the cameras and microphones…with additions!

It has been obvious to geologists for around 100 years and to members of the public who follow the latest investigations since at least the late 1990s, that the 'bluestones' of Stonehenge were not dragged from the Preseli hills by man. The attempt in 2000 to move a single stone ended, even with the use of modern lifting equipment, in abject failure, yet Professor Mike Parker Pearson [on television] and Dr Josh Pollard [at a historical society private lecture], co-directors of the Stonehenge Riverside Project in 2009 claim that around 80 of these stones were moved by man from West Wales…the purpose, according to Professors Tim Darvill and Geoff Wainwright in 2008, was for healing at Stonehenge…well if the stones were dragged all that way by men they would need more than healing by the time the stones arrived at their destination…many would have died on route…But we also have some sandstone from Brecon at the site and so it has been suggested that the route was not as originally thought, via the Bristol Channel in boats, [as that proved virtually impossible] but

overland…over the mountains to Brecon…with some 80 stones each weighing many tons…and Brecon is roughly the halfway mark…it gets worse.

All this farcical nonsense is in the face of the logical answer that has been available for over 100 years since geologists and glaciologists first made it quite clear that the stones were transported by glaciers. Archaeology has jumped on a report that stated that the stones almost certainly were not moved to the vicinity of Salisbury Plain during the last major freeze…perhaps not, the extent of the ice edge at that time is not absolutely certain but in times past the stones most certainly could have been moved to the region via glaciers, even the Scilly Islands were deep frozen so from where does the refutation arise? The geologists do not agree with the archaeologists and the movement of such material is a geological subject area…a geologist would not argue with an archaeologist over the date or style of a piece of pottery so why should an archaeologist debate the results of the geologists studies?

However, this obviously does not apply to all archaeologists as in Issue no 45, June 1999 of *British Archaeology* an article by the famed and respected Aubrey Burl was published that totally refuted the idea of the stones being moved from Wales by man and supported the glacier theory...but Burl was honest enough to admit having supported the 'human transport' theory in the past.

One is inclined to assume, as given that it is ten years since Burl's article and the same nonsensical notion of man moving the stones is still being broadcast by well known professional archaeologists, that a part of some archaeologist's training is never to let logic, reason and research get in the way of a good story. It is now thought, announced Professor Mike Parker Pearson on a *Time Team* television program that the aristocracy of Pembrokeshire were involved in the design and construction of the Stonehenge site…and he seemingly was not jesting… This concept was possibly based on the fact that geochemical studies have conclusively shown that the 'bluestones' were derived from multiple regions within the Preseli Hills of Pembrokeshire, sites that are up to eight miles apart… even though it is known that the stones were in the Salisbury region before Stonehenge was built…This is academic logic? The statements are not based upon the results of logical scientific investigation but are founded in imaginative fiction.

7.6 Stonehenge metrology

Much has been written regarding the dimensional aspects of the Stonehenge site over the years. However little of this is of much value and most is contradictory. The counts of units of whatever measure is applied have appeared to have no meaning or implication other than being a count of measures. This extended paper will rectify this and reveal that a set of coherent measures that link one to another across the ancient and not so ancient worlds as is seen throughout this book, were in use here.

In examining the metrology of Stonehenge it will be found that the *outer circumference* of the Sarsen lintels [the lintels being where the important metrology is to be found] was seemingly not of great importance, it was the *inner and outer diameters,* the *lintel width* and the *lintel centre circumference and diameter* that holds the information for which any metrological investigation of the site searches. The inner circumference does reveal that it is 88 times the

lintel width or 35.4 [lunar year = 354 days] x 8.64 [within 0.1184 of an inch] with the outer circumference being the lintel width x 1.1785714285 x 80. The inner divided by the outer circumferences results in 1.178571428 / 1.1 or 1.07142857142. These evaluations certainly show numerical associations and go some way to explaining the carefully curved outer edges of the lintels, implying that this was the place to measure and not at the sarsen vertical stones, where the similarly albeit lesser worked inner edges of the sarsen uprights indicating that the inner lintel faces above were also of importance even though they were not worked in parallel to the outer lintel edges, and the mortice and tenon joints holding the lintel to upright were ensuring that no movement modifying the structure's dimensions would ensue. If the dimensions of this lintel circle were not critical to the monument then there would be no necessity for such elaborate jointing, work that was meticulous in design and execution. It is therefore obvious that the lintels held any important metrological information here and not the sarsen supports. Yet few seem to be suitably impressed by this highly skilled masonry work that was accomplished with the most basic of tools that a modern craftsman would probably condemn as being devoid of any useful purpose. This lintel circle remained for thousands of years the most accurate piece of stonework that had been conducted in what very much later became known as Britain.

While the study of ancient metrology, both linear and volumetric systems, is apparently not fashionable, it remains a very interesting and indeed archaeologically speaking, a very profitable pursuit. We rarely hear the question raised of, "*Why is it that size?*" applied to remains exposed by archaeology and yet knowledge of the ancient measurement systems can often reveal more than just a basic metrological assessment of the uncovered structure. Numerical symbolism has played a large role in the past, even into mediaeval times when religious buildings often portrayed reference to Biblical artefacts in their physical dimensions. [See Chapter 11 of *Measurements of the Gods* for evidence for this statement.]

In our modern world we are obviously familiar with accurate measures but away from mechanical elements we usually see this in relation to clean corners on buildings or other obvious situations.

As Chippindale stated in *Stonehenge Complete,*

Megalithic dimensions, so far as we assess them, are almost always approximate, because the stones themselves are [except at Stonehenge itself] unshaped *and unusually large…these cannot be studied in the same way as a neat figure with defined spot points for corners and sides in integral multiples of a unit.*[4]

So we look for other elements to examine…such as the centreline of a circle's stones…when this is determined its diameter can be found…with no requirement for Chippindale's 'spot points'. This is precisely what has been achieved at the Aubrey Circle of Stonehenge [to which Chippindale was not referring, his statement was in reference to the Sarsen Circle] and yet the dimensions given to the Aubrey Circle by Hawkins and others including Thom are not questioned, [even though there are variations] they are not seen as one of Chippindale's 'approximations' even though all that was here to measure was a series of holes of various shapes and sizes. So if a series of holes that once held posts or stones can be

dimensionally ascertained this way and the dimensions accepted, why not another set of stones? The same criterion applies and hence while the stones of numerous stone rings are generally not dressed, this has no bearing whatever, other than the difficulty of making the assessment, upon the dimensional appraisal of the circumference centreline.

It is easy to assume, as apparently has Chippindale, that accurate measures were not widely utilised as they had no real purpose until such a time as structures with sharp corners evolved, but to make such an assumption is erroneous and unscholarly, in fact is unsupported nonsense, and even Chippindale assumes that a measure of some description had to apply to the Sarsen Circle due primarily to the shaping of the lintels defining the outer face of the circle. Yet because a circle is finely worked at its outer perimeter this does not imply that any definitive measure was used in its construction hence the reasoning here is nonsensical. The radius here was almost certainly a length of rope but again, 'how long is a piece of string?' That rope can be any length and does not require a fixed dimension…only the length of rope. So Chippindale does not put up a sound argument for or against the use of accurate measures at Stonehenge even though he sees circles or rings where the stones are undressed as too inaccurate for measures to have been in use…his assessment here is decidedly 'ropey'. At the Aubrey Circle there were not even any stones to assess…yet we still have an accurate value for the circle's dimensions…that from Hawkins as shall be demonstrated.

Some attempts have been made to assess what units of measure [if any] were in use in Britain during the Bronze Age and possibly earlier with the most often quoted being the 'Megalithic Yard' of Professor Alexander Thom and his son Archie. Thom has been derided most unnecessarily for his concerted efforts over an extended period and while he may not have had all his assertions correct as he was something of a pioneer, the value of the megalithic yard [2.72 feet, *albeit with an essential extended fraction to 2.7272727feet*] certainly does apply in a number of cases. For example, at Gray Hill in Gwent we have a stone circle or more likely the remains of a small kerbed and possibly chambered cairn that has 11 of these expanded measures to the inner diameter and 12 to the outer. [Measures here derived from a survey by Gillian and Harry Sivertsen.] In fact at Stonehenge this extended megalithic yard can be applied to the Sarsen Circle centreline circumference as we shall reveal, but the simpler 2.72 feet has no place at Stonehenge and very few other locations with those where it does appear to work being coincidental as other units also apply, usually in a more accurate fashion, to the relevant dimensions.

Regarding the 'megalithic yard', in Mike Pitt's book *Hengeworld* we read of a derogatory statement aimed at Alexander Thom by Clive Ruggles,

…the megalithic yard is a figment…and all attempts by others to prove the Thoms right by informed statistical analysis have failed [5]

To put the attitude taken by Ruggles and others into perspective regarding measures perhaps the comment regarding stones and measures from Ruggles in *Astronomy in Prehistoric Britain and Ireland* cited by Pits explains much.

A stone can only be reduced to a point on a plan to a precision of its width, perhaps a metre, not 1mm, yet the case for the 'megalithic yard' is entirely dependent upon precise mathematical patterns…[6]

In the ensuing narrative, we show that this sort of pompous arrogance is completely out of place, that Ruggles is totally wrong and that indeed, accurate measures were in use at Stonehenge as suspected as long ago as the 18th century by Stukely and others, measures that remained constant until the onset of metrication. Stonehenge is used here as an example of the application of measures that can be found throughout the ancient world by anyone who has the ability to survey accurately and apply knowledge of the values entailed.

Further, it is apparent that Ruggles has not made any serious attempt to understand any ancient measurement system that may be utilised among the stone circles as he only cites others using 'informed' statistical analysis. Why not cite his own experiences in trying to assess the viability or otherwise of the value; obviously because he has no such experience. Then the most obvious question is raised, why go to the trouble of an involved mathematical process, statistical analysis, even though Thom utilised the methodology, when all that is necessary is to check whether the derived megalithic yard complies with the surveys or not? If it does not then no amount of mathematical manipulation can alter the fact. Ruggles ought to refrain from vigorously commenting on what he does not understand and stick to his own specialities.

Explanations, argument and evaluations

While circumstantial evidence can be interpreted in different ways and hence the purpose of a site be interpreted differently by diverse researchers, a measure is a fixed entity and cannot be explained in any way other than its dimensional properties. Having made that statement, the measure of an article may reflect another object in its numerical properties. This applies to Stonehenge and equally to old texts such as the Bible where much has been hidden via the use of numbers. Dimensions can reflect the size of other objects symbolically and again counts of days or even years may be revealed that reflect important time periods. Hence measurements can sometimes display considerably more information than merely their own dimensional properties. Biblical translations have varied enormously as language has evolved, many of the latest versions with 'updated and modernised English' fail miserably as the punctuation and wording had frequently been altered to such an extent that the context and meanings of statements are not that seen in, for example, the King James Version; and yet numbers, be they counts of time or measures or even of people stay the same. It is this consistency that has in part enabled research in metrology and associated concepts to reveal errors in Biblical updates to wording and punctuation. In archaeology a key challenge ought to be to understand whatever dimensions were originally given to artefacts and structures-in the original metrological units-but as indicated above with the Bible reference, the discipline that involves an understanding of historical metrology has importance to more than just archaeology. The book *Deluge:From Genesis to Atlantis* reveals more in this direction. This

current narrative indicates that indeed much can be revealed via a working understanding of the ancient metrological systems.

Stonehenge displays a number of lunar associations that its author has not seen described in any other paper or publication. John Michell[7] hinted at some of these from a metrological viewpoint but not the calendar associations, only the numerical values and even then, the lintel length and its associations were completely missed. The Aubrey circle was unfortunately assessed in what now appears to be a rather cavalier fashion although given his parallel research at the time this was understandable.

Some lunar relationships seen at the site are dependent upon understanding the measures applied while some are not. However, the counts described below are utterly dependent upon the lintel width of the sarsen circle complying implicitly with the circle's diameter. The lintel width can be counted 30 times across the overall diameter, 29 times to the centreline of the lintels and 28 times across the inner diameter.

The synodic month has [in round figures] 29 days, the mean of the synodic and sidereal month [27 days] is 28 days while the commonly utilised 360 day year has a 30 day month. Hence the diameter of this circle displays counts of days in three different lunar configurations, a count that is completely and irrevocably dependent upon the lintel width and circle diameter being exactly as they are…precisely as described in this narrative and in this case by John Michell from whom this specific information was initially derived, pity he missed the lunar count associations though. For these counts of days to occur this lintel/circle configuration had to be the design criterion of this part of the monument, it could not happen by accident and the structure had to be accurately built. Hence the lintel width is directly associated with the circle diameter and a variety of monthly values counted in days. The sarsen supporting uprights dimension played no part whatever in this matter other than being supports. Their centre points were set at one thirtieth of the lintel circle centreline circumference and that is the only value that they embody.

So far, not a measure has been mentioned in conjunction with Sarsen Circle diameter yet we have proportions that give counts of days. Hence it is reiterated that if either [A] the lintel width or [B] the circle diameter were not as they have been described, none of the above lunar configurations would apply. The lintel width and circle diameter are intimately and irrevocably related. The dimensions applying here are seen below. From this alone it is clear that the builders of the structure were familiar with basic geometry and arithmetic combined with a sense of proportion.

There are unfounded arguments regarding whether the Sarsen Circle was finished or not but that debate is not involved here. [See *Stonehenge Dating* for an argument regarding this that in fact indicates a dating sequence from historical lunar configurations that complies with the carbon dating at the site] Leaving out that debate, there were 30 sarsen uprights that supported lintels and 30 supported lintels. The lintel supports, at their tops, were very carefully crafted with tenons cut to fit into mortices in the lintels ensuring a firm linked structure that was enhanced by tongue and groove joints at the lintel ends. The lintels were housed over the tops of the vertical members to ensure a flat overall surface and great care was taken in the attempt to make this elevated ring of stone as level as possible, it is within about seven inches of being level across its 100 odd foot diameter.

If knowledge of, and the ability to use accurate measure did not exist, this would not have been achieved. The use of what today are basically woodworking joints meticulously cut in large sections of stone with what would be seen in the modern world as very crude tools implies a well-developed technical ability; an ability that understands the concept of proportion; and proportion implies a reckoning of one size to another. This very clearly indicates a familiarity with the conceptual ideas of number and measure.

A count of three times the number of upright lintel supports of the circle, marked off day by day, perhaps by moving a small stone daily, would result in a count of 90 days, a quarter of the 360 day year. Clearly the quarters of the year, solstices and equinoxes could be calculated easily here. A continual count of 73 times the circumference [six years] would bring the 30 day month, seen here in the count of upright lintel support stones, in line with the 365 day year. i.e. 73 x 30 = [count of upright stones or spaces]= 2190 = 6 x 365.

Stonehenge Sarsen Circle, whatever else it may have been, was undoubtedly a calendar with both lunar and solar implications. As we shall see, it was also a depositary of measures.

The research from which this analysis is derived has found repeated references to the moon in a context that seems to have little relationship to the usual idea of a female lunar association. One can suppose that the feminine element is taken from the menstrual period being associated with the month but there is little else that connects femininity with the moon.

Given that the female is generally associated with life and life giving and assuming that this gender context has any meaning, it follows that given the lack of early lunar and feminine connections, the female element is more likely to be found with solar linkage. If this were the case then the lunar aspect would be male and be associated with death.

According to ethno-botanist Fred Hageneder in his work *Yew: A History,*

...many ancient goddess religions linked the permanent Sun with the eternal mother archtype and the waxing and waining Moon with death and rebirth cycles of the mythical son, the vegetation god.[8]

It would therefore appear that the lunar associations of Stonehenge seen in this narrative, derived from the proportions and measures evident at the site, concur with the recent findings [The Riverside Project] in the region of Stonehenge and the monument's association with death.

In 1740 Stukely published his interpretation of the dimensions of the monument and made the overall of the Sarsen Circle 104 feet which comprised [according to Stukely] 60 'Hebrew' cubits.[9] We have moved on somewhat since then but he was reasonably close, within 3.269 inches. Petries survey, published in his 1880 work *Stonehenge: Plans, Description and Theories* p 23 [10]made the inner diameter of the Sarsen Circle 1167.9 inches or 97.325 feet and he claimed that this was within a maximum tolerance of 0.72 of an inch. This is much closer in reality than the survey by Alexander Thom. 100 long Roman feet equate with 97.32096 feet which is within 0.04848 of an inch of Petrie's conclusion. The lintel width according to Atkinson in the 1950s in agreement with Petrie, was 'about' 3.5 feet.[11] Note that the Sarsen Circle was here being defined by the lintel circle dimensions and NOT via the stones supporting the lintels.

Chippindale states that,

Obviously some unit of measure must have been used and the megalithic yard and rod seem to work better than any of Petries measures.[12]

So here we have another little piece of nonsense, how does one set of measures 'work better' than another? Either they fit what is being surveyed or they do not. One could count in banana lengths and arrive at a conclusion…indeed early British and Welsh measures used barleycorns to represent the inch! At least the records tell us this…but they cannot always be believed. Petrie was recording what he discovered only applying feet and inches and NOT attempting to fit a calculated specific unit to his results. Where Petrie gained over most surveyors here is that he clearly stated from where and to where he was measuring. A statement regarding a dimension for a circle's diameter or circumference is no use without an indication of what is being measured as all has a thickness. Is the measure to the outer, central or inner circle? Petrie makes it clear, too many others do not. Thom had already surveyed numerous circles and had arrived at his conclusions regarding the megalithic yard before surveying Stonehenge. Table 5.1 of Thoms 1971 work *Megalithic Sites in UK* is headed *Circles and rings of which the diameter is known to plus or minus 1 foot or better.* [13]The listings following loosely agree with this and reveal counts of megalithic yards that occasionally have a result in fact over the stated foot away from the stated diameter. Many results are quite close however and it is admitted that it is not easy to discover the diameter of a circle when its length can be between the approximate centre line of stones of various widths. Thom's results vary but a fair idea can be given by the values in his list where his round figure counts of megalithic yards vary from his measured diameters from plus 1.3 feet [15.6 inches] to minus 1.3 feet. [Thom's own published values.] Hence the count of units at 2.72 feet can be complete anywhere within a window of 2.6 feet and this 2.72 foot megalithic yard is only 1.44 inches longer than the maximum tolerance! In fact for many of the measures an extended version of the megalithic yard at 2.727272727 feet fits much better than the 2.72 feet and this value has links to a system that long predates the stone circles of Britain and was widely used in the Middle East and beyond. Note that 12 of these longer units will make a difference of over an inch against 12 of Thom's interpretation at 2.72 feet.

In Thom's listing at site B7/6 we have a circle of 39.2 feet diameter which Thom evaluates at 14 megalithic yards at 2.72 which in reality amounts to 38.08, some 13.44 inches away from the diameter measure. However, the foot value of the extended megalithic yard at 2.727272727 is 1.09090909 and this multiplied by 36 gives 39.27272727 hence there are 14.4 mega yards at 2.7272727 or 36 feet at 1.09090909 or 5.76 of the megalithic rods at their extended value of 6.8181818 feet, all within a tolerance of 0.0727 feet or 0.872 inches. These numbers all connect with the very much larger and more widespread system and the indication is that this circle was set out to suit measures from that system. What is seen is numerical symbolism with the most obvious being 36 which probably would be seen as associated with the count of days in the canonical year. Circumference here using 22/7 is 113.142857142 which we shall later see is directly associated with the Aubrey Circle at Stonehenge as 1.1314285714 x 792 results in the centreline circumference of that particular circle.

Thom gave circle P2/3 has a 28 foot diameter which he denoted as 10 x 2.72 feet or 27.2 feet, 9.6 inches away from his survey result. Here another likely connection is seen. Seen below is a circumference for the centreline of the Sarsen Circle of 316.8 feet. This, divided by the extended megalithic yard of 2.7272727 feet equates with a count of 116.16. Regarding connectivity 116.16 inches is seen not only within the pyramid of Khufu [length of anti-chamber and result of dividing the floor area of the Kings Chamber into the ground plan area of the pyramid at 756 feet per side] but in the Bible [side elevation perimeter of Noah's Ark and square feet area of plan of Ark of the Covenant] [See *Deluge:From Genesis to Atlantis* for explanation] and at some important religious sites of the Christian era such as Rosslyn Chapel near Edinburgh and Chartres Cathedral in France [see *Measurements of the Gods*]. Divided by 12 our 11.616 inches is seen as 0.968 of a foot. Now returning to Thom's circle P2/3 of 28 feet diameter, it is seen that 29 x 0.968 feet = 28.072 feet. This is within 0.864 of an inch of Thom's measured diameter of 28 feet against his whole value count of 10 megalithic yards at 2.72 feet or 27.2 feet. It would appear likely that 29 x 0.968 feet would be the target value, after all, 29 days is the length of the synodic month represented across the diameter of the Sarsen Circle of Stonehenge hence it could equally be seen in a similar context here. We can add that using a pi value of 3.144396475 a circumference of 12.96 of Thom's megalithic rods emerges. 12960 years as half the precessional count was understood in the eastern regions at this era so why not here? However, there is another way to look at this circle.

1.1785714285 x 23.76 = 28.00285714 and this diameter using 22/7 results in a circumference of 63.36 x 1.1787514285^2 [1.389030612]. Looking back to site B7/6 and the foot value of 1.13142857142 we can see a direct connection to 1.17857142 as the commonly utilised factor for change in the ancient metrological system, 24/25 or vice versa or indeed 0.96 is the connection here:- 1.17857142 x 0.96 = 1.13142857142.

It is essential to utilise lengthy fractions in these calculations even though the practicalities meant that such accuracy could not be achieved; by working accurately we can deduce what was the probable target measure.

The Ring of Brodgar is another example of interest. Here we see the use of a foot value of 1.01376 which Michell terms the long 'Greek' foot. It is shorter than the British foot of 1.056 [British explanation in latter pages of this narrative] via the 25/24 factors or 0.96. An increase from the British version leads to the foot value 1.1 feet British which was utilised by the Saxons and millennia before them people in Mesopotamia and India…A further reduction by the same factor from the Greek foot results in the Roman version seen across the inner diameter of the Sarsen Circle.

Thom made the diameter of this circle, the Ring of Brodgar, 340.02 feet plus or minus 0.6 feet. At 340 feet we find exactly 125 of Thom's megalithic yards and using 3.14 for pi 68 megalithic rods is the circumference. However, by allowing Thom's tolerance of 0.6 of a foot and calling the diameter 340.62 we find that at 340.62336 the 'Greek' 1.01376 divides exactly 336 times. Using 22/7 the circumference then shows exactly 1056 of these same feet. 336 is the count of 12 x 28 which is the mean month in days and 1056 is seen as a principal value at Stonehenge, it is the centre dimension between the Sarsen uprights of the circle, the length around the curved centreline of each lintel and as there are 30 of them must be seen to represent the days of the canonical month.

Hence while this may appear to be cherry picking it is clear that there are viable alternatives to the megalithic yard. Many of Thom's circle values can be assessed in a different way albeit with links to other metrological values and usually the result is more accurate than the megalithic yard/rod configuration. The results do not often result in whole numbers of units but are seen as measures that show numbers that are recognisably related to other numbers within the system, a system that was widespread from India westwards long before the outer ditch of Stonehenge was dug.

Decimal points come and go in a practical consideration but symbolically do not exist hence 36 can be 3.6 or 3600. When much has been seen across the nations of such connectivity it becomes clear that decimal fractions were understood as other fractional values would not carry the same obvious numerical linkages. Decimals were derived from India and the measures were in use in India millennia before Egypt had dreamt of the mastaba that predated a pyramid. We often see the same numbers applying in different contexts. The cubit of 1.76 feet [1/6 of 10.56] in inches is 21.12. In Britain we often find this as a measure in miles between churches with some of these being probably ancient pre-Christian sites. One example in South Wales is a circle of 4 churches on the circumference with one at the centre plus two Norman mottes, a stone [no longer extant but found on old OS maps] and one ancient farmhouse. Others of the values seen in this narrative have been seen with similar 'mile' applications. [see *Measurements of the Gods* for further evidence]

Stonehenge is evaluated via this ancient system in the following narrative and the accuracy that was applied to the site will become apparent which it does not via Thom's explanation. This site is obviously something much different to any other stone circle with its lintels connecting via tongue and groove joints and connected to the tops of the vertical supports by mortice and tenon joints. This immediately shouts the words care and more specifically, accuracy, no other stone circle does this as no other stone circle has lintels cut with care to define the measures of the circle above the stones that were not so well defined for dimension or shape.

Taking this into account it must be assumed that Chippindale did not reason that the most carefully cut joints meant anything of note as he assumes that Thom's megalithic units which are reasonably close here but not quite fitting were the measures that were in use as they 'seem to work better than any of Petrie's measures'. Again, it seems that Chippindale has ignored the large tolerances allowed by Thom on other circles as the construction of the Sarsen Circle with its well-formed and jointed lintels implies that it would be quite accurate and that any allowable tolerance here would be very small…as is the case in Petrie's survey results, certainly not in the region of 15 inches each side of a target measure. Chippendale is very obviously not a practical man familiar with construction operations and skills. Petrie, who was a very logical person, merely gave the dimensions he discovered, and these naturally were only in British measure hence if familiar British measure was not used to construct the monument then the measured results would not have any specific association. There would be no thought of fitting any specific unit to the monument as no firm knowledge of any such historical unit was available. This is akin to attempting to understand a book in foreign language…one needs knowledge of that language to comprehend the content of the book; the same applies to metrological systems as with any other branch of a mathematical subject. Thom's survey

values [NOT the application of the Megalithic Yard of 2.72 feet] for the circles that do not include Stonehenge are as close as they could be expected to be given that he had no knowledge of the greater system seen in use here. Thom accomplished a great deal although if he had extended the fraction of his measure he would have had a more viable unit as already noted. However, when he commenced his work the values seen applied to Stonehenge in this narrative were only just beginning to be understood and much of his work was complete long before they became available to the public. Again, as it was Michell who made the assessments based upon the work of numerous others before his time and Michell was himself derided by academia then Thom would probably not have read Michell's work. In any case, by that time Thom had arrived at his own conclusions.

Had Chippindale sufficient metrological knowledge he would have realised that the megalithic measures of Thom, while tolerably close, do not work very well here and therefore, given the care taken in building the structure, some other criterion must have applied; a different base unit or units. In *Stonehenge, Neolithic Man and Cosmos,* John North claims that Thom's 'megalithic' measures were almost certainly in use at this site but we prefer to accept measures derived from people who were not attempting to prove that their own metrological theories are valid, rather we take the work of Petrie and Hawkins as being more reliable…which in this case they most definitely appear to be. This will become plainly obvious from the results seen a little later. It seems to have been forgotten that the circumference measure of a circle is dependent upon the length of the radius and not vice versa. As Thom claimed that whole values of megalithic yards or rods were generally in use at the circumference of the circles such as the 131 megalithic rods [1 megalithic rod = 2.5 megalithic yards at 2.72 feet= 6.8 feet] of the Aubrey Circle, there are 41.69 of these rods for the diameter or 20.849 for the radius which are rather odd fractions. *Of necessity, this radius would have to have been calculated to accurately set out the circumference. Hence if the setting out is accurate then pi was understood and used. We do not read of this admission in the modern books regarding Stonehenge however and Thom utilised a number of approximations…*

Given that the inference from Thom is that the circumference is in whole numbers of megalithic rods and the diameter whole megalithic yards, and that he worked to the nearest whole to his measured diameter, pi in this application cannot, by definition, be of an accurate consistency but will be dependent upon whatever round figures Thom applies to the relevant circle. Thom's 131 megalithic rods for the Aubrey circle mean that Hawkings 56 spaces at 16 feet were 55.6 spaces of 16 feet…In fact this circumference evaluates at 896.0914285 feet or 56 x 16.00163265 feet which shall be amply demonstrated a little later in this narrative.

However, North [14]p475 of *Stonehenge Neolithic Man and Cosmos,* has the Sarsen Circle *radius* at 20 megalithic yards [whole number] which gives a diameter at 108.8 feet which is around 4.5 feet wider than the lintel outer diameter which clearly is the dimensional indicator here as this elevated circle is carefully worked and fixed via the meticulous jointing methodology. It would appear that Stukely did a better job in 1740! This is purportedly in association with the station stone rectangle and the Sarsen lintel circle does not exactly fit the width of this rectangle. The station stone rectangle was almost certainly set out as described a little later and its width was some 6.5 feet wider than the Sarsen lintel diameter overall value of 104.27245 feet. It was set within the confines of the zone of the stones [holes] of the Aubrey

Circle and [according to North] had a width of 40 megalithic yards with the side lengths of the rectangle being 104 megalithic yards. This latter measure evaluates at 282.88 feet whereas as we shall later see an evaluation of the inner Aubrey Circle of 282.24 which is 7.68 inches from this dimension. Evidently the station stones were kept within the zone of the stones [holes] at the Aubrey Circle. Our evaluation appears to be a little more logical than these counts of measures that effectively mean nothing.

As the diagonals of this station stone rectangle cross at the centre of the Aubrey circle and it is therefore very easy to check these measures on CAD and we find that the diameter of the Aubrey circle using these measures of 40 and 104 megalithic yards from North for the station stone rectangle evaluates to 303.08 feet. This is 17.96 feet greater than the diameter applied by this researcher and which complies with the surveys of Hawkins. It appears that the length of the station stone rectangle has been taken as the Aubrey Circle diameter with no allowance for the increase across the diagonals which do conform to that diameter. Indeed if the Aubrey Circle diameter is taken to be 282.24 feet then the station stone rectangle length would be 263.427 feet following the proportions of 104 and 40 applied by North. In any case Thom made the Aubrey Circle diameter 283.76 feet and using this value the station stone rectangle length would be [maintaining North's proportions] 264.698 feet or 97.3 megalithic yards. Confusion rules!

A few pages earlier, p420 in *Stonehenge Neolithic Man and Cosmos*, North allots a dimension of 'nearly 32 metres for the Sarsen Ring overall diameter;[15] this evaluates at 'nearly' 104.9868766 feet which description is far more reasonable as it is just over 8.5 inches larger than the evaluation seen a little later. Nonetheless, this measure has no relationship to a count of megalithic yards.

The inner circle of the Sarsen circle construction had a circumference of 45 megalithic rods according to North [after Thom] which gives a radius of 17.91 megalithic yards.[16] The circumference value noted here is with 1.6 inches of Petrie's measure and the diameter at 97.4304 compares favourably, within 1.313 of an inch, with the 28 lintel widths that give 97.32096 feet. However this diameter/circumference count involves a pi approximation of 3.144783359. This is very close to the 3.144396475 evaluated in relation to circle p 2/3. Regarding pi, it shall be demonstrated that 22/7 or 3.142857142 was commonly applied with an alternative value of 3.1418181818 also being frequently used. The use of both versions will be seen in the evaluation below. Stonehenge principally uses 22/7.

The lintel target width Michell claimed was 3.4757485671feet which he claimed was the 'sacred Jewish rod'. The internal diameter was 97.32096 feet or 100 of the feet that Michell terms Roman. Compared to Petrie's evaluation of 97.325 this is a good likeness, within 0.04848 of an inch or 1.23mm. As evaluated a little later we have the lintel centreline diameter at 100.8 feet.

Hence 100.8 less 97.32096 = 3.47904 and this unit is within 0.039497148 of an inch [1.003mm] of 3.475748571 which is related to Egyptian measure and indeed the stade value utilised by Eratosthenes. He, [Eratosthenes] is commonly accused by those who do not understand the metrological systems of being completely wrong in his assessment of Earth measure but in fact his calculation, while unsound for descriptive reasons which are rarely mentioned by these critical folk, actually gave an accurate [within 23.7 miles of the NASA

interpretation] value for Earth meridian circumference as seen among Greek, Indian and Egyptian calculation and which was utilised until the French surveys for the purpose of metrication. It is apparent that others and NOT Eratosthenes wrote the description of the reasoning he is said to have used and which has been completely discredited.

Such terminology as Greek, Roman and Egyptian were given to various interlinked measurement units by Michell but are for ID only and do not necessarily mean they 'belong' to those countries. The units predate any of these as viable nations and in any case were international.

It appears that Thom's results have varying values for pi as he 'made the megalithic values fit' and yet to construct a given circumference a constant value for pi ought to exist as the variable, until correctly calculated, was the radius. The radius is decided upon by the application of pi to the given circumference…or vice versa. Pi should remain a constant. Adding this to the tolerance allowed on the circles and the whole implied methodology of our forebears appears more than a little questionable. To maintain an accurate measure of 2.72 feet and then not have a fixed value for pi does not seem feasible. The pi value may not be any with which are familiar although it will be somewhere near, but if the linear measure is constant then the same mind set should apply to any pi value applied. Thom demonstrated a good ability in astronomy by the ancient folk of Britain and Ireland and this involves much observation, calculating and recording. To set out circles in such an approximate manner does not appear to gel with their ability to trace intricate the movements of the lights in the sky, specifically the moon. To account for the involved lunar movements, as we are led to believe that these ancient folks did, these people must have been more than capable of evaluating a consistent approximate version of pi that was close to that accepted today; they were thinking in terms of distance and alignment…geometry in effect. In any case there is little coherence between counts of values in Thom's type of interpretation and no apparent symbolism of any kind unlike the explanations that follow in this narrative where values and representations that are found across the ancient and not so ancient worlds can be seen. The measures applied have a proven history as the books *Measurements of the Gods* and *Deluge from Genesis to Atlantis* very clearly demonstrate.

The dimensions of Stonehenge

The values deduced by Michell are valid in this evaluation…not only here at Stonehenge but over much of the world from ancient times to the late mediaeval era…and since in some cases. However, some of the units described in this chapter were missed by Michell and as far as we can tell other researchers of the Stonehenge site. Certainly to the best of the author's knowledge the relationships between Sarsen and Aubrey circles in terms of square area have not been seen elsewhere nor other metrological connections that are explained in this narrative.

For purposes of accurate calculation the use of extended decimal fractions will be apparent. While these will be seen as impractically accurate the values can be viewed as the target dimensions. By reducing a unit's measurement to a length that is feasible for practical application, and using this as an integer for calculation purposes, overall measures will not

display the numerical count that would be the target value. That such care was taken is apparent from the structural features and dimensions of the monument. Numerical symbolism was important.

It was noted in early investigations that the outer faces of the lintels were slightly curved; to quote engineer Herbert Stone in 1924,

...it is of interest that the outer face of each lintel is dressed approximately to an arc of the circle against the circumference of which the stone is placed. A corresponding feature is to be seen in the case of the trilithon lintels.[17]

The *inner* lintel face circular shape is therefore *assumed* on the lintels, it *symbolically* follows concentrically that of the outer worked face. Notable also is the fact that the *inner* faces of the *sarsen uprights* of both this circle and the trilithons were dressed in a similar albeit lesser fashion. The outer faces of the vertical sarsens were left undressed. The dressing of the stones all points to the inner circumference being important and being associated with the outer lintel faces and circumference…in addition to the diameter being equally as valid in its symbolic application.

Utilising the measures from Petrie and Atkinson, 97.325 feet for the inner diameter with a lintel width of 'about' 3.5 feet, we have a diameter between the *centres* of the lintels of 100.825 feet. Using *modern pi* of 3.141592654 this results in an area of 7984.106893 square feet.

Thom made the outer circumference of the Sarsen Circle 48 megalithic rods or 326.4 feet. This results in a diameter [using modern pi] of 103.8963469 feet. Deducting the inner diameter from Petrie at 97.325 we have 6.57134685 or 3.285673425 for the lintel width. Atkinson had this value at circa 3.5 feet and the calculations show that within a fine tolerance this is correct. Yet Thom makes this lintel over 2.5 inches narrower than this…obviously this measure is astray somewhere. Using the evaluation that works here of 30 x 3.475748571 for the outer diameter we have 104.2724571 feet which is 4.51332276 inches more than the calculation from Thom. Circumference in this narrative is seen as 3.475748571 [lintel width] x 80 x 1.17857142 [HSMF see below] Evidently the 48 megalithic rods does not exactly comply here and indeed our diameter x modern pi results in 327.5815853 feet which is 48.17376285 megalithic rods, an increase of 1.181585291 feet over the round figure assessment of Thom. The approximations do not work and this is evident from his incorrect sarsen lintel dimension.

We now move back in time approximately 500 years, to what is termed Stonehenge 1, the works that included the Aubrey Circle.

Gerald Hawkins was the first researcher to apply computerised astronomy to the site and his investigation revealed that the Aubrey Circle pits [or stones as is now thought] may have been used as an eclipse calculator. In his 1965 book *Stonehenge Decoded* he recalled that,

The Aubrey holes vary from 2.5 to almost 6 feet in width and between 2 to 5 feet in depth and were steep sided and flat bottomed. Although irregular in shape, there was little irregularity in their spacing. They formed a very accurately measured circle 288 feet in diameter with a 16 foot interval between their centre points. The greatest radial error was 19 inches and the greatest circumferential or interval spacing was 21 inches. Let it be known that

such accurate spacing of 56 holes around the circumference of so large a circle was no mean engineering feat.[18]

However the diameter here was not derived from Hawkins own surveys, it was seen in an earlier work by Atkinson:-

[t]here are fifty-six Aubrey Holes, set in an accurate circle 288 ft.in diameter…. Thirty-four of them have been excavated…. The locations of the unexcavated holes have been found by probing and 'bosing' [sub-surface echo-location](Atkinson, 1956,)[19]

These variations of 19 and 21 inches can easily be accommodated by the fact that we have no idea of the dimensions of the stones that were placed here and quite probably the centres of these were at 16 feet. Certainly the distance would something very close indeed to 16 feet. Perhaps the concept of stones being removed from these holes is the more pertinent thought here; during any such removal operation the holes would necessarily be enlarged and distorted leading to the observed variations. According to John Edwin Wood [1978] in *Sun, Moon and Standing Stones*[20] a later assessment concluded that the deviation of the Aubrey circle from being a true circle was no more than 6.7 inches. Yet without knowledge of the design criterion which certainly is not made clear in his book, Wood could not confirm this. How can such a suggestion be made without firm knowledge of the original intended diameter? Hence this is yet another piece of nonsense as to what measure does the 6.7 inches apply? This is not stated. However, we can feel assured that this circle was accurately set out and that its circumference centreline would be almost certainly 16 x 56 feet around its circumference or something very close to this measure.

As a circumference measure through the centres of the holes gives 16 x 56 feet or 896 feet, the stated diameter of 288 feet is therefore for the overall diameter and not the centreline diameter because the diameter of a circle of 896 feet would be very close to 285 feet.

The 896 feet of the Aubrey Circle circumference calculated from the 56 spaces of 16 feet, again using modern pi has a diameter of 285.205658 feet and a resultant area of 63886.0674 square feet. If we now divide the smaller Sarsen Circle area of 7984.106893 square feet into the larger Aubrey Circle area the result is 8.0016545819.

Here we observe that one circle is virtually exactly 8 times the area of the other with both measured to the centre lines of the stone zones, in the case of the Sarsen Circle the raised lintels and Aubrey Circle the centreline between holes that gives the 16 foot x 56 foot circumference. Here the calculations show that if the smaller circle were to be increased eightfold then the difference in diameter to the Aubrey circle would be merely 0.3538996 of an inch.

Let us take this exploration a little further. The circumference of the Sarsen Circle through the lintel centreline [still with modern pi and Petrie's diameter] measures 316.7510793 feet and divided for the 30 lintels and their supports, the number 30 representing the days of the canonical month, there is a unit measure of 10.55836931 feet; here we observe a measure that is a mere 0.01956828 of an inch less than 10.56 feet. [0.01956828 of an inch equates with 0.5 of a millimetre. Compare to Ruggle's comments above.]

The diameter of the Aubrey Circle as seen above divided by another monthly value representing the days in the sidereal month, 27, gives a unit measure of 10.56317252 which is longer than 10.56 feet by 0.0380780222 of an inch or 0.967 of a millimetre. Hence using reliable survey results by researchers who were only recording the dimensions of the site with no knowledge of any other unit values that may fit, we have a mean value for the division of the Sarsen Circle lintel centre circumference by the 30 days of the canonical month which is denoted by the number of lintels and sarsen stone supports of 10.55836931 feet and the Aubrey Circle diameter divided by the days of the sidereal month resulting in 10.56317252 feet. Given that the difference to 10.56 feet is less than a millimetre in both cases, [compare to Ruggle's comments above], can there be any doubt that here we find a metrological common denominator to both circles?

Applying 27 x 10.56 feet we have 285.12 feet where 27 equates with the days of the sidereal month in common with the lunar configurations of the Sarsen Circle. This can also be seen as 108 x 2.64 [step with foot value of 1.056 feet] or 30 x 9.504 [reed value of the 1.056 foot] etc. This value can be accepted as the centreline diameter of the Aubrey Circle, it fits in so many diverse albeit intimately connected ways. Using 22/7 we then have a centreline circumference of 896.0914283 feet which slightly alters the 16 foot spacing as calculated by Hawkins to 16.00163264…an alteration of some 0.0195917 of an inch [0.497mm] per spacing.

If we use 10.56 as the curved centreline length of the lintels then an area calculated via 22/7 for pi multiplied by 8 for the Aubrey Circle results in an Aubrey Circle diameter [again using 22/7] is within 0.1745 of an inch or 4.4 millimetres of the 27 x 1056 feet or 285.12 feet of the Aubrey Circle diameter, a margin of error of 1 in 19,607. Compare this tolerance to those of Thom.

The centreline circumference of Sarsen Circle using 10.56 x 30 and 22/7 measures 316.8 feet and the diameter 100.8 feet [100 of Michell's 'short Greek feet']

The Aubrey Circle centreline diameter of 285.12 feet divided by the Sarsen Circle centreline diameter of 100.8 feet results in a step value of 2.828571429 which has a foot measure of 1.13142857142 and this divides into the circumference of the Aubrey Circle centreline exactly 792 times. 7920 British miles is the round figure diameter of Earth measure and four times this will result in a value that is becoming familiar here, 31680 seen in the Sarsen Circle centreline circumference as 316.8 feet. This is further evidence that the builders of this monument were familiar with the measures in use further afield. It is familiar from numerous places, Egypt for one and again it occurs in the Bible. Biblical metrological material is seen and explained in the book *Deluge: From Genesis to Atlantis*.

However, these values do require some verification and this is seen in the form of the results of a photogrammetic survey of Stonehenge.

In his 1973 work *Beyond Stonehenge* Hawkins cites the results of photogrammetric survey of the Stonehenge site and includes the resultant contour plan. This survey was executed by Hunting Surveys, England. With the photogrammetric engineers was a descendent of Sir William Herschel the famous astronomer, also well known as an accomplished musician. Hawkins was shown the results of the surveys in accompaniment of Mr C.R. Herschel the lesser known descendent of Sir William. Hawkins noted that:-

Previous authors gave 288 feet as the diameter of the Aubrey Ring; measured from the new plan it is 285 feet. The Sarsen Circle diameter 99 feet 1 inch measured at the centre of the stones, and 97 feet 4 inches at the inner face.[21]

97 feet 3.85152 inches [97.32096 British feet or 100 long Roman feet] which is the internal diameter of the Sarsen Circle in Stonehenge is within 0.14848 inches of the measures derived from the photogrammetric survey. Both Petrie at 97.325 feet [97feet 3.9 inches] and this survey using far more modern equipment agree within the smallest variation which is negligible being little more than a thick pencil line. This could not be said of Thom's results here.

Centreline diameter noted as 99 feet 1 inch is incorrect and by such a large margin that there is an obviously simple error. This diameter is 100.8 feet and the stones are a theoretical 3.475748571 feet in width, call it 3.5 feet after Atkinson. Half of 3.5 feet is 1.75 feet . 99 feet 1 inch plus 1.75 = 100.83333. this we can accept as the correct value. Hawkins had only added the half lintel width instead of the whole width for both sides of the circle. A very easy error to make but one that is understandable.

From these evaluations it can be seen that the photogrammetric survey agrees with the values for the Sarsen Circle seen in Stonehenge Measures. This being the case there is no reason to doubt the results for the Aubrey Circle where we observe a recording of 285 feet against the Stonehenge Measures evaluation of 285.12, a difference of 1.44 inches which after all was something of a guess as it was to the centreline of a circular series of holes of varying widths. Let us not forget the virtual exact agreement in circle diameters based upon a multiplication by 8 of the area of the Sarsen Circle using 22/7 for all circle calculations…the math gave results within 0.1745 of an inch. Taking connections a little further we shall later see that the 288 feet supplied by Atkinson also plays a role here.

We now look to a measure seen a little earlier in relation to one of Thom's circle assessments and the outer circumference of the Sarsen Circle. It is a unit that has emerged quite recently via researchers Peter Harris and Norman Stockdale. The unit is 14.142857142 inches which in feet is 1.1785714285. This is termed for ID purposes the HSMF or Harris/Stockdale Megalithic Foot.

Some unusual, intuitive but logical thinking has led to this value and all is revealed in the intriguing book researched by Harris and Stockdale[22] the measures certainly appears to be associated with Stonehenge and as we shall see, other elements well away from and much earlier than Stonehenge.

This unit, [which itself is exactly 3/8 or 0.375 of 22/7 or 3.142857142 etc] x 0.96 = 1.131428571, [22/7 divided by 2.77777r] which is a lesser version, being 24/25 of the HSMF. So evidently this is a part of the ancient system as indeed is the shorter version. There are 792 of the 1.13142857142 feet in the Aubrey Circle centreline circumference and 760.32 of the HSMF measures and their fractions indicate both units are closely related to the pi value of 22/7. In fact three times 22/7 equates with 8 of the HSMF measures.

760.32 = 432 [12 x 36] x 1.76 [10.56/6]. 760.32 feet is also seen at the Great Pyramid being the design dimension of one length of the pyramid at the 'socket lines' beneath the outer paving according to Michell.

[1.1785714285 / 225] x 224 = 1.17333333 which is the foot of 14.08 inches, the 21.12 inch cubit of 1.76 feet , the step of 35.2 inches or 2.93333 feet and of course the reed measure 10.56 feet or 126.72 inches. That this unit was a part of the ancient system of measures is clearly apparent.

It is likely that this unit was at least occasionally associated with eclipse values as is claimed by Harris and Stockdale. At this point we should take a look at the station stones. These are placed between the holes of the Aubrey Circle which at one time self-evidently contained stones. As the Sarsen construction in the centre region of the site prevents visually connecting these positions accurately we can safely state that these date to before the Sarsen Circle and Horseshoe. Further the Aubrey circle stones would have been in front of the entrance to the avenue and so it seem probably that they also predate that and were removed when this was developed along with the Sarsen Circle. In fact it is now thought that the Bluestone Circle was made up of the stones removed from the Aubrey holes.

The station stones are intriguing as they have both dimensional and astronomical considerations. Perhaps the drawing below is easier to follow than a multitude of words on this subject. The dimensions here are counted in the unit developed by Harris and Stockdale which for Identification purposes have been termed the HSMF or Harris/Stockdale Megalithic Foot.

As far as this investigation can ascertain, in width we have 93.3333 of these units and in length 224 In imperial feet this then is 110 x 264 = 374 and in the HSMF feet unit 317.3333 x 1.1785714285. This does not seem very meaningful but let us add the diagonal of this rectangle which as proportional sides of 5/12/13. The diagonal has a length of 13 times the base proportion unit which in this case is 22 hence a measure here of 13 x 22 = 286. This, in terms of HSMF = 242.6666 another value with no apparent numerical meanings. However when we add these values for the perimeter of the triangle a different picture emerges.

In the perimeter of the triangles we therefore observe reference to the count of holes in the Aubrey Circle and by inference to whatever these holes indicate. Also apparent is a reference to the count of miles in Earth diameter at 7920 Imperial miles. [While it seem more than a little strange, the measurement system was based upon Earth dimensions and hence possibly this was meaningful count known by the designers here as is implied by later information.]

In terms of the Saxon mile of 5500 British feet [foot value of 1.1 British feet] we find 7603.2 miles in Earth diameter. [Seen in terms of HSMF around the Aubrey Circle circumference.] Hence we now have the perimeter of the square containing the circle of Earth represented in circular format at the Sarsen Circle with its 316.8 feet centreline circumference. In addition we see further connections to the diameter [one side of that Earth square] of the Earth at the station stones.

HSMF	93.33333	Imperial feet	110
	224		264
	242.6666		286
Total	560		660 [7920 inches]

These station stones also have another purpose and that is to indicate the direction of sunrise and sunset at the festivals between the equinox and solstices. Hence we have Beltain and Lughnasadh sunsets at circa 296.6 degrees azimuth and Samhain with the sunrises of Samhain and Imbolc at circa 116.6 degrees azimuth. These are of course seen by sighting along the diagonal, the *station stone* line formed by the rectangle which only applied before the sarsen erections in the centre of the site which blocked the view.

The *station stone markers* which form the opposite diagonal tell of a different scenario which took place at Samhain. We have the large cross which is Cygnus setting in the north not long before the small cross Crux appears in the south. Cygnus could be seen sinking below the northern horizon with its bright star Deneb finally disappearing at an azimuth of circa 342 degrees azimuth. This was at around 2AM. At approximately 162 degrees azimuth, the reciprocal angle, the small Southern Cross would be observed at about 5 AM. As sunrise was 7.19 approximately both events would be highly visible with the blessing of a clear sky.

Beltane today is classed as being Mayday, the first day of May but at Stonehenge we are looking at a time before such calendars and here we have days that would have almost certainly been 45 days after or before the equinox. These are the cross quarter days. The investigation has taken a date of 2750 BC which is roughly half way between the initial setting out of bank and ditch etc along with Aubrey Circle and the building of the Sarsen complex and allowed the 45 days in relation to the equinox to discover what is described.

Many will take the position that there is no allowance for refraction here. Correct, there is not but the refraction index would be approximately half the diameter of the sun anyway and the positions cannot be exactly tied down hence we may be looking at a day before or after the 45 days and if the reference ought to be earlier then again this may alter the positioning very slightly. The point here is that the station stone diagonal indicated the positions as stated to within an acceptable visual tolerance to indicate the days as desired.

Regarding Cygnus and Crux, these are constellations and the criterion is the visibility of these. Deneb would sink beneath the horizon where stated…and approximately is the word used in the description above. Again, the description is close enough to have been recognised for this purpose. In addition there are sun and moon alignments along the sides and ends of this rectangle as denoted by others. Indeed, adding to the lunar counts across the Sarsen Circle there is a considerable amount of astronomical learning here at Stonehenge.

It now appears that contrary to the derogatory opinion of Clive Ruggles who has unnecessarily insulted Thom and his efforts, who believes that a stone width *'perhaps a metre, not 1 mm'* is as close as ancient stone builders could measure, along with those who has influenced him and those he has in turn indoctrinated, the builders of Stonehenge certainly were aware of and familiar with the use of fine measurement. The evidence seen in this narrative gives results that are within the stated single millimetre and being dependent upon the results of accurate independent surveys by people only trying to assess the dimensions of the site and not trying to make their own metrological ideas work can be accepted as they are as fine as one can hope to achieve. It is also ironic that as the surveys utilised are those with which Ruggles would [ought to be] be familiar and would logically accept, these same

investigations into the dimensions of the site prove his arguments and those of others who follow the same mind set to be utterly fallacious.

But condemnation without evidence applies also to Hawkins

Hawkins second contention is that the fifty-six Aubrey Holes were used as a 'computer'...for predicting movements of the Moon and eclipses, for which he claims to have established a hitherto unrecognized 56-year cycle.... It is questionable whether a barbarous and illiterate community..., which has left us no other evidence of numeracy, could successfully have recorded the data needed to establish a cycle which exceeded contemporary life-span.... [23]

"...detailed reassessments of the ideas of ... Gerald Hawkins... have shown that there is no convincing evidence that, at any stage, constructions at Stonehenge ...served as any sort of computing device to predict eclipses...there is no reason whatsoever to suppose that at any stage the site functioned as an astronomical observatory.[24]

[We recommend the paper *New Light on Stonehenge from Ancient Greeks.* By Vance R Triede (see references) from which these citations are drawn. Triede makes a fine job of supporting Hakwins ideas with evidence from other locations and ancient scholars.]

Preconceptions are an enemy of discovery, while the investigations for this work have been carried out with a completely open mind. What is reported is what has been discovered, no more no less. The author has been amazed at the accuracy of the site that has only become apparent via this sort of research. Even without the refinement of measure seen here the metrology applied shows that this site was put together by people who were very well versed in these units and their application. This idea shall be reinforced as we delve further into the measures of Stonehenge.

The smaller Sarsen Circle was constructed later than the larger encompassing Aubrey Circle. This made pinpointing the centre not an easy task but within 1.6 feet[25] this was achieved. To almost pinpoint this circle centre was no mean feat, as no sign of any post or stone marking the original centre has been discovered, this was done by calculation and trial and error.

From the perspective of calendar use, this Aubrey Circle circumference divided by the 27 days of the sidereal month or 13.3333 degrees of the circle [360 /27] amounts to 29.33333 x 1.13142857142. We note that 2.933333 is the step measure related to the reed length of 10.56 feet. Of interest is that 27000 long Roman miles of 5000 x 0.9732096 feet or 4866.048 British feet results in the Earth circumference of 24883.2 British miles. In a similar manner the long Greek mile is counted 25920 times. Hence in these counts there is astronomical information, days of the month and the precessional count.

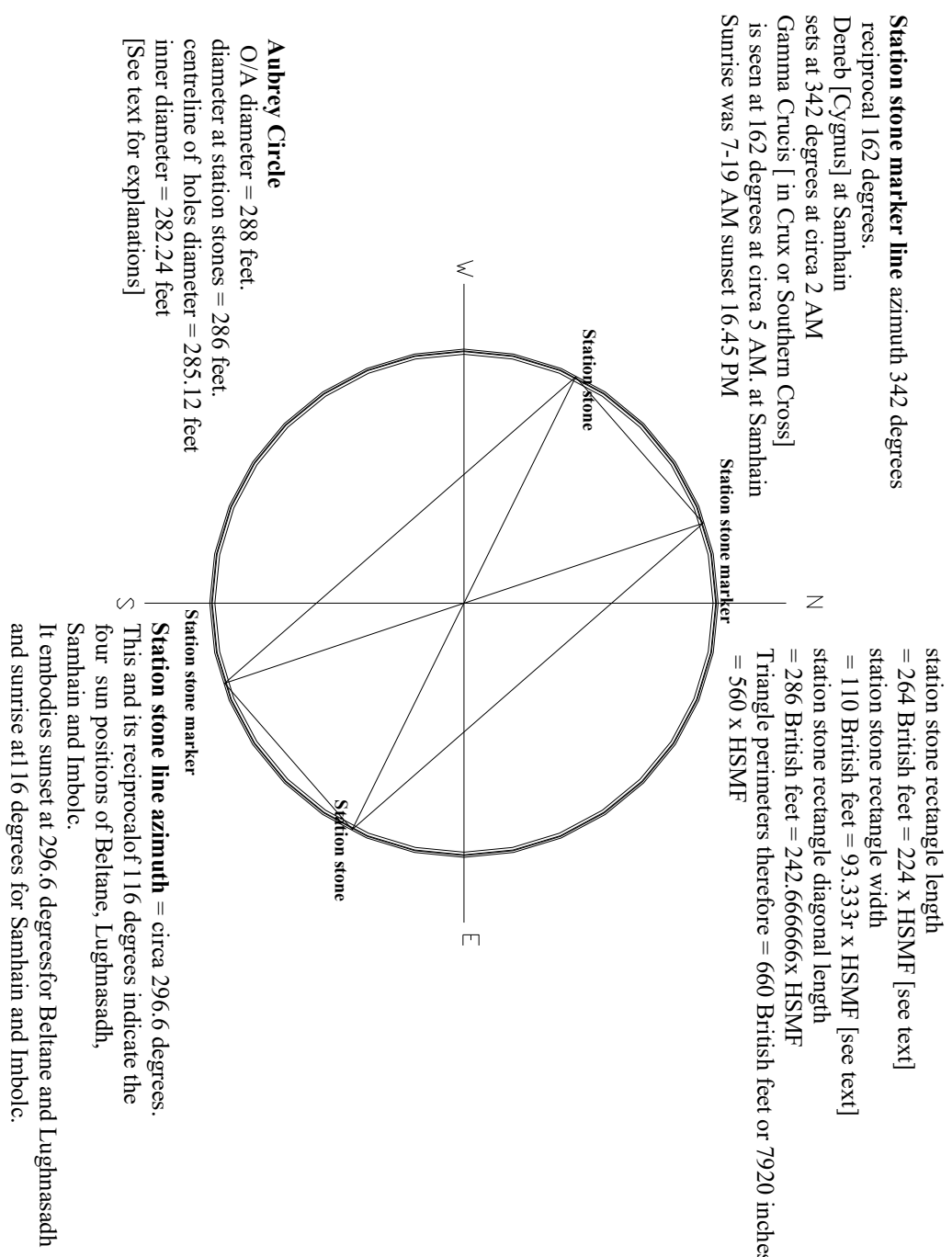


Fig.7.7 Aubrey Circle and Station Stones

The Sarsen Circle centreline circumference at 316.8 feet is 1.1111111111[$1^{1/}_{9}$] the diameter of the Aubrey Circle centreline to centreline diameter. The Sarsen Circle inner circumference is exactly 88 times the lintel width. A foot value associated with the 10.56 foot reed is 1.173333 feet. The 316.8 feet of the Sarsen Circle centreline circumference divided by the 27 days of the sidereal month = 11.7333333 or 10 feet related to the 10.56 foot reed. This reed has a cubit measure of 1.76 feet x 6 and 1.76 divides into the 316.8 feet circumference exactly 180 times representing 2 degrees per cubit, or perhaps 2 days of the 360 day year.

The lintel length of 10.56 feet when divided by 1.11111111 = 9.504 or 9 x 1.056. The reed of 9.504 feet has a foot of 1.056 British feet, it has a cubit length of 1.584feet and a step of 2.64 feet.

Note that 2.64 x 1.03030303 = 2.72 but we find virtually no evidence for the *accurate* application of 2.72. It most certainly does not apply at Stonehenge except in a very approximate manner and rarely fits any of the circles mentioned in Thom's work. Compare this with the accuracy seen in the alternative analysis in this narrative using the measurement system that endured from thousands of years before Stonehenge to quite recently with the British Imperial system being an integral element of that system and hence in fact still partially in use today.

316.8 /2.727272727 [extended megalithic yard] = 116.16 = 110 x 1.056.

11.616 inches = 0.968 feet and this is an important Biblical value also found within the Great Pyramid. [See Chapter 11 of Measurements of the Gods]

316.8 divided by 1.584 = 200 and 316.8 divided by 2.64 = 120.

316.8 divided by 9.504 = 33.333333 and 316.8 divided by 2.933333 = 108

30 x 9.504 = 285.12 Aubrey Circle centreline diameter.

2.64 x 108 = 285.12

1.584 x 180 = 285.12

1.76 x 162 = 285.12

2.933333 x 97.2 = 285.12.

A reed measure of 9.72 has a cubit value of 1.62 and a foot of 1.08

Hence from this small collection [there is much more] it is possible to see something of the connectivity of these measures. All these units fit perfectly, no tolerance, no near fit.

The value ascribed to the Sarsen lintels of 3.4757485712 feet relates to the long Egyptian cubit [Michell's terminology]

3.475748571:- 1.728 x 2 = 3.456 and 3.456 / 175 [x 176] = 3.475748571.

175/176 is used frequently as a link between long and short values. For example, the short 'Greek' foot of 1.008 feet seen at the diameter of the Sarsen Circle can be increased by the factorial method:- divide by 175 multiply by 176 to 1.01376, the long version.

Here, however, we reiterate that lengthy decimal fractions are necessary for calculation purposes while from a practical perspective are unrealistic. Nonetheless, the value of these measures in multiple will often result in a whole number or at least one with a short fraction and it is these that usually are a target overall value.

When Thom's megalithic yard is extended to 2.7272727 feet it is compliant with some of the measures of the ancient world and via these connections, the whole of the system. Hence values connected to this by definition are also connected to that system.

The Egyptian step measure of 2.5 feet at 1.152 = 2.88 and this divided by the step of 2.64 [see above] = 1.09090909 and this is the foot value associated with the extended megalithic measure of 2.7272727.

1.09090909 connects the values associated with 10.56 with the Egyptian units hence 1.056 x 1.09090909 = 1.152.

2.72727272727 x 105.6 = 288 or 100 long Egyptian steps.

This is the overall diameter of the Aubrey Circle as recorded by Atkinson.

Hence Atkinson and then Hawkins had completely unknowingly given 100 long Egyptian steps for the overall diameter of the Aubrey Circle. As this overall diameter is linked to the centreline diameter and hence to the area of this circle divided by 8 to the Sarsen circle, we can determine a link to the work of Petrie in the late 19th century. Two completely independent researchers surveying at completely different times arriving at measures that agree to an extremely fine degree with the system of metrology seen across the ancient world and these measures have been confirmed by photogrammetrically survey. Such correspondence and accuracy do NOT apply to any other sets of measures for this site. Given the number of the connections to a larger measurements system seen here this could not be coincidence…neither researcher was aware of the existence of that system, it had not been uncovered by the time of Atkinson and Petrie had no inkling of its existence. Yet both arrive at values on different albeit mathematically connected sections of the site that are part of the broad system. There are no other surveys of Stonehenge that comply in such a plainly correct manner and then also link to the greater system that applied internationally since before the building of Stonehenge.

The Sarsen Circle is late compared to the Aubrey Circle and yet as we are seeing, both circles comply with the ancient metrological system as a whole. Here we see that at circa 3000BC the measures were in use at Stonehenge.

At the Aubrey Circle have an overall diameter of 288 feet, a centreline diameter of 285.12 giving a difference of 2.88 which for the two sides is divided by two for 1.44. If we double this for a hole or stone zone of 2.88 feet each side we have a diameter for the internal measure of 288 less [2.88 x 2] = 282.24feet.

Here we have 28 x 10.08 [1/10 the Sarsen Circle centreline diameter]..another calendar count and the use of a measurement unit in two locations on the site.

It is also 1.68 x 168 [1.68 is the cubit value of the foot of 1.12 feet seen at Holyrood Abbey and Palace at Edinburgh]

The British mile of 5280 feet / 1680 = 3.142857142 [22/7]. The Aubrey Circle centreline circumference divided by the Sarsen Circle circumference = 2.82857142 which is the step value of the foot valued at 1.13142857242 which is counted 792 times in the same Aubrey Circle circumference and 280 in the Sarsen Circle centreline circumference.

The Aubrey Circle inner diameter at 282.24 feet gives a circumference of 887.04 which can be seen as 504[1008/2] x1.76, 84 [3x28] x 10.56, or 336 [12x28] x 2.64 and finally the 56 stone centres at this inner circumference would measure 15.84 feet apart or 1/20 of the Sarsen Circle centreline circumference.

Hence for this zone of the Aubrey Circle pits or stones we have an overall diameter of 100 long 'Egyptian' steps, a centreline diameter of 99 of the same and the inner diameter shows 98 of the same measure.

While this latter evaluation of the Aubrey Circle measures is admittedly a little speculative, it certainly fits the measures available from Atkinson [288 feet] and Hawkins [258 feet for a hole centre approximation] the latter with the highly accurate photogrammetical survey and therefore as a basis for argument is completely valid. Taking measures from Google Earth may not be the most accurate method of evaluation but it certainly is accurate enough to check within acceptable margins whether an assessment is reasonably accurate. The measures seen in this narrative can be approximately checked via Google Earth and it will be found that the fit is far better than Thom's values which show no connectivity whatever. The configuration described in this text also goes some way towards showing the interrelationships of the values, measures that can be found on numerous monasteries, churches and cathedrals in addition to ancient sites in the Middle East and further afield. Some additional measures information is seen later in this narrative.

Commentary

It now appears confirmed that the holes of the Aubrey Circle were set out to a centre diameter that utilised a very specific measure, 10.56 feet which was coupled with the count of days of the sidereal month and that the Sarsen Circle evaluation is also correct. The values of the circles have been confirmed by photogrammetrical survey.

However there are other values to take into account. The extended version of the megalithic yard, 2.727272727 divides into the Sarsen Circle centreline circumference 116.16 times. 11.616 inches is 0.968 feet. The step value of this foot is 2.42 feet.

The Aubrey Circle centreline diameter at 285.12 feet divided by 242 results in a value that was used on the outer ditch and bank according to the measures of Petrie. This is 1.178181818. The step value of this foot is 2.945454545 which is the extended megalithic yard of 2.7272727 x 1.08 as is commonly accomplished among measures in India. The foot value here in inches is 14.138181818. The foot length associated with the 2.7272727 foot step is 1.09090909 and this divided into the step of 2.945454545 results in 2.7 which has a foot length of 1.08. Connections abound.

These values result in a neat series of circumference measures here using not 22/7 but another commonly utilised pi value of 3.1418181818. In fact this links the 24883.2 mile circumference of Earth that was utilised from antiquity until the surveys for metrication by the French in the 18th century, to the round figure diameter of 7920 miles seen represented earlier in the Aubrey Circle and indeed the Sarsen Circle. These Earth values can be found across the ancient world. For example, a number of Egypt's colossal pharaonic statues are 66 feet in height. 66 feet is the 22 yards of the cricket pitch or the length of the surveyors chain and as surveyors measure portions of the Earth it is quite fitting that 22 yards is 792 inches…the Earth diameter /10 in miles represented as the height of the statues in Egypt. [See later quotation from *The Book of the Dead*]

Both the foot at 1.178181818 feet and the step at 2.945454545 feet fit a number of Thom's diameters and circumferences [using 22/7 or the alternative 3.1418181818] very accurately. These counts sometimes are in whole numbers and sometimes reflect other values within the system such as 2.93333 [step associated with 10.56 foot reed]. Here we have the circumference of two circles [Thom ref P 2/8] 27.5 feet diameter equating with 2.945454545 x 29.33333 at 86.4 feet and here the pi value is 3.1418181818. These values are exact.

Circle B 2/5 has a 43.6 foot diameter which Thom denotes as 16 Megalithic yards or 43.52 feet. Here we see a correlation in that at 37 x 1.178181818 we have 43.592 which is within 0.87 of an inch of Thom's estimate and 0.096 of an inch of the measured diameter.

Two further examples here and the first of 1.09090909 x 36 which is 39.27272727 where the target is the diameter of 39.2 [result within 0.872 of an inch] and 1.09090909 is the foot value of the extended megalithic yard of 2.727272727. This applies to circle B 7/6. Thom denoted this as 14 megalithic yards which is 38.08 feet.

Secondly we have 66 x the long Greek foot [Michell's terminology] of 1.01376 which is 66.90816 feet. This is compared to the 66.9 feet diameter of circle B 2/3 and is within 0.0979 of an inch of the measured diameter. Thom claims that the value here was 25 megalithic yards which is 68 feet…1.1 feet away where 1.1 feet is a foot value associated with the 16.5 foot rod, pole or perch from Saxon times in Britain. Its step value is 2.75 feet and it is found in India dating to before 3000BC being known there as the *gaz*[26].

Notably here 288 [Aubrey Circle overall diameter] x 1.1 is 316.8 feet [Sarsen Circle centreline circumference] hence this number relates directly to Stonehenge…both circles.

These are just an example and much more can be discerned among the listings of circle dimensions from Thom. But from this can be seen many possibilities for an alternative explanation…one that generally is likely to fit far better than the megalithic yard of 2.72 and which will then link well to the ancient metrological system as a whole.

The outer extremities of the Stonehenge ditch give a diameter of [A] 374.5833 feet according to Petrie[27] while the inner diameter here is [B] 337.O83333 and the inner edge of the ditch is [C] 299.583333 feet. These measures Petrie claims are within +/- 4 inches but in reality we can allow a little more than this as here we are dealing with soil and not stone. Nevertheless, we maintain Petrie's 225 inches for the ditch zone.

We arrive at values of [A] 375 which is within 5 inches of Petries evaluation and an inch outside his estimate of tolerance. We view [B] as 337.5 again within 5 inches and [C] as 300 feet, here within 4.16 inches.

Here we return to the foot measure seen above, that of 1.178181818 feet. This has a neat count of 1000 [outer ditch edge], 900 [inner ditch edge], and 800 [inner bank edge] when applied to the circumferences calculated via 3.1418181818 of the outer elements of Stonehenge 1 as seen above. Given the connections already seen these almost certainly were the design measures and the tolerances are reasonable given the soil factor.

If we now try this evaluation using 22/7 for pi we find that precisely the same numbers occur except that the count is now in HSMF [Harris/Stockdale Megalithic Foot] measures. This clearly demonstrates the connectivity here between the values. We see that 3.1418181818 for pi gave the same count in the 1.17818181818 measures as 22/7 did for the 1.1785714285 [HSMF]

value. The connection between these values, both the measures and the versions of pi, is 3024/3025. Hence (22/7 [3.142857142] / 3025) x 3024 = 3.1418181818

In terms of dating at this point we are looking to circa 3000BC when Egypt had yet to build a pyramid but was building mastabas and hence had abundant metrological knowledge. The measures are ancient; the basics of the British Imperial system were ancient long before Rome had even thought of creating an empire. They predate Greeks and Egyptians and are evident at circa 7000 BC in India. Abundant evidence for this is seen in the latter chapters of *Measurements of the Gods.*

Given the many cross correlations of measures between the Aubrey and Sarsen Circles seen here and now the outer ditch and bank along with the very great accuracy involved, there really cannot be any doubt as to whether these measures applied at this site or those others of Alexander Thom. The great differences in accuracy between these evaluations and those of Thom and others have been seen and the neat connections from even the outer ditch to the remainder of the site are evident. There are numerous measures that refer to lunar months of three different counts of days. There are references to Earth measure and what could be more fitting than the 316.8 feet representing the canonical four times diameter square containing the circle of Earth diagram in circular format which itself is constructed with 30 supports and lintels representing the 30 day month? [See below for an extract from Egyptian material in confirmation of the concept]

It is repeated that all these measures are ancient knowledge long predating this site and evidence for such knowledge is in the book *Measurements of the Gods*.

Regarding lunar symbolism, Ruggles allows a 'tentative working hypothesis' that there was lunar symbolism in Stonehenge 1 and 2 but Pitts states that archaeology offers little support…while Ruggles continues to aggressively deny Thom's interpretation of numerous other sites derived from many years of painstaking investigation and analysis. Notable is the fact that Ruggles criticism seen earlier did not involve his own efforts but he only stated that others had failed to find agreement with Thom via statistical analysis. The author of this narrative does not accept that statistical analysis has any part to play here, each and every site has to be examined in isolation from any other, most will have diverse measures and yet if the analysis is correct, these will eventually be seen to be metrologically interrelated…and that will almost certainly include a metrological relationship to the Stonehenge analysis of this paper or at least a connection to some of the units of measure applied here. Some indications that this is the case have already been seen.

Stonehenge has been altered a number of times with Stonehenge 3 phase II being the erection of the Trillithons and Sarsen Circle. Stonehenge 1 involved the outer ditch and bank and the Aubrey Circle while Stonehenge 2 consisted of some timber posts now long lost with their positions scattered among the stones of the Sarsen Circle and inner elements of the site. As this is the case some posts may well have stood where there are now stones and it is therefore impossible to give an accurate assessment of the appearance of Stonehenge 2. Hence any 'tentative working hypothesis' regarding lunar symbolism on Stonehenge 2 is little more than an outlandish guess and is as totally meaningless as Ruggles' comments on the use of fine measures on stone circles.

This 'symbolism' does not include any alignments that may be involved at the site, this is a different scenario perhaps best seen in North's extensive work. On Stonehenge 1 all there is to associate with the moon is a count of 56 [28 x 2] holes in the ground or the obvious 56/3 = 18.6666 a count here directly associated with the eclipse cycle, the period it takes for the two lunar nodes to swing completely around the sky and hence involve both sun and moon…that is unless, of course, one involves counts of measures…Other than this one has to speculate regarding the theoretical height of stones in the Aubrey Circle although at the 'Station Stones' rectangle positive alignments of the cross quarter days sun position and the extremities north and south of the moonset and rise can be determined. However, an alignment to a horizon point where the sun or moon rises or sets at a very specific time of year can hardly be termed symbolism. Symbolism on the site can be seen in the counts of days in measures and elements such as the proportional relationship between the lintel width and circle diameters at the Sarsen Circle.

Evidently, contrary to the prejudiced view of far too many researchers, accurate measures did feature very highly at Stonehenge as did lunar symbolism and calendar counts and this began at the very early stage of the digging of the pits of the Aubrey Circle, some 500 years prior to the erection of the Sarsen Circle and Horseshoe.

All the measures and many more related values can be found on ancient structures in the Middle East and India, Malaysia and indeed mediaeval Europe on Christian buildings.

As an example, the Biblical Patriarch Noah was born according to Genesis in the year 1056 after creation. The Bible utilised 10.56 and its cubit value for the dimensions of Noah's ark. The dimensional units actually fit a natural stone formation in Turkey that was denoted as the vessel involved in the Chaldean flood tale. This is found in the exact location mentioned in the story. 1.76 was used for the Ark of the Covenant and this specific artefact [whether imagined or real] was emulated at both Chartres Cathedral and Rosslyn Chapel in the proportions and dimensions of both structures. Details for these evaluations and more are found in *Measurements of the Gods*. The George Washington monument in the USA tells of the days in the year including fractions…within 0.3 of an inch of complete accuracy in terms of long Greek cubits of 1.52064 feet.

The measures are international and have remained in use since circa 7000BC as is clearly demonstrated with ample reinforcing evidence in *Measurements of the Gods*.

It may be noted that the measures of the Bluestone Circle and the Horseshoe have not been included. The measures given here from Michell[28] and appear to be rather speculative but are probably correct given the connections to Earth measure seen in the Sarsen and Aubrey circles.

Bluestone Circle target diameter 79.2 feet
1/4 of Sarsen Circle centreline circumference
Horseshoe diameter [Sarsen] 50.4 feet
[half of Sarsen circle centreline diameter]
Horseshoe diameter [Bluestone] 39.6 feet.
1/8 of Sarsen Circle centreline circumference

If correct then this would make a beautiful correlation but the Bluestone Circle is not very accurate and it is uncertain how many stones were put into this circumference. Hence in this narrative no judgement was made on this element of the site, specifically regarding the controversial Bluestone Circle. However, given the connections to other constructions such as pyramids in terms of measure, Michell has probably hit upon the target dimensions here and they would definitely slot in very neatly alongside the analysis of the Sarsen Circle.

A degree division of the Sarsen Circle centreline informs us that every 2 degrees is 1.76 feet, every 12 degrees is an upright sarsen support. Hence a single degree is represented by 0.88 feet or 10.56 inches.[88 feet was the Biblical Ark beam.]

The lintel measures have been discovered in America, at Teotihuacan by Hugh Harston Junior. He was unaware of the implications of his discovery as he had not heard of the unit and thought it was a local Mayan value which he termed the Hunab, the Mayan word for measure. Michell noted this discovery and John Neal has undertaken further research in this direction with his evaluations seen in his work *All Done With Mirrors.* Michel in fact [and Neal has followed suit here] saw this value as being 1/12000000 of the polar axis of Earth. He termed this the Sacred Jewish Rod and in fact Newton also searched for such a measure. Michell claimed that in the ancient times the two different circumference measures of earth were understood as was the polar flattening. However, no reference to the value of the polar diameter arises until into the Christian era and the meridian circumference of Earth which he calculated was that utilised as THE circumference of Earth. The pi value 3.14181818 was applied to this to reveal the 7920 mile diameter hence the circumference was seen as 24883.2 miles which stood until the French calculations for the development of the metric system. The equatorial circumference was not known and only two measures were utilised for Earth dimensions, 24883.2 miles and 7920 miles. These have been divided into feet etc and indeed India has a neat 5000 yojanas for the circumference which makes the relevant yojana 4.97664 miles or 25920 long 'Greek' feet…other related yojanas were also in use and these and their smaller divisions then linked to Chinese measure.[See *Measurements of the Gods*]

Many have made much of the apparent link between Stonehenge and the Great Pyramid in connection with the triangle formed by connecting the Sarsen Circle to the square formed by the diameter of the Bluestone Circle. As can be seen in the illustration, this links the Sarsen and Bluestone circles and only exists due to the application of 22/7. The elevation of the Great Pyramid fits this triangle exactly.

The Great Pyramid has a base of 440 cubits per side and that cubit contained, apart from hands, spans and digits, a count of 18 inches. 440 x 18 = 7920 and of course that is for a single side. Hence the complete pyramid in plan shows a perimeter of 31680 inches of a variety related to the cubit in use, in this case 1.7181818 British feet, that termed the 'royal' cubit. Michell terms this the short Egyptian cubit and it fits within Petrie's tolerance for this cubit which he denoted at one point as 20.6 inches as the mean value. This has stuck ever since, being called the Royal Cubit. It is not quite correct but 20.6181818inches [1.718181818 feet] is the exact value that fits the remainder of the system. In fact at para 141,Chap 20 of The Pyramids and Temples of Giza Petrie stated that,

> *'On the whole we may take 20.62 ± .0I as the original value…'*[29]

This value is within 0.0018181818 of an inch of the 1.718181818 feet denoted by Michel and which is directly linked to the greater system and is within the +/- 0.01 of an inch of Petrie's tolerance. Regarding the square containing the circle of the Earth, in text from Egypt, from the *Book of the Dead*, we extract the following from the *Papyrus of Nu, the Chapter of Making The Transformation Into Ptah, Of Eating Cakes And Of Becoming A Living Beig In Anu.* [Heliopolis]

The subject of the chapter revolves around taking up residence among the gods.

Verse 9 and 10 read as follows

9 My head is like that of Ra and when my members are gathered together I am like unto Tem; the four sides of the domain of Ra

10 And the width of the Earth four times.[30]

It is an inescapable fact that the designers of both monuments, in North Africa and Western Europe were using the same measurement and geometrical systems, representations of Earth, representations that are pervasive throughout the ancient world and far predate any Classical Greek knowledge. Nonetheless, given that after the Ice Age for thousands of years people were spreading outwards and northwards from the warmer climes where development continued during the colder period this is not in the least surprising. Modern genetic studies reveal much about the emigrations and immigrations of modern man. We have mentioned the early date of 7000BC in India for evidence of the measures but here we have another step backwards because this system was virtually complete even then, it was brought to India by people from Sundaland, or South Malaysia, now under many feet of sea water. The measurements were developed at the equator on the other side of the globe during the Ice Age. When the available evidence is examined this makes much sense. This also then links to other developments in India, much blossomed in the years immediately after the arrival of these folks at Merhgarh, India [now Pakistan].

It is now apparent that the early Britons, due to the movements of both people and knowledge leading up to and during the Bronze Age, would have a similarity of learning to their counterparts in warmer regions and this ability included measures. But that does not explain the use of these units at Teotihuacan. This remains a mystery but one book may just have the answer. The Chinese were explorers and while Gavin Menzies has made these sort of claims in his book *1421,*it seems that Henriette Mertz has the right idea and the evidence. Original copyright of 1953, her work *Pale Ink*[31] is a must read for anyone interested in the early exploration of the Americas. This was published in 2008 by Bibliobazaar and the book just may tell us how the same unit of measure that was used for the sarsen circle lintel width arrived in Meso America. Of course the Chinese also had the measures a long time ago as is implied above via Indian measure.

There does, however, remain an important unanswered question. How these diverse albeit related measures were so very accurately transferred across thousands of miles and years has yet to be satisfactorily explained. There must have been rods with marks but timber is not the ideal material for great accuracy. However, as we have stated and will reiterate here, for practical purposes the extended fractions are unnecessary and cannot play any part in a craftsman's practice except in calculation. The longer fractions came from calculation and were

maintained sufficiently well for us to discover the values today. We should also take into account that memory was used to a very much greater extent before the advent of writing and much would have been memorised ensuring the need of only a minimum of fixed dimensional rods to cover most eventualities.

It is a pity that no measuring rods other than a few markings on stone and some bronze have been found. Egypt has revealed some bronze rods that are informative and the remains of a timber rule and others made of bone have been discovered in India. In fact the remains of a scale on a piece of shell from India showed a value of 1.32 British inches. To indicate connections here, 1.32 feet is 15.84 inches.

This is better than Babylon from a much later period. We have records of brilliantly accurate astronomical calculations of sun and moon but no remains of the instrumentation that simply had to exist for the observation to have taken place.

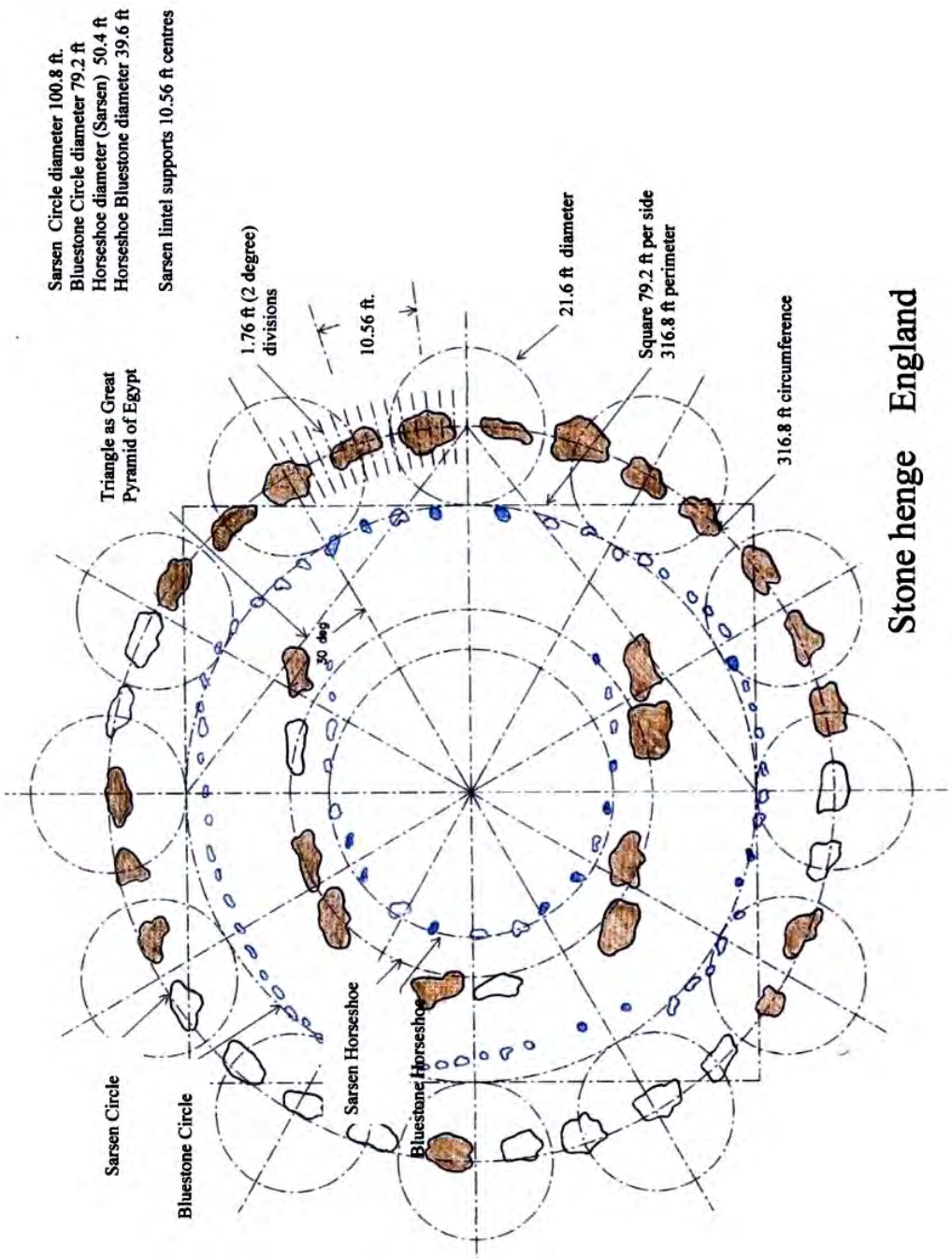
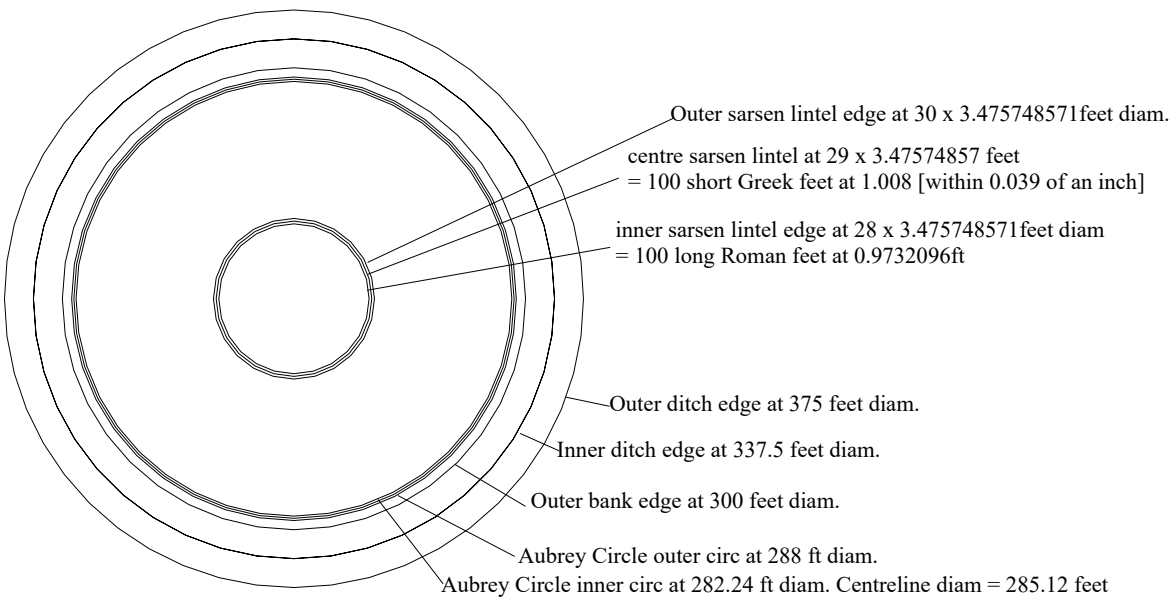


Fig. 7.8. Plan of Inner Stonehenge.

At Stonehenge we have the stones and a few holes from which to obtain our information. We then compare the knowledge gained with other monuments such as the Great Pyramid…and the triangle indicated in this illustration…numerical associations and parallels abound across the nations and millennia and here we have a triangle that denotes the shape of the Great Pyramid fitting the circles of Stonehenge. This is purely due to the fact that 22/7 was applied at both sites.

Fig.7.9. Principle Stonehenge Circles



7.7 Alexander Thom and the Megalithic Yard

Born in Scotland in 1894, Alexander Thom later became a student at Glasgow University, returning there as a lecturer between 1922 and 1939. He later became a Professor of Engineering at Oxford University, a post he held from 1945 until his retirement in 1961. However, it is not for his technical knowledge of engineering that he is renowned, but his interest in:

….The solar observations of megalithic man…

as the title of his first publication was called, in 1951.

His article, published in the *Journal of the British Astronomical Association*, was the result of an interest that went back as early as 1934 in prehistoric stone circles and their astronomical associations. Thom also undertook the project of accurately surveying and carefully measuring megalithic sites throughout Britain, the initial results of which he

published in 1955 in the *Journal of the Royal Statistical Society*. After his retirement in 1961, he published two more articles in the same journal, in 1962 and 1964, which addressed *megalithic units of length*.

His discovery of what he called the *megalithic yard* [2.72 feet, or 0.83 metres], a unit of measurement he found employed consistently at many prehistoric megalithic sites, is a key feature of his book *Megalithic Sites in Britain,* published in 1967. Thom had surveyed some 300 megalithic circles, alignments, and isolated standing stones in order to produce a statistically-based common unit of measurement. Besides the megalithic yard, Thom also explained the true geometry of stone circles, and showed there were six types: true circles, ellipses, two sorts of egg-shaped circles, and two sorts of flattened circles.

Alexander Thom's second major claim was that large scale and systematic observations of the heavens, particularly of the movements of the Sun and the Moon, took place at stone circles and standing stones. This had the implication of an organised later British Neolithic society, with an associated, possibly organised, priesthood. Both ideas were radically new at the time in the world of British prehistoric archaeology and not surprisingly, Thom's ideas launched a massive debate about the technical abilities of Britons in the Late Neolithic, one amongst other issues, being whether or not there were roundhouses in the British Late Neolithic/Early Bronze Age, a debate that still continues.

How does Thom's work relate to what has been revealed so far in *Measurements of the Gods*? As stated, Alexander Thom developed the *megalithic yard* from the examination of numerous western European stone circles and stone rows. The statistically derived figure he published for this unit was in fact 2.72 feet +/- 0.002 of a foot [or 0.024 inches]. However, the circles examined by Thom were categorised into those which were within 12 inches of a round figure of *megalithic yards*, and those which were just outside this list.[18] To understand the differences between our approach and Thom's let us examine Stonehenge a little further.

According to Thom, the outer perimeter of the Sarsen circle was 48 Megalithic Rods [A unit that was comprised of $2^1/_2$ megalithic yards]. The internal circumference measured 45 of the same units. These Megalithic Rods were said by Thom to be 6.8 feet. The two measurements were therefore 326.4 and 306 feet respectively with a consequent mean value of 316.2 feet. [As we have seen, the target value for the builders for this centreline circumference was actually 316.8 feet, some 7.2 inches different to Thom's evaluation.] Unfortunately, Thom seems to have ignored the diameter measured by the renowned Petrie of 97.325 feet. Both of these people were capable of evaluating this figure within extremely close margins of each other. It is significant nonetheless, that Petrie did not have any specific unit of measure that he wished to prove existed, as he was merely recording the dimensions of the structure. Thom's calculation of a 306feet inner perimeter, based upon his own so-called megalithic measures, results in a diameter of the circle [using modern π] of 97.40282517feet, almost an inch away from Petrie's results. If it were not for the claims for great accuracy from Thom, this small deviance might have been ignored, but claims for great accuracy must be verified.

The outer circle circumference, according to Thom, gives a diameter of 103.8963469 feet. When Petrie's inner diameter is deducted from this value we are left with 6.57134685feet or [3.285673425feet x 2 for the two lintels]. Yet, according to Professor Atkinson, this value

should be about 3.5 feet, and Michell says it should theoretically be 3.475748571feet, a difference to Atkinson of 0.291017148 of an inch. Something is obviously radically astray in Thom's interpretation – he is almost 2.57 inches out in the width of a single block of stone.

The outer circumference utilising the modern π factor should be in the region of [97.325 + 7] x 3.141592654 or 327.7466536feet, some 1.34665358 feet different from Thom's 326.4feet. It is clear that Thom has attempted to persuade us that his megalithic yard is relevant in the field of ancient measurement standards, when in reality it appears here to be of little consequence.

In fact, to utilise the ancient dimensional units the internal diameter is asserted by Michell with whom we agree to be 97.32096feet or 100 *Long Roman* feet. And as we said earlier, by using Michell's *Sacred Jewish Rod,* for the lintel width, we find, as he claims, an outer diameter of 30 these rods, with the inner diameter being 28 of the same units. Utilising the 316.8-foot circumference through the centres of the lintels, we find the diameter figure, [using modern π or 3.142857142] within 0.486 of an inch of 100.8 feet or 100 of what Michell terms the *Short Greek* foot. However, when we utilise 22 / 7 for π, the value that was extensively used in the ancient world, for example in Egypt, these figures work exactly - 100.8 x 22/7 = 316.8, the Classical Greek scholar Pliny's measure of the Earth divided by 100.

7.7-1 The Real Megalithic Yard

Thom's *Megalithic Yard* may not be of much use in understanding ancient measurement, because he was not aware of the underlying system behind the value for which he searched. However, the fact that statistically there seemed to be a unit related to ancient measurement around 2.72feet, meant that it would probably be a fruitful exercise to look for a *close-fit* value. This would work in a similar way to that in which the intended scaled sizes of the maps in Chapter 5 were ascertained. It did not take long to find a value of the so-called Megalithic yard that has a relationship with the measurement system used in antiquity. The actual value of the Megalithic Yard is 2.7272727feet which relates with the system as exemplified by :

316.8 divided by 116.16 = 2.727272727

As we have seen, 3168 is a factor common to both the Great Pyramid and Stonehenge. 116.16 is a factor that features in the internal dimensions of the Great Pyramid, and elsewhere in Biblical stories. More simply, it relates to the 7920 mile diameter of the Earth [in feet] e.g. 7920 x 5280= 41817600 and 41817600 divided by 360 = 1161.6. Hence, we can see that in fact Thom was applying his slightly erroneous unit to the wrong circumference, he should have been looking at the centreline of the lintels where 316.8 / 2.727272727=116.16.

In fact, the 28 x Jewish rod internal diameter reveals an associated inner circumference of 88 Jewish rods when using 22/7.

7.8 Stonehenge: A Shortage of Sarsens?

7.8-1 Introduction

Here we have a more recent investigation. There are a number of stones missing from Stonehenge. Current feeling among archaeologists and geologists is that the monument was not completed simply because the builders had run out of material. This may have happened with the 'bluestones', we are not prepared to comment upon that scenario but the subject here is the odd stone classified as stone number 11 which is a rough sarsen, shorter than the remainder and therefore with no connecting lintel to its neighbours.

The idea that due to a shortage of material a shorter, inferior stone was utilised instead of a sarsen, seems more than a little strange. As is explained later in this section, if the builders were short of just one sarsen upright, then its position would not have been that of stone number 11, the oddball stone of the circle. If material shortage were the case, why should a different and inferior stone that was too short to support the lintels of the design be utilised at this specific position?

Curiosity getting the better of Harry Sivertsen, the principal author and researcher of these works he began an investigation into the circumstances surrounding this particular the odd stone. After a few days of deep thought and a little investigation on astronomy programs the answer appeared quite plain. A site visit with Gillian for photos early in 2009 and all became even clearer. This section is the result of the investigation. The evidence presented implies that this stone was not a substitute for a larger, shaped sarsen, which could not be erected as no remaining stone was sufficiently large, but was an inferior stone deliberately placed in this specific location for a very specific reason.

The shortage of material theory that is generally deemed correct has arisen due to the fact that there are a number of 'bluestones' missing from the site and five of the upright sarsen stones of the circle are also not to be found, hence it is generally assumed that this stone is a substitute for a larger sarsen stone. So initially, we shall examine the site for reasoning that casts doubt upon this assumption.

Firstly, the bluestones were erected after the sarsen circle and horseshoe, between 200-300 years afterwards. Many now think that it is probable, although not proven, that the bluestones were actually placed in the holes of the Aubrey Circle before the erection of the sarsens. That something was in the holes, whether stone or timber is almost certain and hence there is no argument with the theory. The only proviso here is that at least one would have had to be removed to allow the transport of the large sarsens into the inner area of the site. Of course, this could have been replaced later.

The sequence of events of erection of the Sarsen Circle and the inner Sarsen Horseshoe are obviously that the horseshoe was set out and erected before the circle. This has to be the case as the huge stones of the horseshoe construction could not be moved to their locations and erected if the circle was already in place. So the horseshoe, at the time of erection of the circle was pre-existing. It faces [its 'mouth'] to the direction of the midsummer sunrise. However, given the accuracy of the circle there can be no doubt that the circle was set out, possibly only as an inscribed circle on the ground, prior to the erection of the horseshoe. It

had to have been inscribed via the centre point and a radius, whether a length of rope or timber was utilised to mark that radius. This could not have been achieved with the horseshoe already in place; the stones of the horseshoe would have been in the way of the setting out of the circle.

7.8-2 Investigation

The numerical system ascribed to the 30 stone positions of the Sarsen Circle in the early 20th century starts with no.1 at the south side of the summer solstice alignment; [see Fig 2] hence stone no.11 is immediately to the east of due south. The circle has been said to be incomplete due primarily to the oddity of stone no. 11. So if the builders had run out of suitable stones why was it at this specific point?

All structures have a logical place at which to commence works, a setting out point. Here, this would have been one the stones adjacent to the summer solstice alignment or to that of the winter solstice. These were the critical directions that had to be correct. Logic dictates that the builders would have moved sequentially from this position a stone at a time until the circle was complete. Hence, if they were short of just one stone, the position of that stone would be once more adjacent to either the summer or the winter solstice positions.

Again, if the five missing stones are omitted due to a shortage of material, the logical places for these to have been left out would be the five places prior to the last stone of the overall sequence, or perhaps alternatively between other stones. However, that is not what is to be seen.

The missing stones are numbers 13, [15 according to some researchers but a small fallen element is numbered this by others] 17, 18, 20 and 24 [see Fig.2] hence there is no logical pattern here whatever. Certainly, the builders would not have simply left out stones at completely random locations, as in fact would be the case if the missing elements were non existent due to a lack of material. Any suggestion that all these stones are missing due to shortage of material implies that the gaps were left in a haphazard manner which in itself implies that those erected were additionally placed in a similar unregulated fashion: this is not the case as the refinements of the sarsen lintels clearly indicate; these builders were skilled and numerate artisans. Hence it is relatively safe to make the assumption that the circle, with the exception of stone no. 11 was originally complete and that stones fallen have been removed for building elsewhere since the site went out of use. While the Romans were reticent to destroy or damage any sacred religious site, they may well have taken stones that were already fallen for their building purposes with others being removed since their time of occupation as at Avebury where in the 17th century John Aubrey observed the breaking up of a large stone via the use of fire and water. Stukeley also recorded such events in the following century. The earliest records and descriptions of the Stonehenge site have no indication of a full set of stones at the Sarsen Circle. Hence, given that at least one of the stones has fallen in more recent times, a trilithon in 1779, shortly after John Wood drew the first accurate plan of Stonehenge in 1740, we can accept that the site has been in a state of disrepair for an indefinable period but that no stones have been removed since at least the early 17th century. Wood's drawing distinguished between stones that were erect, leaning, flat, buried, and lying on the surface of other stones. It was Flinders Petrie in 1877 who confirmed that no stone had left the site since Woods survey

of 1740. So there is no doubt that with the exception of one trilithon, and more modern works, the site was the same over 350 years ago as it is today.

There are a number of fallen stones which are listed as nos. 8,9,12,14,[15 although some classify this as missing],19,and 26. [see Fig. 2] Whether any of these fallen stones still have the remnants of the tenons that are seen at the tops of the extant standing stones is unknown by the author of this work but again, given the disparate positions of the missing stones, it appears safe to work on the assumption that these fallen sarsens indeed were of the same pattern as those still standing.

Hence given the available information it appears that stone no.11 is the only odd one in the circumference of the circle. So this being the case, *why should this very specific location be chosen for the oddity?* If there was a shortage of stone, feasibly this space could have been left as the implications are for a complete circle and indeed the tenons are visible at the top of its neighbour, stone no.10 and these certainly do imply that it was intended to complete the circle to it full height all round. If the space were to be left with no stone then surely the tenons would have been cut from the top of the uprights adjacent, clearly showing that that was the limitations of the circular structure. However, the extant tenons may also be left as a confirmatory sign the indeed the circle was *symbolically* complete and that this odd stone was intentional, that *this specific location was deliberately chosen for a specific purpose.*

The location is to the south. There is no stone at the most southerly point; south is flanked by stones 11 and 12. As is pointed out in the essay relating to Silbury Hill and is further seen in the examination of the flood epic, north played a great part in associations with the ancestors, the dead who resided with the gods. Hence, if this circle were in fact associated with the ancestors as is now thought, an entrance would probably be from the south. But there is much more to understand than merely speculation regarding a 'south gate' to the circular monument.

That this specific stone location was chosen in conjunction with associations of the ancestors is confirmed via the evidence that follows.

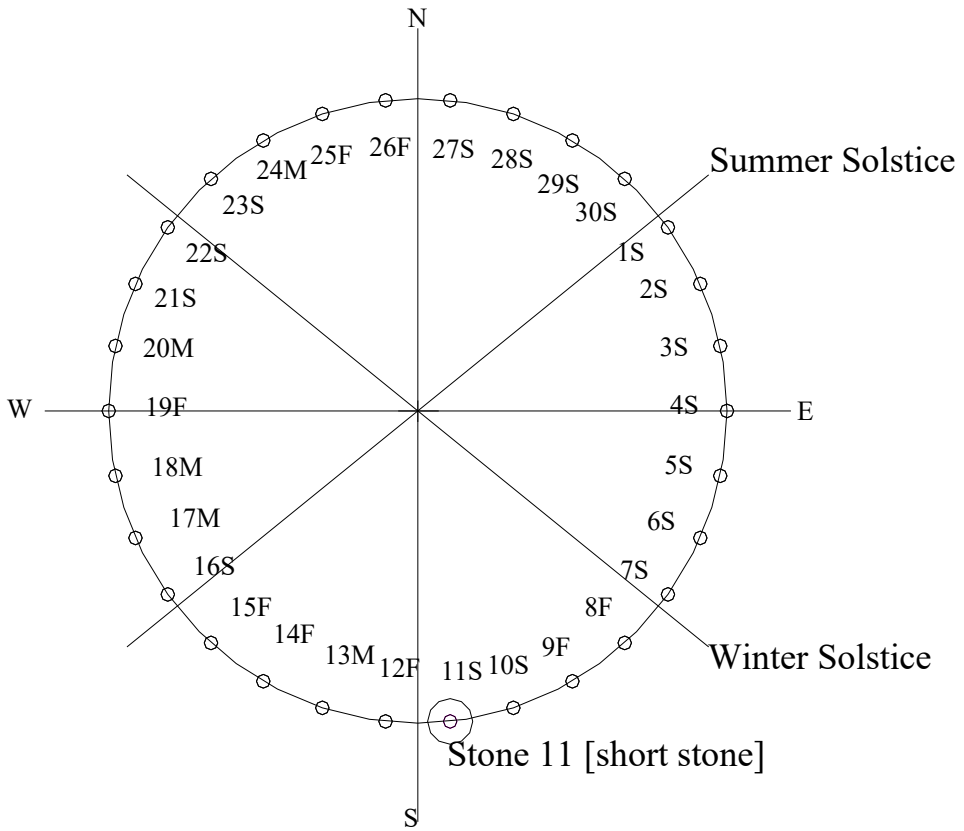
7.8-3 Explanations

So what may have been the reason for such an oddity? Stonehenge, as a monument is basically a calendar with very strong lunar associations. This is seen in the count of days in the Sarsen Circle perimeter where lintels [or stones] count to 30 in the complete circle. It is seen in the diameter where the lintel width is counted 30 times overall, 29 to the centres of lintels and 28 across the inner diameter, all denoting the various monthly configurations. Even more such lunar associations can be found when the dimensions of the site as a whole are taken into consideration. So it would appear that here we may have a stone indicating a specific day; in fact this is the case.

Stonehenge is unique. While some of the large early burial chambers of Britain display the use of quite intricate corbelling, no-where in early Britain does the stone mason's craft show as at Stonehenge. Here we have intricate mortise and tenon joints cut in stone, the tenon at the top of the upright stones of the Sarsen Circle and the mortises in the lintels, we have tongue and groove sections at the ends of the lintels. The lintels were carefully curved on their

outer faces around the perimeter of the circle while the inner surfaces of the massive sarsen stone supports were faced to indicate the equally important value of the inner side of the circle. From the available evidence, it would appear that the skill employed here was not from home grown sources but was probably that of people from a different region, from somewhere where meticulous stonework was more commonly deployed.

However, things are often not what they seem and some highly accurate stonework is seen in other locations around the world surrounded in the same geographical region with work of lesser quality, just as we see with Stonehenge here in Britain. Again, to emphasise the ability to work with stone to a fine degree, at an ancient site at Skara Brae in the Orkney Islands a variety of multifaceted stone balls dating to approximately the same period as Stonehenge have been discovered. Similar finds come from the east coast of Scotland and from Ireland. Hand axes and other tools had been made from stone for millennia hence the necessary skills were available, it is the design that is different and that design makes this site stand out above other stone circles, design and quality. The concept of this circle is unique. According to Aubrey Burl in *The Stone Circles of Britain, Ireland and Brittany* we see a British type circle, albeit with lintels, surrounding a horseshoe that is typical of Brittany. Local tradition is seemingly conjoined with concepts borrowed from a neighbouring culture, as genetics indicates was the case with 'beaker culture'. Regarding the latter, there was no influx of people bringing their particular beakers into Britain but merely the copying of a cultural style.



Recognised stone numbers
S= Standing
F = fallen
M = missing

Fig. 7.7 standing, fallen and missing stones-diagrammatic view

Fig. 7.8 Stone 11 leaning outwards behind the full size stone 10

There have been continual influxes of immigrants from the Ice Age retreat regions since the last big freeze and as there were family, cultural and trade relationships, [for example stone axes from the Italian Alps] some have invariably travelled back to their roots. But more than people, there has been an interchange of culture and ideas between the Ice Age retreat regions, Britain and all stops between. These retreat areas had their own connections with surrounding districts, regions that had commonalities with the cultures of India, for example Persia and Turkey. Hence, the concept of Stonehenge and the horseshoes of Brittany may have arisen from a number of combinations of ideas from a wide variety of locations.

The cultures with whom these climatic escapees came into contact not only had some very highly skilled artisans in stone, who were familiar with the measures seen in this book, units utilised for example in Mesopotamia and Egypt at around the time of the erection of the stones of Stonehenge, but also utilised a lunar calendar that had its commencement with the *first new Moon after the winter solstice*. This was a commonality among many cultures and applies to early [pre 1000BC] eras in the Bible, India and elsewhere. Hence, it would be natural for the north western Europeans sitting out the freezing centuries to adapt and take on board this type of calendar. It would appear that for the commencement of the month the later Celtic peoples counted from the first quarter Moon.

In India a 366 day year was in use in conjunction with the 354 days of the lunar year to give a mean value of 360 days for the year. These calculations were utilised in a five year period known as a yuga. 5 x 366 = 1830 as also does 62 synodic months. 62 months is two months over five years and hence we see here an intercalary two months every five years to keep the lunar and solar calendars in line. The same process applies to the Coligny Calendar which was in use in Gaul during Roman times. We also see here the division of the month into 'light' and 'dark' fortnights, precisely as in India. [For more detail of the Indian calendar see *Deluge* and the Yugas]. Some elements of this construct were almost certainly applied to Stonehenge.

Regarding the commencement of the year at the first new Moon after the winter solstice, we see evidence that indeed this was the case at Stonehenge, and with stone no. 11 we have strong evidence for its use at the site. This stone, counting a stone for a day in the direction of the daily north moving Sun, is to be found at a position which is 26 days after the two stones flanking the winter solstice [stone no.6 = day 1]. This defines a set of dates which relate directly to the Metonic cycle, the recurrence of Sun and Moon in the same relative positions every 19 years as the same position is no 19 when counting from immediately after the summer solstice position [stone no. 29 = year 1].

On the following pages are a further diagrammatic illustration and tables that replicate what was to be seen at the Sarsen Circle during an extended period.

The Metonic Cycle of 19 years was first written of by the Greek astronomer Meton of Athens in 432 BC but logically was observed and understood, except for its variation seen below, far earlier. This cycle determines when the Sun and Moon return to the same respective positions in the sky but is a little of an approximation as it actually gains a day over a period of 219-220 years, a cumulative effect which is noticeable. Allowing for slight variations associated with the lunar cycles where the Moonrise is after midnight and hence denoted in the tables as the following day, we have a list of dates that show what was denoted by the Sarsen Circle at Stonehenge. The cumulative error is seen in the table below, but would almost certainly not have been understood during the era in question, although when it was apparent that there was a day difference, questions would have been raised and indeed, this stimulated an alteration to the circle and the erection of the bluestones inside the sarsen circle. The operative period for the 19 year cycle calendar was between 2569 and 2303BC. Prior to this, the count of days to stone 11 after the solstice was a day shorter and afterwards a day longer. Allowing for a period of observation prior to building, this complies with an erection dates of circa 2400-2500BC for the sarsen circle and at circa 2300BC [average of carbon dates published] when the

bluestones were erected inside the circle. Here we see a change in thinking regarding the circle…complying with a loss of the 26 day count which had now extended itself to 27 days. Allowing three cycles of observation or 57 years we would have a commencement date of the build at 2512 BC hence it would be safe to allow the first cycle in use being that of 2493BC. The 19 year period would then be in use until 2303 which is 10 cycles. We now see an overall a) observe, b) build and c) use period of circa 266 years or 14 cycles of 19 years. This later date, after which the accurate count of days did not apply, approximates the erection of the inner bluestones.

The dating from astronomy agrees here with archaeological findings and perhaps, as these dates are more positive than carbon dating, the method utilised here can be seen to refine and confirm the previously accepted dating. The first new Moons after the winter solstice between 2569 and 2303BC are seen in the table below. The end of the last 19 year cycle is actually in 2284 but at that time the count had increased to 27.46 days and hence was not applicable, the connection with stone 11 had ceased to work.

Calendars around the world have started at different times. Our modern Gregorian calendar starts at midnight, in common with the Chinese. The Hebrew and Islamic calendars start at sunset while the Indian is sunrise to sunrise. Currently there are around 40 different calendars in use around the world. We know that in ancient times, the year frequently [but not exclusively] commenced with the first new Moon after the winter solstice and the evidence here confirms that this was the case for the people of Stonehenge but when did their day commence? Given the importance of the Sun at solstices at Stonehenge, it is accepted that sunrise was the dominant factor and that it was the start of the day. Hence, we base our count on the sunrise of the winter solstice.

Sunshine period [sunrise to sunset] at the time of the first new Moon of the year during the period in question was around 8.3 hours per day. Within a couple of minutes variation, this is consistent. Hence, we count from the winter solstice sunrise to the appearance of the new Moon.

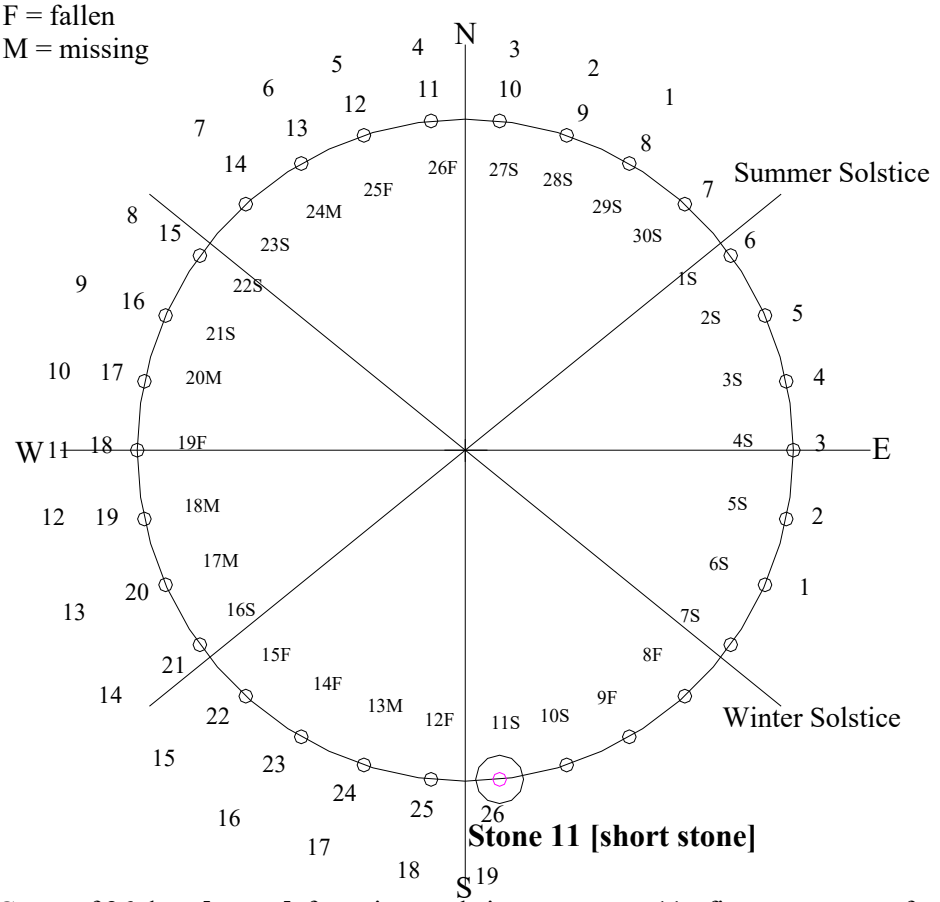
At the first new Moon after the winter solstice on the earliest of the dates indicated, 2569 BC, the Moon was rising at 08.27 am almost in conjunction with the Sun which rose 3 minutes earlier, merely three degrees away, close to its minor standstill position and within ten minutes of arc, which is 1/3 of the apparent visible diameter of Sun or Moon, of the Sun's altitude. Hence, the Moon would not be visible. However, Moonrise is necessarily not the emergence of a new Moon, as the movements of the Moon and Sun have to begin to remove the earths shadow from the Moon to show the first glimmerings of the sunlight reflected from the lunar surface. In fact, on this occasion the new Moon was on February 5th at 03.56 am which was in the dark hours before the sunrise of the 26th day [25.8 days] but would have been accepted as the day of the new Moon, the new Moon was visible on the 26th day. Conversely, in 2303BC Moonrise was at 07.29am with the new Moon not showing until 23.56 pm.

The dates of the new Moons are given in cycles of 95 years, 5 cycles of 19 years and the next date of 2474 gives a new Moon at 02.56 hours of the same day [25.76 days] hence again we have the 26th day implicated.

The year 2379BC, 95 years later, saw the new Moon a day later, but within the limits of the 26th day as this was 20.43 pm [26.5 days] and the 2303BC event was at four minutes to

midnight of the 26th day at 26.64 days from the winter solstice sunrise. It was clear that the cycle was changing and 19 years later at 2284BC, it was lost as now the new Moon was 27.46 days after the winter solstice sunrise.

Outer numbers = count of days after winter solstice
Inner numbers = recognised stone numbers
S= Standing
F = fallen
M = missing



Count of 26 days [stones]after winter solstice = stone no.11= first new moon of year.
Count of 19 years [stones] after summer solstice = stone no.11=19 year cycle
This applies every 19 years from 2569 BC until 2303 BC
which approximates the erection of the Bluestones within the circle.

Fig. 7.9

In fig. 7.9 we see the count of time in relation to the solstice positions. Here we can count 19 stones after the summer solstice, e.g. from stone no 29 through to stone 11 giving the count of years, and 26 stones after the winter solstice, giving a count of days. Both counts meet at stone no.11.

Note:The calendar dates given in the following tables are derived from Chris Marriot's *Skymap* astronomy program and here for clarity we give conventional dates against astronomical Julian dates which many would not understand.

The year 2379BC, 95 years later, saw the new Moon a day later, but within the limits of the 26th day as this was 20.43 pm [26.5 days] and the 2303BC event was at four minutes to midnight of the 26th day at 26.64 days from the winter solstice sunrise. It was clear that the cycle was changing and 19 years later at 2284BC, it was lost as now the new Moon was 27.46 days after the winter solstice sunrise.

Table 1

BC Date	Sunrise winter solstice	New Moon	Difference.	Time
2569	10 Jan	Feb 5	25.8 days	03:56
2550		Feb 5		
2531		Feb 4		
2512		Feb 4		
2493		Feb 4		
2474	9Jan	Feb 4	25.76 days	02:56
2455		Feb 4		
2436		Feb 4		
2417		Feb 4		
2398		Feb 4		
2379	8 Jan	Feb 3	26.5 days	20:43
2360		Feb 3		
2341		Feb 3		
2322		Feb 3		
2303	8 Jan	Feb 3	26.64 days	23:56
2284	7 Jan	Feb 3	27.46 days	19:47

The bluestones were probably being organised, if not in place by now.

In eastern cultures, the dark fortnight of the month, was that from full moon to no moon and not as one may expect, the actual dark fortnight with no moon at its centre. Recent discoveries have revealed that large celebrations took place at the locality of Stonehenge in the winter on a regular basis during the period in question. Here we supply a periodicity that has been missing from the analysis to date. As the site seems to be dedicated to the ancestors, or at least the deceased, it may well be that this occurred immediately prior to the first new moon after the winter solstice with celebrations then for the living following in the new month. However, as the year commenced with the new moon we shall assume that it was this that was celebrated at Durrington Walls in conjunction with the 19 year cycle and the end of the 'dark fortnight' of the ancestors. All denoted by stone number 11. These celebrations in association with the dead and the commencement of the year are not in the least surprising. The calendar counts give a date and in Asia are to be found stone circles at most collections of burial

mounds, dolmens and similar structures. Sometimes this extends to singular or to pairs of standing stones. This has been known for a number of years and there is no reason to assume that the Western European cultures were greatly different in this respect. For example, at the Rollright Stones, not far from Stonehenge, we have a close formation stone circle and burials with astronomical associations between the two. There is also a standing stone in evidence. Hence, there appears to be a cultural commonality not only in the erection of standing stones, circles and dolmens along with other burial mounds, but also in their affinity one to another.

At Stonehenge have a period from 2569-2303 when the count after the winter solstice to the first new Moon of the year was accepted as 26 days, a period of 266 years or 14 cycles of 19 years. Before and after these dates the cycle did not work to the 26 day count. The circle was raised very shortly after this 26 day count cycle was calculated and was altered via the erection of the bluestones at the end of the operative period of the cycle.

Between the 19 year periods, the Moon appears at diverse dates as is seen in the table below.

Table 2 reconstructs the dates of new Moons and the relevant involved stone following the count of days during the 19 year period [Metonic Cycle] between the years 2436 -2417. The count of days to the first new Moon following the solstice is included. Here we observe a great variation and while of course any of these dates are repeatable in a similar fashion as those above*, only the beginning and end of the cycle denote the relevant stone, stone 11.*

Table 2 First new Moon after the winter solstice between 2436 – 2417BC

Date	New Moon	Difference to winter solstice [days]	Stone no.
2436	4 Feb	25.73 [Night preceding 26th dawn]	11
2435	24 Jan	15	22
2434	13Jan	4	5
2433	1 Feb	23	14
2432	20 Jan	11	26
2431	9 Jan	0	7
2430	28 Jan	19	18
2429	18 Jan	9	28
2328	5 Feb	27	10
2427	26 Jan	17	20
2426	15 Jan	6	1
2425	3 Feb	26 [not consistent see note below]	12
2424	22 Jan	13	23
2423	11 Jan	2	6
2422	30 Jan	21	16
2421	19 Jan	10	27
2420	6 Feb	28	9
2419	27 Jan	18	19

2418	17 Jan	8	29
2417	4 Feb	26.6 [Night of 26th day]	11

It is apparent that stone no.11 consistently relates with the count of 26 days after the winter solstice day during the period when the structure between the erection of the sarsen stones and that of the bluestones. While the 26 days applies at an intermediate date in the table to stone number 12, a single cycle later, this had altered to 24.4 days and hence the occurrence on 26th day here is coincidental. Effectively no other stone in the circle, extant or otherwise has the 26 day relationship to the winter solstice and indeed this is the one oddity that to date has defied explanation other than a shortage of stones. Likewise, it is only this stone that complies with a count of 19, the years of the Metonic cycle. [Unless we count from the winter solstice for this and utilise the missing stone number 18 which position has no other relationship to calendar counts.]

In the above analysis it is clearly seen that indeed, the shortage of stones explanation is not viable and that the stone in question, number 11, was set for a specific calendrical purpose, perhaps with affiliations to the ancestors and the bodily state between life and eventual conjoining with those ancestors.

7.8-4 Conclusion

As the evidence here makes quite clear, it is now apparent that this stone denoted the first new Moon after the winter solstice every 19 years complying with the Metonic Cycle with the sequence commencing in the year 2569BC and ending in 2303BC. According to Darvill and Wainwright in a 2008 investigative dig, the bluestones were erected within the circle at "between 2400BC and 2200BC" or circa 2300…within 3 years of the astronomical date seen in this chapter. What form did the bluestone setting out take? According to Aubrey Burl, it comprised a circle of 'about' 57 stones and a horseshoe of 19 stones. [p.366 *The Stone Circles of Britain, Ireland and Brittany*]. It does seem rather coincidental that these stones were erected immediately after the count involving stone 11 ceased to function and that here we see, assuming Burl has the correct number of stones, a count of 19 [years of metonic cycle] and three times 19 or 57. Almost certainly, the fact that the count of days associated with the Metonic cycle and stone no 11 had ceased to function was the instigator for change to Stonehenge as opposed to the inclusion of an additional feature. It additionally appears highly probable that the Metonic cycle was to be numerically represented by the blue stones, now erected within the sarsen circle.

The dating here, being of an astronomical nature, is to the day and not merely between 200 years as with a succession of carbon dates and this astronomical dating clearly complies with and clarifies that given by other methodologies. This also gives a 19 year periodicity for the winter celebrations that evidence from the Stonehenge Riverside Project has revealed occurred in the region.

It is therefore confirmed that the Sarsen Circle was originally completed but that the odd stone 11 was deliberately placed to mark this important calendar count and the circle's association with the ancestors. It now appears that the tenons on the adjacent sarsen stones

were left to imply a complete circle and that stone 11 was deliberately left in a rough state indicating the body after death, perfection being achieved when one has left the mortal state, the body had been dealt with and the individual become a spirit, one of the ancestors. The remainder of the circle would then be the domain of the deceased, perfection in spirit as there was perfection among the stones.

It would appear that insufficient importance has been attached to the count of stones in the various stone circles discovered in Europe. While many circles remain to be fully explored and the stones of others appear to be of various sizes and shapes, defying any logical pattern, many others are well known and the count of stones around their perimeters is recorded. As an example, a list of such detail relating to the South Western England is included. These are selective for obvious reasons and are but a small collective of appropriate circles; other counts may denote the number of days of visibility [or invisibility] of, for example, a specific star.

Dartmoor: - At Buttern Stone Circle and at Fenworthy North Stone Circle there are counts of 30 stones in the perimeters…as at Stonehenge. Grey Weathers North has 29 stones in its perimeter; clearly here, there is lunar connotation in these counts of stones.

Bodmin Moor: - Craddock Moor has 27 stones while Goodaver, Hurlers NNE, Hurlers Centre, Leaze SE and Stipple Stones all have 28 stones in their circumferences, again with lunar implications.

Lands End: - both Boscawen-Un and Merry Maidens have 19 stones, perhaps replicating the Metonic Cycle.[32]

At these circles we have calendrical counts similar to those discovered at Stonehenge.

7.9 The Designers of Stonehenge

Unlike Old Kingdom Egypt, we know little of the rulers, designers or builders of Stonehenge. Situated in historical Wessex, the monument is centred in a rich heritage of contemporary archaeological sites, such as *Avebury* and *Silbury Hill*, as well as Early and Late Neolithic/Early Bronze Age counterparts.

Dr Julian Thomas in *Understanding the Neolithic* perhaps takes us furthest in piecing together the cultural changes that took place through the British Neolithic period [4000BC to some point between 2400 and 2200BC]. His conclusion on the nature of Neolithic world-view is that in the Early Neolithic there was a strong sense of tribal unity and a continuum between life and death, as seen perhaps in the burial practices in the Chamber Tombs of the period, such as *West Kennet* in Wiltshire. Thomas claims that by the Late Neolithic this view had changed, and there was a more distinct sense of self, with a clear distinction between life, death and ancestors [a trend also seen in Pre-Dynastic Egypt].[33] What lay behind the changes of the British Neolithic Thomas does not investigate, only noting Shamanic influences twice.

However, in passing, we can possibly say that by the late Neolithic, the close tribal/Shamanic link was being loosened – their links to the ancestral world being more of an adjunct than a central plank to societies being run in a more organised way. Their knowledge, probably in countries like Egypt earlier than in Britain, was then subsumed into a more priest - orientated subculture of the state – or more likely chiefdom, one that existed in a more warlike

world. What we *can* say however, is that an often repeated assertion, that the building of large monumental structures is a process of state formation, *does not* apply here in Wessex, as here, as elsewhere in Britain, although evidence of settlement in the vicinity of Stonehenge is growing, we do not see generalised evidence of colony for some 1000 years. This is an important site to people over a wide area but while large gatherings took place at the nearby Durrington Walls area this was not a permanent, all year round large settlement and may well have been preserved for ceremonial gatherings. It now appears certain that Stonehenge was primarily a calendar and sighting device that was also a repository of fine measure in addition to being associated with death. Stonehenge indeed appears to be a complex monument with more than a singular application. We may add that the lintels of Stonehenge may well have been utilised for the practise of excarnation where a body was left for the birds to pick at and the flesh, what the scavengers left of it, to decompose before the bones were buried elsewhere.

7.10 Silbury Hill: A Fast Track to Heaven?

Introduction

We have mentioned the practise of excarnation and the movements of people into Britain after the last Ice Age and during the periods since up to circa 2000BC.
Among the ancient peoples the practise of excarnation was widespread. A number of methods for de-fleshing before burial have been utilised over the ages but common to a number of cultures, including Persia, Iran and Turkey and other Mediterranean regions was the practise of leaving bodies on platforms for scavenging birds to peck at; vultures could clean a skeleton of flesh in a few hours. [See Herodotus *Histories*][34]

The people who came to Britain would have been well aware of this practise and indeed, in Anglesey, North Wales, one tomb, when opened, contained the bones of more bodies than it would been possible to push into the chamber. It is a distinct possibility that these were from bodies that had been deliberately de-fleshed in this fashion and as there were little traces of cuts to the bones as would occur in battle, or accidentally when cleaning flesh from them if it was conducted by tools; the idea of the bodies being picked clean by scavengers such as crows hence appears a strong possibility.

It therefore appears likely that this methodology was practised in Britain from circa 3000BC onwards, perhaps very much earlier. Some sites near Stonehenge suggest that timber posts supported platforms designed for this purpose. Here we supply some evidence to the effect of Silbury Hill having a similar function…with a difference.

7.10-1 Silbury Hill

Why was Silbury Hill built? It was under construction according to the latest carbon dating at some time between 2445 and 2190 BC, giving a mean date of 2317.5BC and a build time of circa 140-150 years. Hence here a date of 2300BC has been taken as datum. Stabilising work and more recent [2007/2008] investigation has revealed a number of Sarsen

stones in its structure, both at the base and indeed at its top with a large amount of gravel utilised in its base.

Numerous suggestions regarding the purpose of Silbury Hill have been forthcoming over the years, none of which appears to have any real foundation. These vary between a gnomon for solar time telling, for which a very large post was to have been placed upright at the top, an exercise that did not require the building of the hill but could have been conducted in any open region, to a viewing platform for various reasons, none of which has any real astronomical association but would have been connected to the local landscape.

One such notion is that it gave a view of a 'double landscape' in that the adjacent Waden Hill outline replicates the more distant horizon and this is seen quite dramatically at Beltane sunrise. However, it is unlikely that a society would go to such extreme lengths simply to view what is a not very unusual phenomenon. Gillian and Harry Sivertsen have observed and commented on such oddities at numerous locations in Britain and while not exactly commonplace neither is such a view very rare. It has even been suggested that the hill was truncated since its erection, yet another nonsensical idea, to where was the displaced material moved…and by whom?

Here we note that the Northern skies have long been studied [note the explanations in the companion book to this work, *Deluge: from Genesis to Atlantis*]and in fact a number of cultures are said to have placed their source, their ultimate 'Garden of Eden' beneath the northern skies in the Artic regions of Earth. A good source for such ideas is the 1885 book by F. William Warren titled *Paradise Found*. [35] According to this work such cultures as the Japanese, Indian, Egyptian, Persian and Greek along with the Akkadian, Syrian and Babylonian all shared this concept. A further 1903 work, *The Arctic Home of The Vedas* by Lokamanya Bâl Gangâdhar Tilak[36] is also most enlightening in this direction. Ultimately, of course, it is the northern skies that were important and not the Earth beneath and this has been misconstrued. Before the discovery of the 'pole of the ecliptic', sometime shortly before Eratosthenes or perhaps by him as he included this in his sky charts, the north polar star was seen as the centre of the universe. This is recorded very clearly in early Indian texts. It will be shown in this chapter that there is a possibility that the concept of 'heaven' being in the north may have been utilised in conjunction with the practise of excarnation in Southern England.

7.10-2 A New Explanation

It appears that no-one has previously associated Silbury Hill with the northern skies. When this is accomplished a different picture of the hill emerges, one that is most intriguing. The illustrations below indicate what would have been seen, specifically clearly at midsummer when the hill was completed. This unusual picture cannot be seen today due to precession altering the position of the skies and the lead player here, the Great Bear or Big Dipper, is now seen at a much lower elevation and therefore the feature does not apply in modern times. However, even allowing for precessional drift, it would have been apparent for hundreds years, at least in an approximate manner but close enough to have been an effective visual picture.

But why, apart from the ability to stand safely, should a hill be built with a truncated top? More to the point, *a hill that appears to have had its top cut off by the actions of a*

heavenly constellation, as is clear in the illustrations. Yes, this is a dramatic picture but although it is easy to understand that this may have been a reason for the structure to be constructed, is it a sufficiently strong idea? Could the notion of Ursa Major swooping down and skimming a hill top be sufficient reason for such a great effort? It is highly probable that a similar view would have been noticed elsewhere, probably along the Wylye Valley, just over 19 miles from Silbury Hill to the south west where the southern slopes of some of the hills would possibly allow such a vision. Note should also be taken that viewed from the base of the hill at the south, the Tor at Glastonbury would also have produced a vision that was virtually identical to that described here at the same time. Perhaps this is yet another reason for the importance of Glastonbury within the landscape? Possibly other, smaller man-made mounds have similar characteristics.

The drawings below indicate a sequence of events where the Great Bear or Big Dipper, a most appropriate name given what was to be observed when gazing up the deliberately created 30˚ south slope of Silbury Hill, 'swoops down', picking up whatever may be on top of the construction. The action skims the whole hill top as the drawings indicate. Any other angle of slope would render this vision inoperable.

The concept of an afterlife appears to be ancient, why else have grave goods? If, as suggested here, excarnation were practised at this location, it would be excarnation with a difference; the souls of the departed would be picked up by the 'Big Dipper' and transported to the northern heavens. 'Towers of Silence' were constructed in the region of Iran and Persia, stone towers built specifically for excarnation, almost certainly the practise was utilised in Britain and here we have a man made hill with no apparent purpose, a hill that was built in such a fashion the Great Bear or Big Dipper would be seen to skim its top. What could a constellation pick up? It has to be something of an abstract nature.

Given the importance of the northern skies this does seem to be more than coincidental, a monument that took many hours and great effort to construct with no apparent purpose but which has a very specific alignment. If the hill was taken up to its natural apex this 'swooping down and skimming the top' action by the Big Dipper would not be observed and hence given that the vision was precise when this hill was built, it would seem that here may well be the answer for its construction; a 'Tower of Silence' with its own 'Fast Track to Heaven' courtesy of the Great Bear.

Regarding the 'heavenly' prospect, the deceased in Egypt were transported to the boat of the Sun god in the heavens and while we have no indicative record, perhaps a similar scenario existed in Britain.

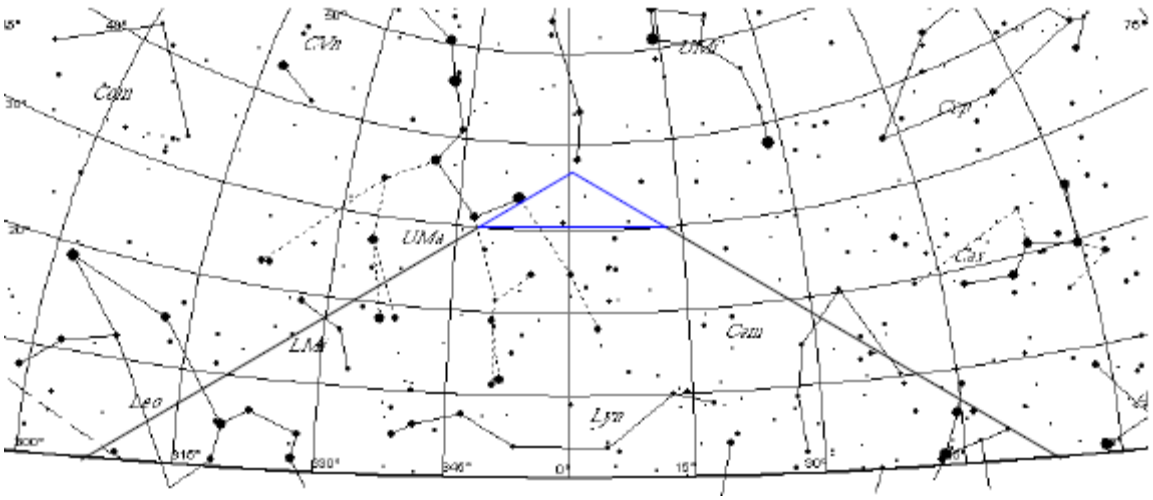


Fig.7.10 Silbury Hill and Ursa Major [Big Dipper] at 20.47 PM midsummer 2300BC.
[Sun has set and is just over 3˚ below the horizon]

Note in these illustrations how the 'cup' of the Big Dipper appears to fit the top of the hill. The truncated section of hilltop is seen in blue showing that only with the hill being truncated does this vision work.

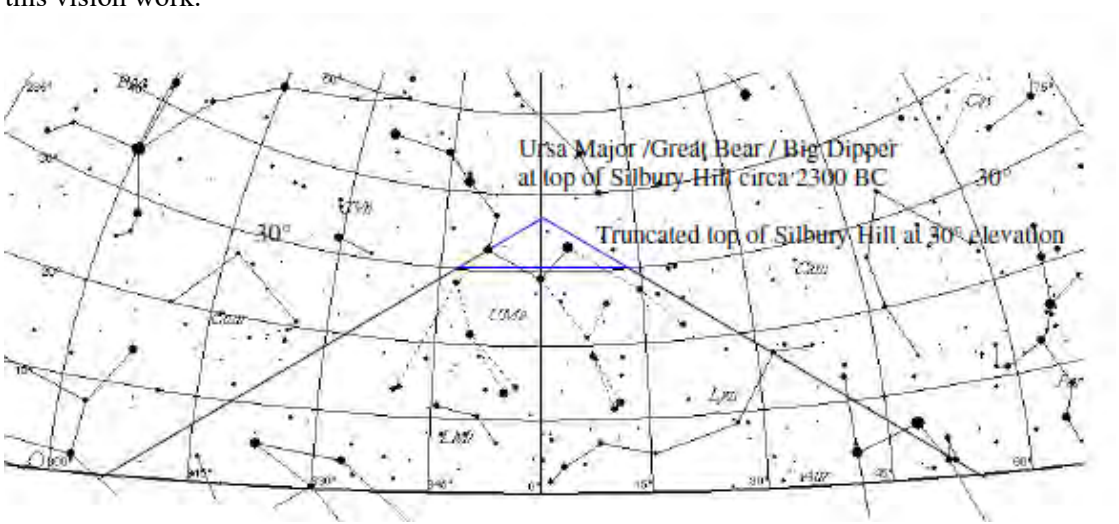


Fig. 7.11 Ursa Major [Big Dipper] and Silbury Hill 22.47 PM Midsummer 2300 BC

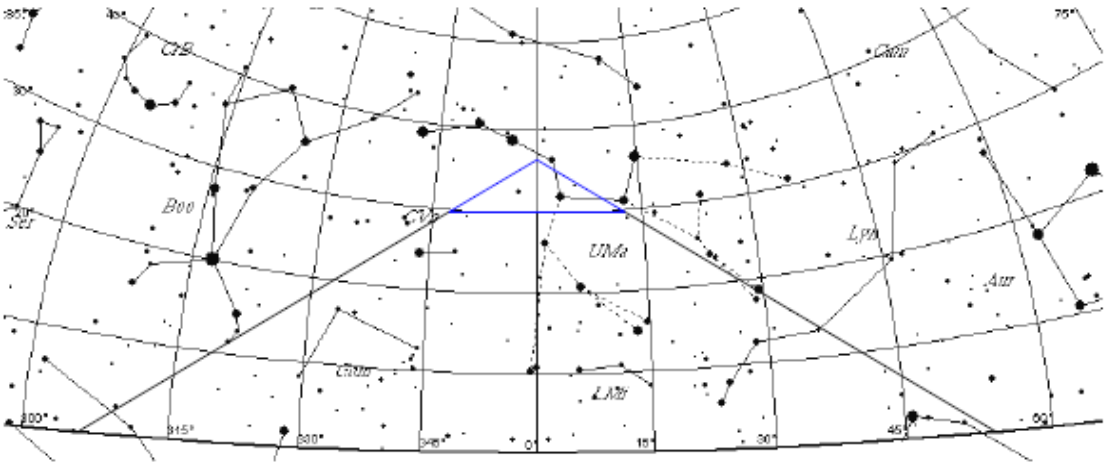


Fig. 7.12 Ursa Major [Big Dipper] and Silbury Hill 0.47 AM Midsummer 2300 BC

Conclusion

It is suggested here that the spirits of the dead, for those residing in the Silbury region, possibly only the important chieftains, we cannot comment any further without evidence, were transported to heaven within the 'cup' of the Big Dipper from the top of Silbury Hill. As there is a path winding its way around the edifice from bottom to top, it seems possible that bodies were carried up the hill and placed here awaiting their 'lift' to the heavenly realm and greater things. It is also possible that that Silbury was constructed as a 'Pillar of Silence' as in the early Zoroastrian religion where bodies were laid out in the open for scavengers to pick off the flesh. As some of the tombs of the region have been found to contain bones of incomplete skeletons, this remains a possibility. It has been suggested by some archaeologists that such a process took place at nearby Overton. The skeleton remains would have been buried elsewhere after the event. However, given that numerous cultures in the Northern Hemisphere see the Northern skies as a place of importance, even the source of their race or possibly mankind, it seems that the Northern skies have a 'sacred' element that does not apply at that period to any other portion of the sky. Indeed, as is clearly demonstrated in the book *Deluge*, the North was the place of creation for the authors of the Old Testament, a notion that seems to have been very widespread and almost certainly stems from India.

To add to the circumstantial evidence regarding direction, in Anglesey Gill and Harry examined a tomb dating to between 2500 and 3000 BC which was orientated with its entrance and axis due North. The dating and angle suggest that the object in the skies involved here was the Pole Star Thuban in the constellation Draconis which was at its peak in 2800BC. The suggestion above involving Ursa Major does therefore appear to be a realistic proposition.

Note: Investigations for the companion work *Deluge* have revealed that a Pole Star is viable in ancient tradition for three degrees [measured horizontally]either side of pole position or a total of 1000 years.

There does remain the problem of location however, why chose this very specific spot to build such a huge edifice. The site of any monument is obviously of importance. Here it is relatively easy to understand and in fact has been noted by others. If we examine the name of the hill, in reverse order of its component parts we see firstly 'bury' which in essence means no more than 'hill'. The second segment of the title is the all telling element because it seems to be a bastardised version of *Sul*, a British goddess who was worshipped from hills overlooking springs, where here at Silbury, we have springs adjacent to its base and a name of *The Hill of the Goddess Sul.* Hence this appears to have been a localised effort; the constellation Ursa Major giving the spirits of the departed what we may nowadays term a '*Fast Track to Heaven'* with the location's associated goddess overseeing events. It would appear likely that this goddess was previously worshipped from the high ground immediately South West of Silbury Hill, this being more favoured for the springs than Waden Hill which while close, is on the other side of the River Kennet.

From the above it does appear that here may well be the long sort after answer for a logical purpose for this hill. The vision is correct for the period, it would have applied for a few hundred years and it is virtually certain that excarnation was practised in Britain. While no skeletal remains from the early eras have been discovered at Silbury, this does not mean that they did not exist here as all bones would be carefully picked up for burial elsewhere.

In the last section and that dealing with the missing sarsen stone number 11 at Stonehenge, we have dwelt not on measurements but the skies. There are commonalities and connections as seen in Chapter 6 where we saw that counts of days denoted the factors between measures. Later we shall show further connections to the lights in the heavens, a very specific bright star that was the ultimate enabler for the development of the measures. We have also shown that since the last Ice Age there have been great movements of people and here we shall demonstrate further evidence to that effect…but evidence that flies in the face of all that conventional history teaches us. Here we look briefly at the ancient measurement system as seen in *the Americas*.

7.11Ancient Measurement in the Americas

Ratios at Nazca

Neal makes a comment regarding the work at Nazca in Peru of Maria Reiche, a highly competent mathematician who spent the best part of her life studying the mysterious animal and geometric patterns set out among the stones on the Nazca Plain. There were many arcs among the patterns set out and while archaeoastronomer Richard Hawkins failed to find any stellar significance in the direction of the lines, Reiche tried a different approach and discovered 'regular mathematical ratios' among the curves of the figures on the ground. These ratios, her calculations indicated, *were codes of regular planetary cycles and the apparent movements in the heavens*. It is unfortunate that little further work has been conducted in this

direction at Nazca and the theory remains unproven, albeit a very strong possibility, it would certainly fit very well with the concepts seen in this book and in *Deluge*.

7.12 A Single Evaluation

The probable technique and location of the measuring of Earth are revealed toward the end of this book. It is claimed here that the Earth had only been measured once, [allowing checks for accuracy, but the process was not repeated other than by one group of people in one location]. We can qualify that assertion by saying that at least a definitive measurement had been only evaluated once, and that measurement value remained in use until the onset of decimalisation in France. We reiterate what was stated earlier nonetheless, that while all the units here are denoted in British feet, initially the various mile units would simply be values connected by specific factors derived from counts of time and not units seen in terms of anything other than their own value.

The evidence now indicates that among the time factors are to be found the origination of the divisions so painstakingly calculated by successive investigators. Any other factorial elements came into play later, via a natural mathematical progression, by divisions that created a sequence of values that all interlinked to a fine extent. However, there remains a great problem, that of transference of very precise metrological knowledge and standards to the region of Central and South America from Asia and Europe. That this occurred there is no doubt, as the work of Hugh Harleston Junior makes quite plain in his surveys of Teotihuacan in Mexico. Here he calculated a value that he termed the *Hunab* which is a Mayan word for measure which he found occurs and reoccurs very frequently at the site, and indeed at other Meso American locations. The value he ascribed to this unit was 1.0594 metres. This evaluates as 3.475721785feet against the 3.475748571feet of the lintel width at Stonehenge, the unit value that is 1/150 of the stade utilised by Eratosthenes. The difference is a mere 0.000321435 inches or 0.026 of a millimetre. There can be no doubt whatever that this is same unit of measure and as has been seen, is related to the remainder of the system. We reiterate that Hugh Harleston Junior, as an archaeologist, had no intimate knowledge of the ancient metrology of Europe or Asia and was working completely independently. It was Michell who brought this to the attention of those who study ancient metrology. John Neal has replicated some of Hugh Harlston Juniors evaluations and drawings in his own work named *All Done with Mirrors*.

From a practical viewpoint It would be virtually impossible for people in the Americas to measure Earth, use the same divisions and arrive at the very precise individual measures that evolved in Asia as seen later in this work; the knowledge was transferred across to Mexico. While people moved to the Americas via the land bridge to the north before the oceans rose and additionally by boat around the Pacific coasts starting [for the coastal voyagers] as soon as the climate allowed, and as the Earth measure dates to before 9000BC [see later chapters], it seems that here we possibly have the connection between measures and America. We also cannot disregard the possibility of explorers say from Egypt or perhaps Phoenician sailors being blown off course and eventually landing in the Americas and passing on their knowledge before expiring in the strange land. However, we have no evidence of any nature that leads us to

accept such a solution, whether by folk travelling the coastline of the Pacific thousands of years ago or more recent Egyptians being blown off course. What is certain is that some of the unit same values that were in use in Europe and the Middle and Far Eastern regions applied in America in the time of the Maya. We do, nonetheless, see a very strong probability that the Chinese transferred this metrological knowledge to the Americas shortly before 2000BC. See the earlier references to Chinese travellers in 4.8. Here is an explanation that does make sense and is enhanced by the metrological evaluation of a solar observatory dating to 2100 BC in China seen in Chapter15.

An extensive examination of artefacts, structures and landscape along with old records, myths and legends has led us to conclude that there is no doubt that over a wide area and long periods of time the same dimensional criteria and perhaps symbolism have consistently applied. Metrology has been seen to be a very useful investigative tool.

Chapter 8
Landscape Setting out in Gwent [UK]

It is clear that the Neolithic communities possessed great skill in civil engineering and organisation...The idea of such intellectually sophisticated practises raises many questions and...(there is a) contradiction between the clear evidence for mathematics and astronomy on the one hand and the negative evidence for recorded innumeracy on the other.

Roberts B.K.1978. Perspectives on Pre History : *In* Butlin R.A.& Dodgeshon R.A. eds. *An Historical Geography of England and Wales*. Academic Press, London. Cited by Henry Lincoln 1991in the *Holy Place* p.84

8.1 Introduction

Many have speculated upon the reasoning for the setting out of standing stones, circles and similar ancient artefacts**.** Since man developed from his ape like form he has been fascinated with the skies due to the fact that apart from the occasional comet or meteor shower and eclipses, the heavens were the only stable element in life; the lights in the sky varied but little; the sun and its position in the constellations and along the horizon predicted the seasons. After a prolonged period of observation, even eclipses were predictable if not understood. However, modern researchers have been confused by ancient terminology and assume in too many cases that superstition ruled when they read of the position of an eclipse being dominated by a demon such as Rahu in Indian lore. This concept takes us back to the composition of myths prior to the advent of writing when stories were invented to explain the movements of the heavens and Rahu the demon [or serpent] was not a belief by the astronomers of the day but part of a tale composed as a memory aid. Effectively the sun and the moon were calendar counters of time, that curious entity that defies explanation. Time, in Indian writings is the creator and destroyer and Indian sages counted time in different fashions. There was *gross time* and *firm time* with gross time being the reality of precise time counts and firm time being utilised for simpler computations. Hence, while the correct monthly values were understood, the 30 day month, as in the Bible, at Stonehenge and numerous other places, was a part of the firm time counting as it worked with the sexagesymal system in use at the time.

In reality, the only definition of time that appears to hold any validity is that it is the measure between events where distance is seen as the measure between objects. A combination of the two results in velocity. Of course the same measure is not utilised in both cases and the basics of time measure one could suppose would originally have been the day, dawn to dawn. Without units of measure such as the day or the length of a stride or the length of a foot for example, neither time nor the space between objects would have any definition. Hence, we can understand why such notions were very early developments in man's history.

The universe is understood mathematically; even our body's functions are describable in such a fashion. We are all ultimately composed of atoms and physicists use mathematics to describe these minute entities. So in fact without math there is very little that we could explain and that includes both space and time. Hence, mathematics was a very early development in man's learning. Modern learning has generally accepted the concept of the 'big bang' where the whole universe was derived from a pinheads worth of pure energy and there was no time or space. The tiny compressed bundle went bang and immediately there was time and space definable by the distances between the objects that were now moving away from each other and their rates of progress. But then we ask, what surrounded the tiny pinhead that exploded- nothing? As things were now expanding and moving outwards, through what were they moving- nothing? So how do we explain nothing? If the universe stretches to distances far beyond our imagination's ability to conceive then how could these distance have been compressed into a pinhead? Space is only definable by its boundaries. The shortest distance between two points is a straight line. Ultimately, we are looking at a complexity of mathematical theories that in reality are not fully understood simply because we cannot understand the cosmos and its vastness. What is infinity? Can anyone actually imagine what is meant by forever? This is no more than a mathematical construct.

However, the same curiosity that drives today's physicists to examine far galaxies originally drove man to create instruments to mark the positions of the sun and moon and other lights such as the Pleiades. This could be understood; at least the visual positions of the lights as seen in relation to the horizon, whether that horizon is natural or man made, could be denoted. In this and the following chapter of the book, the area of Monmouthshire or Gwent [UK] is the subject of a case study that examines some stones and in the process encompasses the locations of some churches and the sun, moon and Pleiades are involved.

What is to be found on the ensuing pages is a report on what is to be found on the ground. The findings will reveal the obvious reasoning behind the locating of some of the stones. Here we are going to look to astronomical alignment. The evidence presented is limited only because further demonstrations to those seen on the ensuing pages may be seen as circumstantial and possibly flawed; merely relating what is feasibly no more than coincidence. Hence what is seen, after much examination and thought is accepted by the researchers as being correct, or it would not be presented here. There appears to be a mix of astronomical and dimensional criterion which has evolved over the millennia, which the evidence indicates commenced locally at around 2950BC. It must also be clearly stated that some stones which are seen in the accompanying drawings and are mentioned in the text are no longer extant but were discovered on the very early OS maps.

Below are shown two examples of stones on the early OS maps neither of which are marked on the 1:25000 scale modern OS maps.

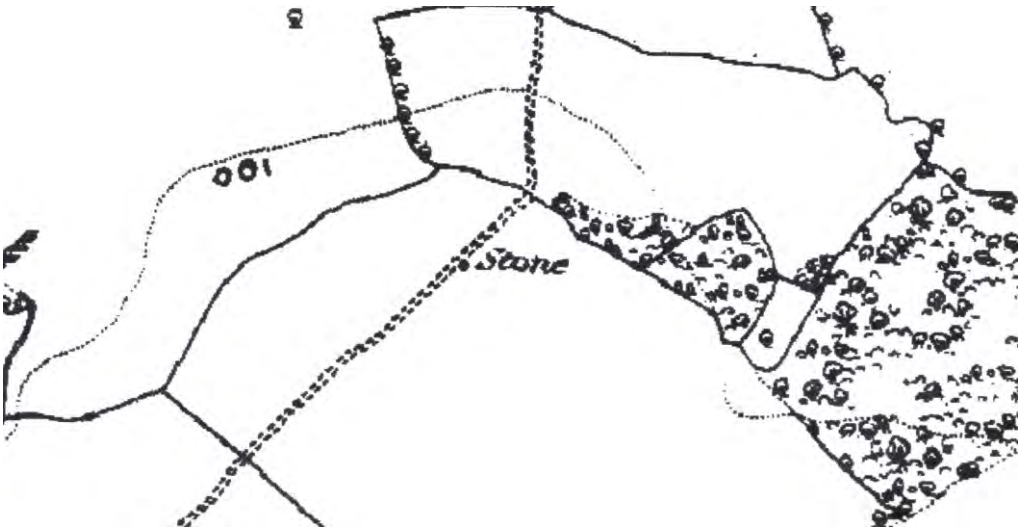


Fig 8.1 Stone *still extant* at Langstone, OS ref. 337689, 189609 now adjacent to motorway embankment *but not marked on modern 1:25000 scale maps*.

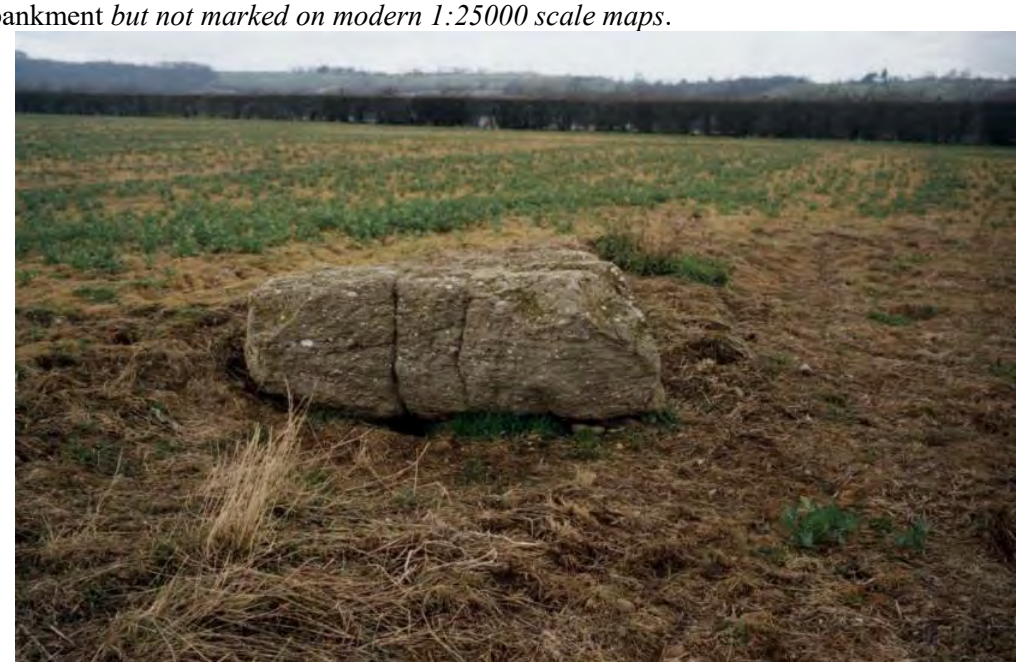


Fig 8.2 Stone *still extant* at Langstone [see above on early OS map]. Stone is prostrate on the ground. There is no record of this roughly square shaped stone being in any other position. Interestingly a number of similar shaped stones can be seen at Shap in Cumbria where they are set at specific distances apart and although the stones are large, our survey was to the centre of the positions…the dimensions were as accurate as the maps in use allowed them to be and that

is within two to three metres. These link to other equally large albeit more conventional standing stones.

Computerised mapping has been utilised at 1:25000 scale. Paper maps can be scaled quite accurately and initially the research was conducted in this fashion but with the computerised versions [not available at the commencement of this exercise] it has been possible to minimise error as zooming in to a location allows us to give readings to the metre, at least that is the map indication but in reality an accuracy of within circa two and half to three metres is more reasonable. This is still accurate enough for the purpose here and the stated dimensions are what emerges from using the positions given on the maps. Given that the distances are in miles and the sites involved are virtually all churches the accuracy is close enough to be acceptable. The dimensions take us to within the boundaries of a site. More recently Google Earth has proved to be a great tool and has assisted enormously. In fact what is seen in this edition of the book is a slightly updated version of the earlier versions…curtesy of up-dating positions slightly due to the visual element of Google Earth.

Nonetheless, not all the required information was available on the latest maps, it seems that more and more material of value is being discarded with even existing stones not marked. These omissions stretch as far as some church sites that should be marked as 'site of' which on the modern map have been ignored and here once more the early OS maps of the 1880s and 1890s have come to the fore. Of course being the results of modern photography these locations will not be found on Google Earth.

As noted above, a number of stones not indicated on the modern maps were discovered on the early OS maps. Whether these would have been mere localised boundary markers or mile stones along a road edge was of no concern at that time, they were stones and as with churches, circles, mounds, cairns and all else liable to have some bearing on things, were painstakingly plotted on a CAD drawing with the church positions being taken from the centre of the church icon. The positions of the artefacts on the old maps could be obtained via triangulation from still extant land boundaries and corners of buildings and so this did not present a problem. Eventually a drawing was produced that was a mass of named positions in Monmouthshire and Somerset to within the accuracy of the map with not a single line in sight. This had been a very tedious process that has taken a number of years but now it began to pay off via yet further painstaking investigation involving astronomy programs and lines on the drawing. No evaluations from Somerset are included in this book but the same type of dimensional criteria has been found to apply as is seen in Chapter 10. In fact this is a commonality across much of Britain, the research has revealed great similarities from Pembroke to Edinburgh and hence the door is open for others to continue this line of examination.

We have lost many standing stones and stones of a lesser variety that have not been given that title although perhaps in many cases it would have been appropriate. Other ancient sites have been lost. During the early research for this project Gillian and Harry discovered the remains of a large cairn in Pembrokeshire with a hedge through its centre hence it had half in one field and half in the next with one half completely ploughed up, no trace left whatsoever. If the land boundary was different then nothing at all would remain to indicate the cairn ever existed, or it would still be there with its circle left intact. Again, as noted above, even church

sites are being lost as can be seen where the early OS maps of just over 100 years ago marked 'site of' or 'remains of' a church, on the modern map there is no indication of the existence of many of these religious structures and yet the information is still available on the old maps. So it pays to look to the early OS maps for additional information to that seen on modern maps.

Fig 8.3 Half Cairn remains in Pembrokeshire: The hedge is across the centre of the remains of a very large cairn and the other side of the hedge is fully ploughed. A case of, "there it was, half gone", to use a term typical of the South Wales of a generation ago.

Churches have come under examination because it is well known that many were built upon 'ancient' sites. In some areas there is evidence of standing stones in the churchyards and some churchyards boundaries have been seen to been utilising the remnants of an old stone circle. The Romans also utilised pre-existing sites and astronomical alignments…possibly for convenience and in ignorance because the dates of the alignments, as with the Christian churches a little while later pre date the Romans by millennia…and therefore no longer served the purpose for which they were originally intended. It appears that tradition played a large part in proceedings as shall be demonstrated.

But there is much more to this than just astronomical alignment, as fascinating as that may be. There is also the little problem of distances between sites to examine and here we find a most intriguing scenario. The answers to the questions raised by this are not to be found in this chapter but in the book as a whole, specifically the latter chapters. We cannot give a detailed answer to the question 'Who was responsible and from where did they obtain their knowledge?' any more than we can describe with certainty the methods applied to obtain the results that will become apparent. However, sufficient information is contained within MOTG to give the reader a reasonable idea of the transference of concepts from other shores to those of Britain. That people and concepts travelled in the distant past cannot be refuted but in general Britain has remained relatively isolated. Yes there have been incursions of peoples from other regions but the DNA of the population of Britain shows little variation over the generations, it

can be ascertained from where and approximately when, immigrations to these islands occurred. The concept of a 'Celtic invasion' from the continent is erroneous, there certainly was contact between Britain and the European mainland but no hordes of Celts invading these shores; they were already here in the shape of the resident Britons who were derived from a variety of people that arrived at the end of the last Ice Age and at various times since. The Beaker folk is another misnomer, this particular style of pottery just happened to be fashionable over a wide area of Britain and mainland Europe, the idea was copied but no invasions of 'Beaker People' occurred. For more information regarding this area of study, two works that are recommended are Stephen Oppenheimer's *The Origins of the British* and Bryan Sykes book, *Blood of the Isle.* This latter book has its origins in the Oxford Genetic Atlas Program which is based at Oxford University. Another excellent book that investigates the origins of the people of these islands is The *Tribes of Britain* by David Miles.

As noted earlier it has been generally thought in the archaeological world that the building of large monumental structures such as Stonehenge is a process of *state formation*, which *does not* apply in Wessex, as in Wessex, as elsewhere in Britain, we do not see generalised evidence of permanent settlement for some considerable time after the building of this structure, even allowing for the establishing of a large settlement at Dorrington Walls adjacent to Stonehenge. Yet to establish such monuments as Stonehenge requires an enormous amount of coordinated effort over a considerable period and here at Dorrington Walls we appear to have a community that utilised the site for large ceremonies that involved Stonehenge and not fully occupying the Dorrington Walls location with its own 'Woodhenge' in large numbers on a permanent basis. This does imply organisation on a large scale, as the ceremonies appear to have occurred at 19 year intervals [see Chapter 7 *A Shortage of Sarsens*?]. Numerous people from, we assume, surrounding districts attended these celebrations. We can possibly add that others from further afield also travelled to the site but given that trade was ongoing and the inhabitants of Britain came here from the continent and may well still have family ties this is not too surprising, even without modern communications and writing. There were cultural links across the waters to Europe and as is evident with the Celtic languages, almost certainly they spoke the same language, at least variants of the same language; they were understood by each other.

There is no doubt that widespread settlement, albeit of a nature that as yet is not fully explained, did occur and the evidence of it can be seen in the standing stones, stone circles, alignments, mounds etc of a period commencing about the same time as Stonehenge. These are still relatively common and if the number of remains of these extant today is any kind of a guide whatever, then their numbers must have been great three and half thousand years ago, some 1000 years after the main phases of Stonehenge were completed.

In essence it does not take a genius to realise that given the numbers of these monuments that must have existed, the previously mentioned historical perception of large monumental structures being a process of *state formation*, is fundamentally flawed. Stonehenge is the most elaborate and accurate of circles but far from the largest and many others are still extant today. One initially has to define what would have been meant to a local populace by monumental. Then what is *precisely* meant by *state formation*? This appears to be a case of fine sounding words meaning nothing. In general, archaeology has little idea of the purpose of

Stonehenge other than its association with the ancestors; and some unproven astronomical alignments, solar solstices accepted. For that matter the other strange landscape anomaly, Silbury Hill is also misunderstood, or to be more accurate is not understood. Both are explained in this work, Stonehenge, as previously revealed is basically a calendar set out in linear measures…on both counts, very accurately. Gillian and Harry's interpretation of Silbury Hill has also been seen in Chapter 7, a logical explanation that has utterly escaped the archaeologists and archeo astronomers. These new explanations are based upon facts and not suppositions.

If we equate stone circles with churches and cathedrals then most regions had their church while the likes of Stonehenge and Avebury would have been great cathedrals. This does not in anyway imply any kind of state *formation*, merely a commonality and very strong belief in a specific cultural concept. Some stone circles and independent standing stones were astronomical units utilised for observations of the heavens while others denoted in their numbers of stones, counts of days and / or years. The heavens were used for practical guidance, *perhaps,* but not certainly, in a spiritual fashion, but note the association of Stonehenge and Silbury Hill with the ancestors. Silbury Hill, incidentally, looking to this idea of state formation, appears to be a local phenomenon even allowing for it being a massive undertaking. Perhaps this was only utilised by the elite. Some stone rows were obviously utilised as a 'processional way' with the stones marking a very specific route, sometimes to a circle while lesser stone rows have sometimes been wrongly interpreted and are of an astronomical nature. Many require further analysis and at Trellech in Gwent [the Harold Stones] we have achieved that reinterpretation. Here a 'stone row' of three stones was previously misunderstood [or in the case of most archaeologists, not understood at all] we now in Chapter 9 have a clear demonstrable explanation for the stones. In some cases [as at Stonehenge], we now see what appears to be a coalition of religion [if observation of the skies can be termed as such] and science into one entity. This is not surprising as the original measures, the divisions of Earth measure, were derived from counts of time obtained from the lights in the sky. Those lights in the sky were thought of as what we can only term 'gods', hence the title to his book. The heavens gave the time of year, essential with the onset of farming for planting, the heavens gave a sense of direction and a man could look at the sky and know in which direction he was facing. The heavens also gave a correlation to the water clock when it was eventually invented.

When one looks to historical studies of the early medieval period when numerous churches were built, the history of village expansion, as still taught at degree level as late as the late 1990s, [personal experience] ignoring historical facts that have been well known for over a thousand years, leaves much unsaid. The known records of early location of churches, in medieval studies, recorded by authorities such as Bede, usually does not have a part to play; according to this teaching the church was built to suit a growing community. Yet as we will see, the church is frequently inherently associated with a time commencing long prior to Christianity. It increasingly appears that the village church was often located on an ancient site. To understand this apparently strange situation we need therefore to examine some early Christian history.

8.2 Early History

It was Constantine who accepted Christianity for Rome after beating Maxentius at the battle of Milvian Bridge in 312 AD and eventually made it an officially accepted Roman religion. He seemingly rode back into Rome as the new Augustus and, most surprisingly, a Christian. Why or how, and the extent of the truth of this conversion is the subject of speculation and we shall refrain from examination of that specific story, but Constantine apparently adopted the Christian emblem on his banners and led his troops to victory after victory. This new God appeared to favour Constantine. In 313 AD the *Edict of Milan* put Christianity on a par with 'pagan' religions and the 314 Council of Arles enhanced this. While today this being on a par with 'pagan' religions may be seen as heresy, to the believers of those days it would have meant something much different, at least their faith was at last accepted by the authorities, it was seen to be a *religio licenta* or licensed cult.

In 323 Constantine defeated Licinius and the following year became sole emperor. Before this he was not actively promoting Christianity but allowing it equal footing with other faiths and beliefs. The *Council of Nicea* of 325 progressed things further for the Christians and the Roman Catholic Church became a reality.

For some considerable time, the destruction of 'pagan' temples was a common practise, as evidenced below. Most of the stone arrangements, be they circles or singular stones, were regarded [according to the Christian recorders of history] as temples, but in reality these were astronomical instruments, showing, for example, alignments of pairs of stones to the various sun positions of the year. The extracts below indicate that it was the zealous new converts to Christianity that were guilty of the destruction, a change of religion means a change of god or gods and a consequential change of icon, artefact or idol, or as in the case of the mind new to Christianity the *destruction* of idols, artefact and icons.

Typical of the situation which arose is that of the pagan Coifi, who upon conversion to Christianity, declared that,

...the temples and altars we have dedicated to no advantage be immediately desecrated and burned. [1]

That some of these temples were built of timber is also apparent from the above statement. Many 'temples' of timber were undoubtedly burnt to destruction but given the numbers that must have existed almost certainly a great number survived. One also does not burn stone circles or indeed burial mounds where ancestor worship, or at least veneration, took place, so it appears that many of these remained untouched and eventually were transformed into what eventually became church sites.

It is known that Christianity came to the Roman town of Caerwent, between Newport and Chepstow, in the Roman era but also that the Romans worshipped numerous gods. They were a superstition people and took no chances with religion, frequently taking on board the beliefs and practises of the people they conquered and adapting them into their own expanding religious pantheon. It is almost certain therefore, that pagan religion was practiced locally alongside Christianity for a considerable time. Indeed, one has only to see the strips of cloth

tied to branches overhanging wells, and the amount of coinage tossed into such places, not to mention the followers of horoscopes, to realise that ancient superstition is still alive and kicking in spite of the almost universal acceptance of the Christian ethic [as against faith] as a correct and humanitarian teaching.

But given the Roman's inherently superstitious nature it is equally certain that only the early Christian converts where the Romans had less of an influence would have been involved in the destruction of the ancient sites, probably the local converts or travelling preachers attempting to raise a storm in the upholding of the teachings of the new faith and its non-use of idols, the pulpit thumpers of the era. If the Romans were as destructive as the new Christian converts in this respect, with their organisation they would have uprooted the stones and used them for building, flattened the burial mounds and again utilised much of the stone for walling as was in many cases accomplished much later in medieval times. Yet even after a hundred years, the circles and mounds still stood in this conquered country, even to the extent of timber 'temples' still being utilised. Hence there can be no doubt that it was the Christians that accomplished the destruction of the early sites and not the Romans, and as seen below, these were Christians rebelling against the teachings of their own leaders.

Sufficient must have been damaged or lost via the vehement zealousness of the new converts to cause a stir amongst those the Christians were attempting to convert. This is evident because The *Edict of Theodius* of AD 392 categorically stated that *'pagan' temples were to be dedicated as Christian Churches*. This clearly implies that church sites were on the same locations as the ancient stones, mounds and circles. A later *Edict of Honorius* of 408 forbids the destruction or damage of these ancient 'pagan temples'.[2]

This destruction apparently continued for a considerable time because a letter dated 601 AD from Pope Gregory to Abbot Mellitus was intended to convey the message to Augustine that pagan "temples" were not to be destroyed, but purified and converted to churches.[3]

In reinforcement of this we find that

> *...It is on record that Patrick, Bishop of the Hebrides, desired Orlygus to build a church wherever he found upright stones or menhirs...*[4]

All the above implies that Christianity took over sites of much greater antiquity but gives no clue of the true age of the '*temples'.* Villages sprang up surrounding the churches, which possibly were originally no more than preaching crosses, perhaps carved out of existing single menhirs. Some of our medieval village sites, therefore, as community places of congregation, may be of great age. It is unfortunate for the archaeologist and historian that the records of many, or in all probability most of these early villages no longer exist. There is a sort of blank between these early Christian times and the coming of the Saxons and then the later Normans with their meticulous record keeping as witnessed via the Domesday Book. Church records where the church is of sufficient age are probably the most reliable in these matters.

Fig 8.4 Inscribed Roman Stone in Caerwent Church

Many of the church sites are indeed very old. The illustration [Fig 8.5] of a plaque in Caerwent Church is of a list of abbots and incumbents of the church commencing in the year 500 AD with St Machutus who was the first Abbot of Caerwent. While this church was established within the walls of a Roman town, in general villages grew around and adjacent to the place of worship, *irrespective of any other industrial reason* which additionally may have caused their later down fall. This happened not only at St Brides Netherwent, where it is thought the plague caused so much death that the village was deserted, but additionally at Trellech, where a large medieval foundry based community sprang up and apparently just as quickly died, leaving a basic agricultural society in its place. [Named 'Tre' 'lech' or 'three stone' after the three standing stones detailed in Chapter 9.]

Churches grew, generally, where people lived, a church in the early days meant not necessarily a building, but a meeting of body of people, [as was the case at Caerwent]. Stone circles and burial mounds may well have been visited only at specific times of the year and hence would not automatically suggest a community living adjacent, although in earlier times this may have been the case. On this basis the difference between churches and ancient sites, in terms of location, begins to make a little more sense. The preachers [as against the religious hermits] needed an audience to convert and this would not be found where people did not regularly congregate. Hence the conversion of ancient sites to Christian sites would likely have occurred in the more populated regions. Additionally if the Sabbath once a week was observed

then a correlation to the month and hence lunar movement would have been in evidence and this would have been more easily understood by the pagan peoples. One implication arising from this is that there probably were a great many more sites with stones, circles or mounds scattered around than is generally thought, even by the most broadminded archaeologists. These would now, in many cases, be occupied by churches.

Fig 8.5 Plaque In Caerwent Church indicating the age of the Church as a place of Christian Worship.

But what did 'pagan temples' mean? What types of ceremonies were conducted at these places? We have little hope of discovering anything firm regarding the ceremonial aspects [if any] but of the 'temples' we can look at the remains that are extant such as stone circles, singular stones and mounds, which as stated above may in some cases have been spared due to their practical application, a criterion which would also apply to some stone alignments. Other than that there are the burial Cairns and Tombs that vary in type and in size. These are sometimes seen in conjunction with megalithic structures, as shall be seen in the case at Gray Hill overlooking Caerwent.

Fig 8.6 Caerwent Church today [South Eastern corner] [OS ref 346858, 190495]

Some old churches embody in the churchyard walls what appear to be menhirs or what we would regard, if they were not a part of the wall, as standing stones. One example is the churchyard wall at Yspytty Cynfyn in Dyfed. Of course because a singular apparently out of place stone appears in a wall does not mean that it is a standing stone or that the church site is on the site of a stone circle. In this case, however, there are four of these stones, which were first noted as such in 1807.[5] The largest standing stone in Britain, in fact, is to be found in a Norman churchyard at Rudston. [Fig 8.7] Clearly the Normans also utilised old sites for church locations and as they were the greatest church and cathedral builders Europe has seen, how many ancient sites are buried beneath or incorporated into the fabric of these Christian structures?

In a [British] Time Team archaeology television program the statutory 'three days' were applied to a dig at an old church at Govan in Strathclyde. Revealed by deep excavation was the fact that the church had been constructed on a very old man made mound. At Govan this was only discernable by soil discolouration. Neolithic remains appeared to be associated with this mound. Hence if the Christian religion adopted places of such antiquity for their worship, they indeed were following a very ancient tradition…as has happened at Portskewett here in Gwent where the churchyard is within the boundaries of such a mound of large proportions.

Fig 8.7 Standing Stone at Rudston Churchyard [now with protective cap]

Given, then, the statements above regarding the adaptation of 'pagan' sites to Christian use, recorded by the early Christians themselves, and the available physical evidence, the general idea of churches standing on ancient sites cannot be disregarded and remains, while in the overriding vast majority of cases unproven via excavation, a very distinct probability. Because the vestiges of many stone circles and cairns no longer remain visible does not mean that stone circles, single stones [equally important as we shall reveal] timber equivalents or indeed burial mounds were not extant at the site at the time of the early Christian takeover. In fact one can sometimes observe patches of stone in a very old church structure which appear to be out of place, as if a large stone which did not arrive at the site with the remainder of the material was cut up for use. Possibly such cases indicate the use of a menhir as building material.

In summary, the evidence implies that many of these old Christian places of worship, whether having a building or being an open air meeting palace with a preaching cross, itself quite possibly carved from a pre-existing standing stone, were, as the stone itself implies, on sites which had been in use possibly for millennia before the birth of Christianity. But as we shall see, the Christians were only following a Roman practise in utilising pre-existing locations and alignments.

Having examined the history of church location however, we now firstly look at some other relationships between locations and a Biblical connection.

8.3 Gwent before Genesis

8.3.1 Introduction

This section relates the setting out on the ground in South Gwent UK of what has been repeated in a number of ancient texts. The reference is to the Pleiades and their loss of view for 40 days.

The Pleiades have been observed for a very long time. Cave painting at Lascaux, France shows the Pleiades just above the shoulder of a bull and this dates to circa 16000BC. The earliest generally recognised reference to the Pleiades is from China circa 2300BC but the Pleiades are applied to calendars from India that date to long before this era. Hence when we note that a dating of 2950 appears to apply to a setting out in South Gwent, this should be seen as acceptable.

What is seen is a connection via two standing stones and some hills that put together reveal something that occurred for around 100 years. There is an established equinox line along which later churches were built and which starts with a standing stone, passes over a small hill that viewed from the stone [before modern buildings were placed in the way] allowed a view of this hill as a small rise above the horizon that would have been perfect for solar sighting. From this hill a much more distant hill revealed that the sunset at the equinox meant that at half set of the sun the northern edge of the solar disc was just touching the highest part of the southern slope of this hill with the centre of the sun at the true equinox position. The stone is at Llanfihangel Rogiet and the small hill is Wilcrick Hill. The distant high spot is Mynydd Meio just to the west of Caerphilly.

To the north and south are other positions that denote 20 days either side of the central equinox position. North reveals the hill with a Norman motte at its peak, locally termed a 'pimple' that is Twmbarlwm, while to the south we find another standing stone at Druidstone. This stone is due south of the centre of the peak of Twmbarlwm. From Llanfihangel Rogiet neither Twmbarlwm nor Druidstone can be viewed as is the case from both of these locations and again they are not in view of each other but the stone at Llangfihangel Rogiet is very accurately placed in relation to these two locations as indeed is Druidstone in relation to Llanfihangel Rogiet Standing Stone and Twmbarlwm.

The earlier editions of this work contained some errors in this section which are rectified in this new updated version. After a number of discussions with people who claimed to discredit the earlier statements but in fact who appeared to understand the subject area less well than we [Steve and Harry] did, the section was again started from nothing and completely re-examined by Harry. The result is what follows and this is correct. As is pointed out, the period of 40 days can almost certainly be shortened but other than that all works very well indeed. The fact that stones and hills are not visible one to another is not important as counts of days gave the sunset direction which could easily be followed to the location required. Twmbarlwm was a hill, a fixed entity while at Druidstone a marker in the form of a stone was placed, which is what humans tend to do, mark locations. Llanfihangel Rogiet stone was set in place on the equinox line and 20 days each side of the equinox line was set out from this position.

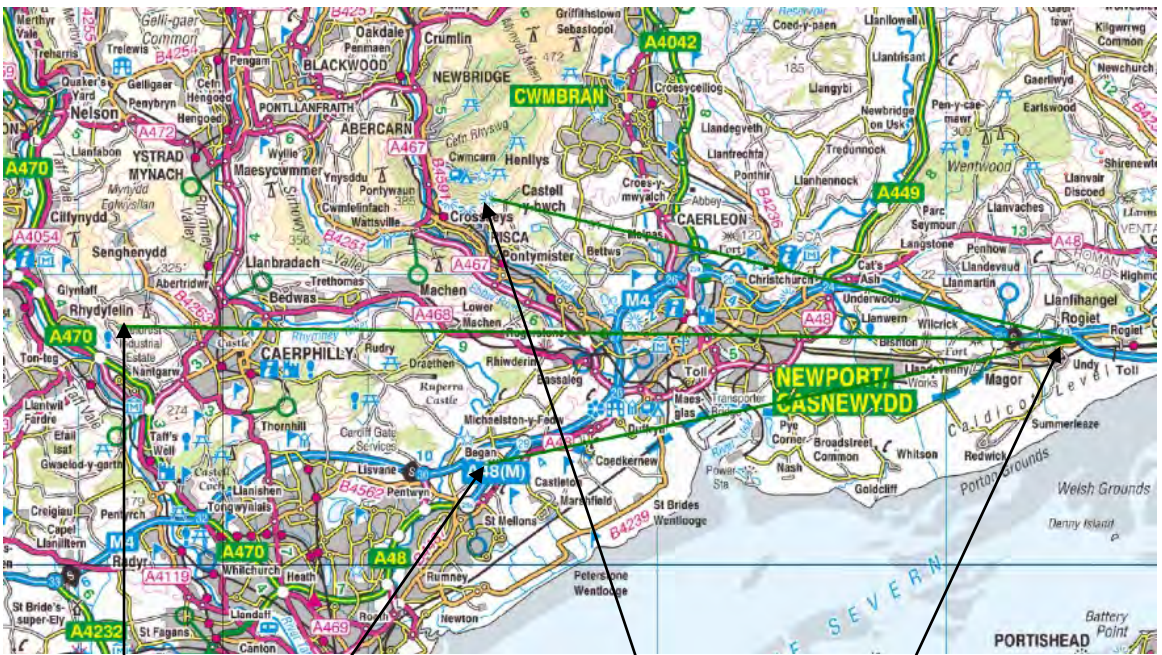
8.3.2 Notes relating to archeo - astronomical alignments in Britain

The following relates to archeo astronomy at any location but specifically here in Britain and the findings in South Wales seen in this chapter. Positions of locations have been denoted by the WGS84 system which is that utilised by the popular Google Earth, astronomy programs and is found on GPS units. As locations have to be entered into astronomy programs the logical step was to use the WGS84 method. The OS National Grid system, which is independent of the latitude / longitude references, has been used to obtain positions for transfer to CAD drawings. It is this methodology that is utilised in the book to give location positions. According to the maps used, these positions are to the nearest metre but in reality are probably within two or three metres but still sufficiently accurate for the purpose.

Light refraction will give a false impression of a stars vertical position when observed at the horizon.

According to a research report by B. Schoefer and W. Liller this refractory error at the horizon can amount in a typical temperate zone to as much as 5 minutes of arc for sunrise position and hence time and they claim that any archeo-astronomy site can be in error to the tune of 0.5 degrees which is 30 minutes of arc. These figures do not correspond. A commentary by J.H.Robinson at 179th meeting of the American Astronomical Society in association with SAO/NASA Astrophysics Data System (ADS) reveals that he has made his own investigations and has found that positions can be established within 20 seconds of arc or less and with sun position at solstice to within a few arc minutes. However Allen C.W. in *Astrophysical Properties* in 1976 made the horizon value 35.4 minutes so there is a considerable disagreement regarding the value of refraction. Nonetheless, as the bulk of opinion tends towards half a degree of arc it is safe to err in that direction and we allow 30 minutes of arc for refraction at the horizon. This makes little difference to the evaluations here however as sun, moon and Pleiades are all circa 30 minutes in visual width and the refraction element is applied vertically so only the time element is involved in a practical manner. Hence if an astro program indicates a time for sunset at the horizon, then in fact the position will be correct but the time will be too early by the period taken for the sun to move its own width or roughly two minutes [of time for 30 minutes of arc]. This will make no material difference to the set or rise of sun but may be relevant to the sighting of a heliacal rising star and hence needs be taken into account. Another matter that can throw things out is elevation. The horizon needs be evaluated up or down from a level situation. This has been calculated by means of drawing Earth circumference at relevant latitude on CAD and heights and distances being set out along this. Eventually a value for elevation or depression has emerged that is very close indeed to reality on the ground and most certainly within any necessary parameters.

We now look to the sites involved with the Pleiades in South Gwent.



Mynydd Meio Druidstone Twmbarlwm Llangfihangel Rogiet Standing Stone

Fig. 8.8 Layout of sites in South Gwent into Glamorgan

While the relevant sites are not visible from the ultimate triangle apex at Llanfihangel Rogiet, all are seen from Wilcrick Hill. Wilcrick Hill was seen from Llanfihangel Rogiet as a low hill just above the horizon. Today modern developments obscure this view. Mynydd Meio is just about visible from the top of Twmbarwlm but not from Druidstone. However, the view from Wilcrick was the necessary equinox sighting and the line to Twmbarlwm gave a clear view from Knollbury 0.9 of a mile along its length toward Twmbarlwm. The count of 20 days gave the direction from the position at Llangfihangel Rogiet which it self was denoted by this same count to sunset over Twmbarlwm and sighting back from Knollbury. Once set up this stone was central to the layout although the sighting afterwards would have been conducted from Wilcrick to the equinox and indeed, when this was set up to Pleiades setting due west over Mynydd Meio 20 days before the sun did the same in the spring of 2950 BC.

Fig. 8.9 Llanfihangel Rogiet Standing Stone late 20th century. [OS ref 344518, 187760]
This stone is known locally as the 'Devil's Quoit'. This is angled towards midsummer sunset.

What was lost by the building of the motorway? The embankment was created and was not here before road construction began. Road embankment, tree growth and housing, effectively general topographical alteration has caused the loss of the view of Twmbarlwm and other locations from this location, a critical view when the alignments were set up. Had efficient archaeological surveys been undertaken prior to the engineering works commencing, would other remnants of the site, even if only traces of timber postholes have been found underground? Certainly, the site, as seen in this chapter, was of great importance albeit with this stone being the focus.

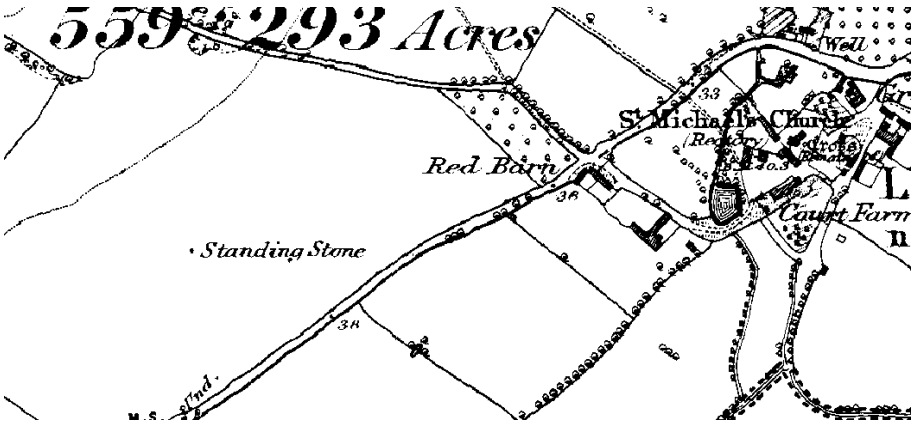


Fig 8.10 Llangfihangel Rogiet Standing Stone circa 1890…no motorway embankments

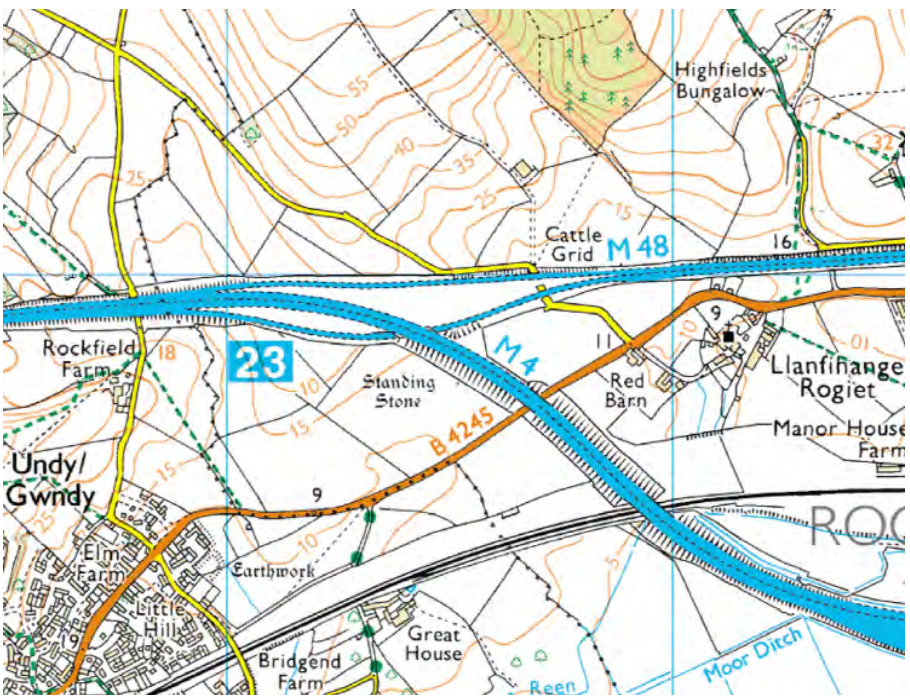


Fig 8.11 Llangfihangel Rogiet Standing Stone late 21st century map.

Fig. 8.12 Llangfihangel Rogiet Standing Stone on a hazy day. The inclination seen here indicates an angle approximating midsummer sunset, midwinter sunrise.

Fig 8.13 The sun angle of Llanfihangel Rogiet Standing Stone seen on the compass

Fig. 8.14 Druidstone House Standing Stone [OS ref 324111, 183493]This boulder does not have any directional implications.

8. 3.3 Twmbarlwm

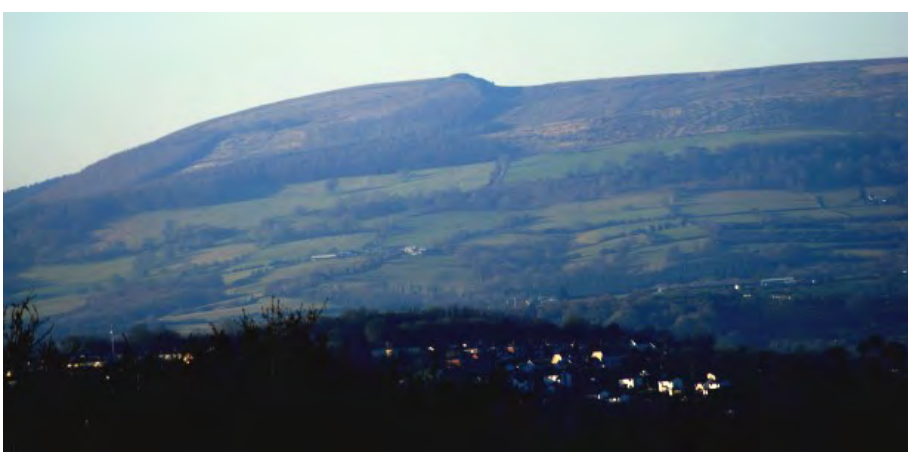


Fig 8.15 Twmbarlwm from Christchurch with telephoto lens.

It should be noted that the top of Twmbarlwm has what has been described on a plaque at the site as an extensive *undated* 'Iron Age' hill fort or medieaval enclosure! Somewhat different! This raises the query of what denotes it as a fort anyway? In our opinion the 'fort'

here, as with some other locations was not a 'fort' but an animal enclosure which via the singular bank and ditch, which are not large enough for defensive purposes compared with ditch around the real Norman motte and bailey castles, kept flocks or herds enclosed within. The region adjacent to the 'motte' which in fact encroached over the original ditch at the eastern end of the region did have the ditch enlarged but the remainder did not. In fact away from the motte this ditch can be comfortably jumped over, it is that small.

Some other Norman 'baileys' have very similar characteristics and we believe that most were originally farmsteads with single bank and ditch for animal security that were taken over and adapted by the Normans. When a real defensive ditch was dug by the Normans it was a substantial affair that indeed did have defensive properties and hence it is apparent that this ditch was not intended as a defensive measure and that the ditch around the motte was dug according to a recognised pattern but the deeper ditch did not surround the motte but was simply an extension and deepening of the pre-existing ditch.

Hill forts built in the Iron Age had multiple defences such as three concentric deep and effective ditches with their raised banks and these indeed were of a defensive nature.

Compare Lodge Wood fort at Caerleon with Twmbarlwm. Lodge Wood is a real Iron Age fort of comparable size.

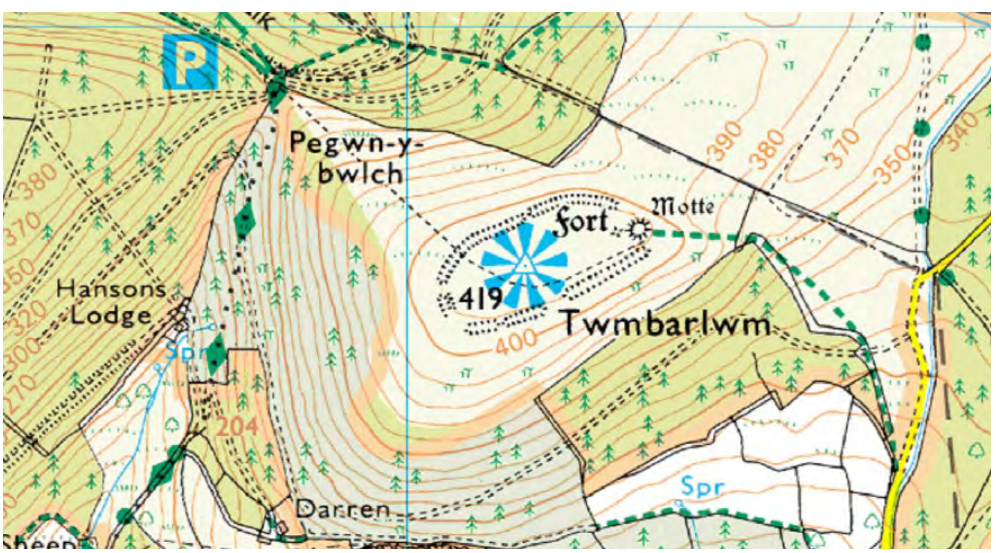


Fig 8.16 Twmbarlwm layout

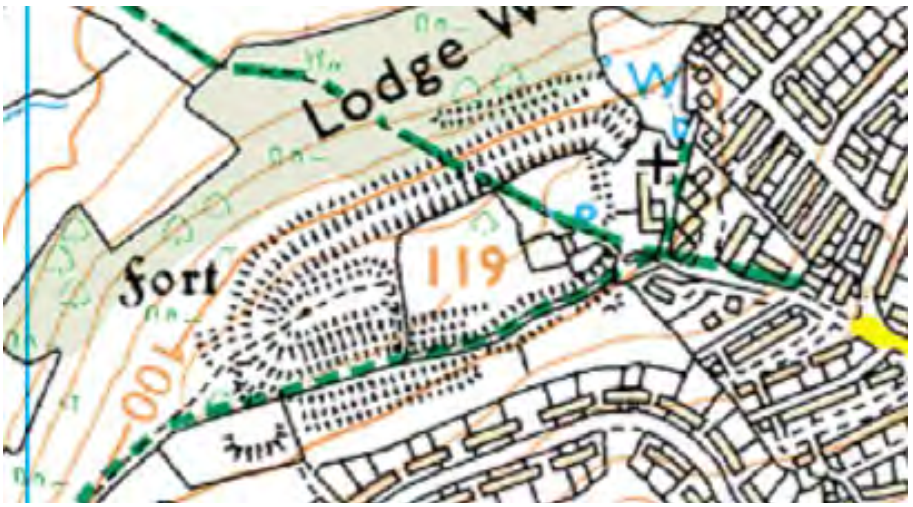


Fig 8.17 Lodge Wood Fort Caerleon. The precise location point in relation to the circle of sites [see Fig 10:2] held a Norman Motte until the last war. Its stone was probably used for war activities or local builders.

Fig 8.18 Remains of Norman 'motte' at Twmbarlwm. The ditch was enlarged at this end of the site.

8.3.4 Alignments in South Gwent

The commencing point for the primary *equinox alignment* in South Gwent is Llanfihangel Rogiet Standing Stone [OS 3445187, 187761] and the line completes some 20.56 miles away 225 feet to the south of the triangulation pillar [OS 311425, 188295] at the peak of Mynydd Meio [now in Glamorgan west of Caerphilly], to a location that is 25 feet lower than

the highest point, which is denoted by the triangulation pillar. This denotes the centre of the sun at equinox sunset while the northern edge of the sun is very close to being the highest point of the hill at the top of the southern slope. This in fact denoted the equinox position as visually it was more accurate than attempting to fix the centre of the sun at a point a little way down from the top of the hill. Northern edge of sun = hilltop= equinox sunset. It is easier to obtain an accurate fix at the edge of the sun than at its centre.

Hence, for practical purposes it is proposed that a straight line can be drawn from the true equinox position on this hill to the location of Llanfihangel Rogiet Standing Stone and that this line can be utilised for the purpose of exploration of the landscape for alignment of ancient sites. The locations between the standing stone and the hill would be only aligned to the hill from the direction of the stone and hence refraction plays no part in this established line.

There are, however, some discrepancies to note when comparing a straight line from this location to the true equinox line that allows for the curvature of Earth and its 23.5 degree tilt. These are noted below but while a true line following the latitude of the equinox is by definition curved, this does not apply to the sight line which is between the hill where the sun sets and the standing stone 20 miles to the east.

Following the WGS84 positions for correct latitude it is found that the true equinox line [as against our line of sight, a straight line] passes through the southerly regions of the churchyards of Llanwern [33 feet within the churchyard], a modern church at Alway [probably coincidentally and hence not marked on diagrams] and Lower Machen [28 feet within churchyard] after traversing the top of Wilcrick Hill. If a straight line is drawn from Llanfihangel Rogiet Standing Stone to the line termination point at Mynydd Meio it is found to be some 66 feet to the north of the precise latitude of the curved true equinox line at Llanwern Church and 82 feet to the north of this curved true equinox line at Lower Machen. This straight line cuts through the centre of the church at Llanwern at 98 feet from the southern extremity of the churchyard. At Lower Machen this straight line is 110 feet north of the south boundary of the churchyard and 6 feet from the entrance to the church. The difference over the top of Wilcrick Hill is slight and given its width the variation is of no consequence. [See figs 8:16/17/18]

These deviations [not due to refraction] amount to a maximum of 3.8 minutes of arc as measured on Cad at Lower Machen with circle centred at Llanfihangel Rogiet Standing Stone but as can be seen, the positions are still within the target sites. If this is compared to the visual diameters of 30 minutes of arc of both sun and moon then it is apparent that these alignments are correct even when a straight line of sight is utilised as the maximum deviation is approximately 1/7 of the visual diameter of sun or moon and hence is contained within the width of the astronomical target. Therefore it is apparent that line of sight and not following curved equinox lines reveals what was set out in the distant past.

The overall width of the star cluster we call the Pleiades, which plays a large part in proceedings here, is measured at even more than the sun or moon diameters and hence the methodology is sound for sun, moon and Pleiades.

The following illustrations demonstrate the differences found between the above mentioned straight line and the true equinox line. Given that the targets here are churches and we have no idea of the location or size of the original target within the relevant enclosed area,

either line could be seen as correct but as the viewpoints were fixed and local and 'on the ground' the straight line is deemed to be have been in use between Mynydd Meio and Llanfihangel Rogiet Standing Stone.

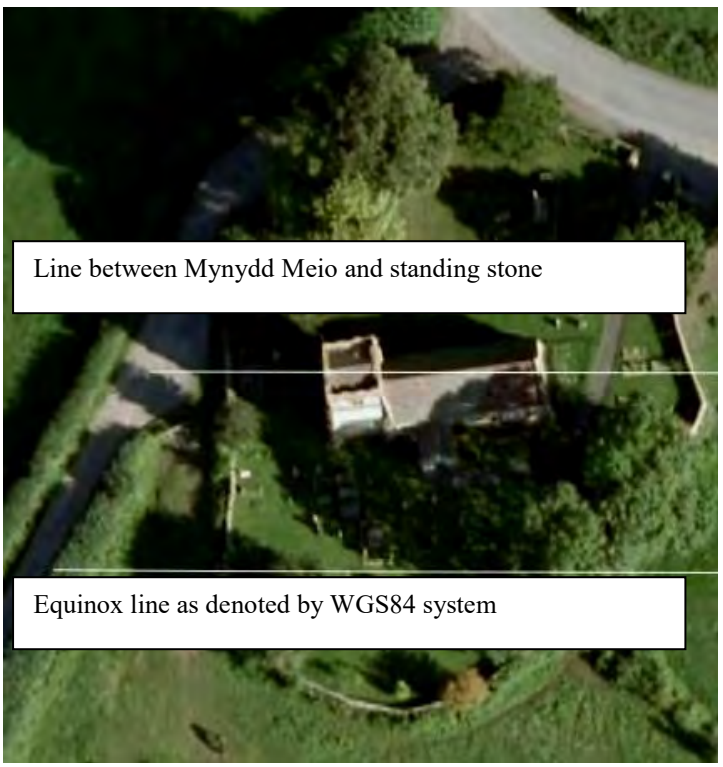


Fig 8.19 Llanwern Church with precise equinox line which by definition is curved and straight line between equinox position at Mynydd Meio and Llanfihangel Rogiet Standing Stone [Google Earth]. Here we see 66 feet between the two lines with the straight line of sight being that which traverses the building.

Fig 8.20. Lower Machen Church with precise equinox line plus the straight line between equinox position at Mynydd Meio and Llanfihangel Rogiet Standing Stone [Google Earth]. At this location there is 82 feet between the lines. Note that in both cases the straight line is close to the centre of the site. This tends to confirm that this straight line was utilised when setting out the original sites as it would be the location of the setting sun that was static and the alignment sightings, once this had been affirmed, could have been carried during the hours of daylight at any time.

Fig. 8.21 Equinox line as denoted by WGS84 system over Wilcrick Hill [Google Earth]

There is something else to take into account here and that is the timing of the autumn equinox, it is on average two days later than the spring equinox in terms of quarter years. The position remains due west but the date is later.

Another pointer which, while not strictly applying in this case, certainly indicates a similarity in thinking regarding time and is worth bearing in mind in this type of investigation is in the Indian work Surya Siddhanta [1:10] where we read:

The time which destroys is the real time the other kind of time is for the purpose of computations. They are of two kinds, the gross one is used for real time use and the firm one for the purpose of computations.

8.3.5 Background

Before revealing precisely what has been discovered, it is nonetheless felt desirable to reiterate what others, in their complete ignorance have managed to have get into print regarding these matters. Firstly *Llanfihangel Rogiet Standing Stone*; according to Children and Nash in *Prehistoric Sites of Monmouthshire,* 'may have' been visually aligned with settlements that

existed to the south of Magor Pill[6]. Further to this there is a firm statement that this stone 'would' have formed a demarcation line between the domestic regions to the south and the ritualistic to the north.[7] What is meant by 'may have' and why to the south? Both locations are known and hence did it align as suggested or not? Where, precisely, were these settlements and what evidence is there for their existence? In any case, south of Magor Pill is in estuarine mud or under water, dependent upon tides, neither case suitable for any permanent heavyweight structures at or since the time that these stones were set up. Timber walkways have been found in the mud at various locations, clearly indicating that the region was utilized for food gathering, fishing etc and little else, the timber walkways confirm that the region was wet even if not as tidal as today in those far off times. The exception to this generalization is the analysis of the remnants of some lightweight timber structures at Goldcliff at a position that in the Bronze Age would then have been above the tide line. This was a peat bed. Ironically some of these timbers have been known to local anglers who have dug ragworm for bait in the region for generations, only quite recently coming to the attention of archaeology and being analysed. They were previously thought to be the remains of trees as there are the remains of an ancient forest protruding through the estuary mud here with some parts of silver birch trees still easily identifiable…well they were a few years ago when the author used to dig for lug and ragworm there!

Further to the wild guess noted above regarding the stone, there is a firm statement that the stone would have formed a demarcation line between the domestic regions to the south and the ritualistic to the north[2]. Imaginative to put it mildly, but there is no foundation whatever for such fairytales. If there was a 'domestic' region then this stone may well have been close to the centre of it and not at its northern extremity, or perhaps at the south of the region…who knows? Guesses only lead to further guesses. Such wild speculation by professionals has been rife over the years and endures today: - we still have the Anglo Welsh stone removal company who specialised in moving blue stones from West Wales to Salisbury Plain! It is acceptable for errors in evaluation to occur, none of us are infallible but to make unsupported statements is far from a professional attitude. The bluestones were undoubtedly moved by glaciers, not in the last deep freeze but the one previous as geologists and glaciologists have repeated for many years. Why do many archaeologists deny the knowledge of other specialists? They would not take the same attitude with a medical professional assisting them through an illness…and a glaciologist or geologist would seek the advice of an archaeologist regarding any old materials they happened to find.

8.3.6 Analysis

So, to the initial analysis; running westwards from *Llanfihangel Rogiet Standing Stone* [OS ref 344518,187760] is an equinox line that takes in firstly at 341097,187808, the centre line of *Wilcrick Hill* [with its later hill fort] at exactly 2.112 miles distant, then *Llanwern Church* [337061,187872] and *Lower Machen Church* [322803,188067]. The line also takes in a modern church [possibly coincidentally, at East Newport among the houses of Alway] and finally terminates 78 metres to the south and 717 metres east of the triangulation pillar [pillar =

311422, 188296] on the summit of *Mynydd Meio*. This point is on a small rise on Mynydd Meio that would be visible from the top of Wilcrick Hill.

The church sites along this equinox line are possibly on ancient sites else why build churches at precisely these locations? [Some dimensional properties between sites may provide an answer here as is seen a little later in this narrative but sun position lines are important as will become apparent.]

The position along the equinox line of the Standing Stone at Llangfihangel Rogiet, to which the extended OS ref seen above gives the position within a metre, was almost certainly initially fixed by sighting to Twmbarlwm from Knollbury, just under a mile towards Twmbarlwm along the line between the two locations. From here the sunset at 20 days after the vernal equinox would have been clearly seen and extending the line backwards was not a difficult task. Hence the equinox sunset was sighted initially from Wilcrick Hill and extended backwards and the 20 days after the equinox sunset extended back from Knollbury. The intersection point was to be the location of the standing stone at Llanfihangel Rogiet precisely on an already established equinox line. From here the 20 days before the equinox was plotted to Druidstone across the river Usk and due south of the centre of the top of Twmbarlwm.

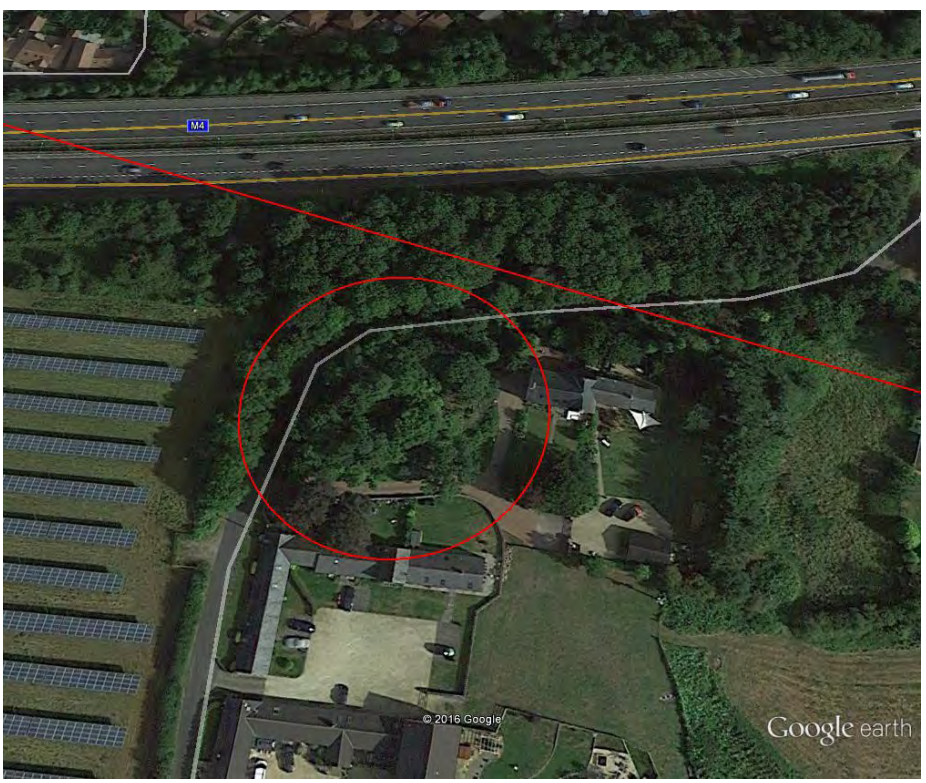


Fig. 8.22 Sightline to Twmbarlwm from standing stone passing alongside the Norman Motte and Bailey, now covered with trees at Langstone Court.[Google Earth] As is the case in many

places, this is not in a very good defensive position for a castle; it is overlooked by a hill to the west [now partially covered in solar panels]and so why build it here? 700 yards to the west would have given a commanding position and the only advantage at the position in which this was built was that of access to water in a nearby stream. Could it possibly be that the pre-existing alignment was an overriding criterion as is the case with the axis angle at Caerwent Roman town? Was this for administration purposes and not defence in which case other criterion such as this line may well take precedence? Certainly the castle is not in a suitable military position and one wonders why.

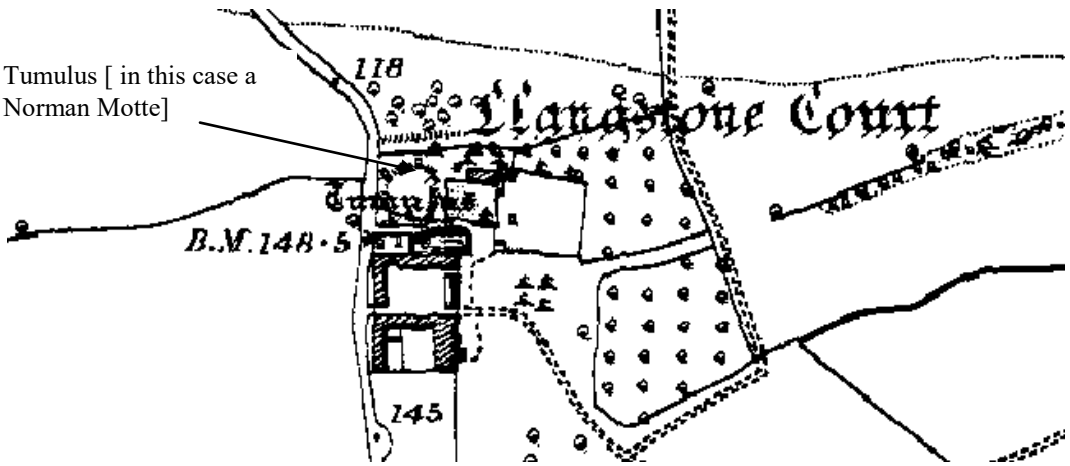


Fig 8.23 Langstone Court Tumulus 1886 map [note change of road direction on modern photograph fig. 8.22 to suit motorway.]

From the now ascertained location of Llangfihangel Rogiet Standing Stone another calendrical element emerged. What is seen is a sort of calendar for the Pleiades.

8.3.7 Historical widespread knowledge of the Pleiades

Greek myth describes the Pleiades as the seven daughters of the Titan *Atlas*. During the spring in India circa 3500BC as recorded in the Rig Veda 1.50 we find that the Pleiades were termed the *Seven Bay Steeds*, [also known as *Daughters of the Car*] the horses pulling the car or chariot of the sun. Evidently at this time the Pleiades rose long enough before the sun to be clearly visible. Indeed this was the case, the Pleiades rising at 95 degrees azimuth at three quarters of hour before the sun, just long enough to be briefly visible for the description to be viable but not so long as the Pleiades are isolated from the sun and hence not apparently connected. The description of the skies relates the approximate dating of the event and complies with tradition regarding the dating of composition of the texts that were later written down. At other times of the year, the sun, as did the Egyptian Ra, travelled in a boat, the Indian version of the sun, *Surya*, here being associated with the god *Varuna.*

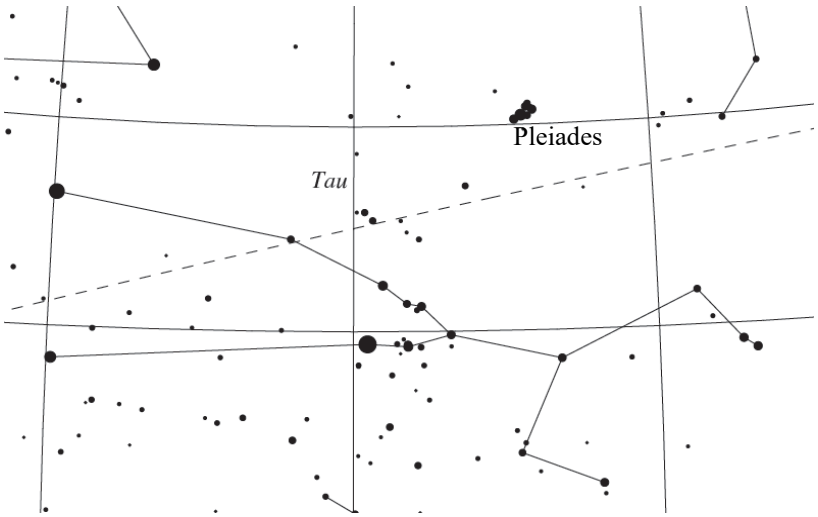


Fig 8.24 Pleiades: a cluster of stars [asterism] within the constellation Taurus. Traditionally there are seven stars in the group.

Hesiod, an early Greek farmer turned poet who lived around 700BC instructed in his *Work and Days* thus:

'When the Pleiades, daughters of Atlas, are rising, begin your harvest, and your plowing when they are going to set. Forty nights and days they are hidden and appear again as the year moves round, when first you sharpen your sickle'.

Some 300 years after Hesiod, the Greek astronomer *Euctenom* [c400-350BC] listed the dates of the year involved, as indeed did the early Babylonians where the forty days in association with the Pleiades here known as *Mul. Mul* is also seen in the *Mul.Apin* texts from Mesopotamia dated to circa. 2340 BC and which reveals the astronomical thinking of the time. However, the dates of the year from Euctemon differ to the Mesopotamian dates, as they should; the variation corresponds to the differences created by the shift over the period by precession, confirming the accuracy of observation at the time. Again, in Arab folklore it was commonly stated that the Pleiades disappear from view for about forty days. So effectively this was a widespread astronomical tradition, as valid as the equinoxes and solstices. The automobile manufacturer Subaru takes its name from the Pleiades as this is the historical name for the asterism in Japan. Legends attached to the Pleiades apparently came to Japan from China [although it is highly probable that indigenous stories were in existence]. The meaning of the word is commonly thought to be 'united' while the Chinese character used for the Pleiades, [Kanji] has a correct association with 'bright'. Putting these names and meanings together we see bright derived from unification or being close together, an apt description of a small group of not so [individually] bright stars. As noted earlier, the sky was of international importance.

The Biblical 40, it is noted, appears in a number of places. But why should this value be utilised for such diverse elements as periods of rain and the Jews 40 years in the Wilderness. [This can reduced to 40 days as the Bible also utilises the concept of 'year for day'; see Ezekiel 4:4-6, Numbers 14: 33-34 and hence 40 years can be reduced to 40 days.] It is repetitive, even to the New Testament where Jesus is tempted by the Devil for forty days. [Luke 4:2]. Taking this a little further, at Sochoth, Saul's army and the Philistines sat and looked at each other for forty days; Ishbosheth, Saul's son, was forty years old when he began to reign over Israel, David reigned for forty years, and as did Solomon and of course there is the tale of the 40 days of rain at the flood.

The implication of many [but not necessarily all] of the examples that one may care to unearth is of unpleasantness, or at the least of strife and struggle, whether physical or moral, yet is the researcher to examine the problem in this context? The answer is not really, because it has an astronomical root.

This commonality cannot mean anything but the same entity, the loss of view of the Pleiades for 40 days. But is that actually the case? Was the asterism in Taurus actually hidden for this period and when during the course of the year did it happen?

In fact this is a tradition that appeared to have commenced quite early but almost certainly came into its own circa 2950BC when the Pleiades were themselves rising and setting due east and west, a very rare occurrence. A tradition arose connecting the Pleiades with the flood story and the Bible gives an excellent example of this. However, to understand to what all that refers one needs to know to what it is to which the flood refers. This is covered in more detail in the book *Deluge from Genesis to Atlantis* and the paper *Stonehenge Measures* also contains some detail of this.

The association of the Pleiades and the sun at the equinox was even noted in India. Satapatha Brahmana [2:1:2:3] notes that the Krittikas [Pleiades] do not swerve from the east. Our astronomy programs confirm that this refers to the era circa 2950BC. This agrees with Professor Subhash Kaks comments on the Indian inclusion. We have not discovered any reference to the loss of view of the Pleiades from India however.

8.3.8 A late date for the flood

Many ancient calendars commenced their year from the first *new moon after the winter solstice* and that utilised in Genesis for the flood story is no exception. The long accepted Hebrew calendar is later than this event, traditionally dating to the time of Solomon or very roughly 1000BC and the recording in Genesis of the flood refers to the more ancient interpretation of commencement of the year. According to Genesis, the Deluge rains began on '*17th day in the second month'* of the year. The *year* of the mythical flood associated with 40 days and nights of rain was 2300BC and is denoted via a different astronomical consideration, a cycle of pole stars as described in the companion book *Deluge.* As seen in that work however, there is an alternative version of this in Genesis…one that has Noah's offspring building up the Middle East including Egypt, an impossibility at this late date because that work had already

been accomplished…This then meant that an earlier date was indicated…and this was ascertained via recorded astronomical observations in Indian material.

So, in 2300BC, by utilising computer astronomy programs we can see that the calendar year began with a new moon 23 days after the winter solstice. The rains are said to have commenced on the 17th day of the second month or 17 days after the second new moon of the year and this should, if the theory is correct, coincide with the 20 days before the vernal equinox when the Pleiades were lost from view. In fact it does…to the day. By no stretch of the imagination could this be coincidence, the 40 days and nights of rain of the flood story mean no more than the tradition of the loss of view of the Pleiades for that period. The beginning of this 40 day period in the spring of that specific year began at the 17th day of the second lunar month of the year, precisely the dating given in Genesis. The loss of view of the Pleiades is explained shortly as is associated with the positioning of the sun and Pleiades and the Pleiades being lost to view due to sunlight.

While it would appear logical that this set up should be seen on the ground elsewhere on the globe, it was mentioned in ancient writings repeatedly as has been demonstrated, this is the only location that the research to date has unearthed that in fact does display such a configuration. However, while it is comprised of isolated stones and hilltops and is not easily spotted, it nevertheless displays an arrangement that surely must be repeated elsewhere in Britain and across the world.

8.3.9 Pleiades and the sun in Gwent

The following sets of illustrations commence with a depiction of this peculiar alignment with OS refs and this is followed by sky charts [from the program *Skymap* written by Chris Marriot] indicating the visibility of the Pleiades which set at an azimuth of 270 degrees during the era of 2950BC. By the time of the Christian period and the Roman building of Caerwent fortified town circa 175 AD, this had altered due to precession to 298 degrees some 28 degrees to the north, yet the Romans made great use of the 20 days from the equinox angle as will be seen a little later. Today the rise of the Pleiades is in June and not in April as it was circa 3000BC although the 40 days period is still roughly acceptable. It would appear that a complete spring-autumn period of change of viewing of the Pleiades is covered by a precessional cycle. The angles involved here however are specific to the 20 days being applied either side of the equinox as was relevant at 2950 BC and these angles were deemed important…not least to the later Romans.

From Llanfihangel Rogiet Standing Stone, measured to the south, to the stone mentioned earlier in the chapter, that at Druidstone house we have a measured angle on our AutoCAD drawing, with all positions denoted by Ordnance Survey 1:25000 scale maps, of 12 degrees 51 minutes27 seconds from the equinox line. To the top of Twmbarlwm, from the same location, we have precisely the same angle, 12 degrees 51 minutes 27 seconds here measured to the north. This is the sunset at 20 days either before or after the vernal equinox. In fact Twmbarlwm could not be seen from Llanfihangel Rogiet as explained earlier yet the stone placements both at Llanfihangel Rogiet and at Druidstone are accurate. Here we have a count of days denoted by the sun over a hill top and a very carefully placed standing stone even

though the sun could not be directly viewed from Llanfihangel Rogiet in that setting position. It is clear that that the solar direction had been followed to set out the stones to the 20 day count before the equinox and the position denoted in this fashion. We have two stones and a hilltop very precisely indicating the positions of the sun at the 40 day period for the loss of view of the Pleiades as was observed at 2950BC. The stone marker at Druidstone became a companion to its larger neighbour to the north, Twmbarlwm. These positions are far too accurate to have any other meaning.

So at 2950BC we have Pleiades setting due west and rising due east and therefore invisible at the equinox. This situation just may occur again some 21000 years into the future…and possibly happened a full precessional period before this occasion in 2950 BC…but as far as human celestial observation was concerned this was a one off that lasted for a short period.

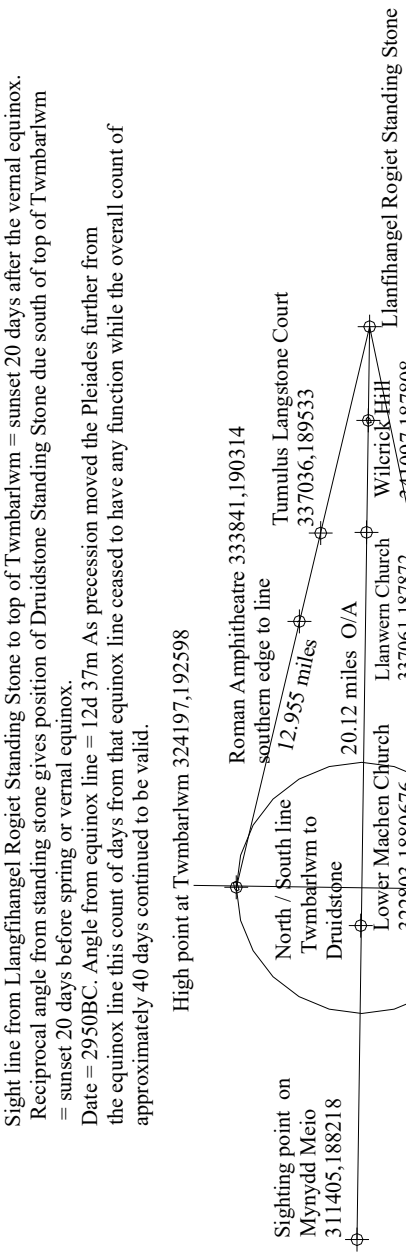


Fig. 8.25 Landscape: Sun alignments 20 days before and after the spring equinox.

8.3.10 Pleiades explanations: 40 days loss?

In this section we utilise Chris Marriot's *Skymap* programs to demonstrate what was seen in the heavens during period under discussion.

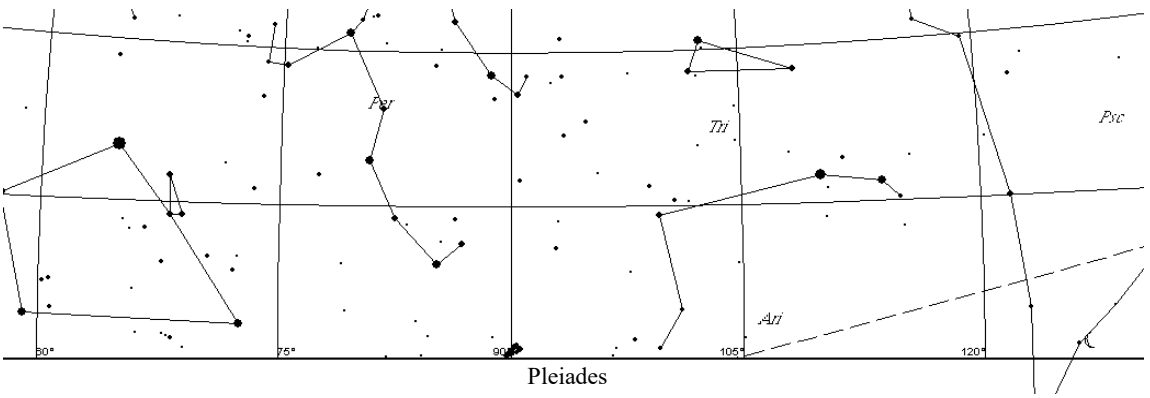


Fig. 8.26 Pleiades rising due east at vernal equinox 2950BC

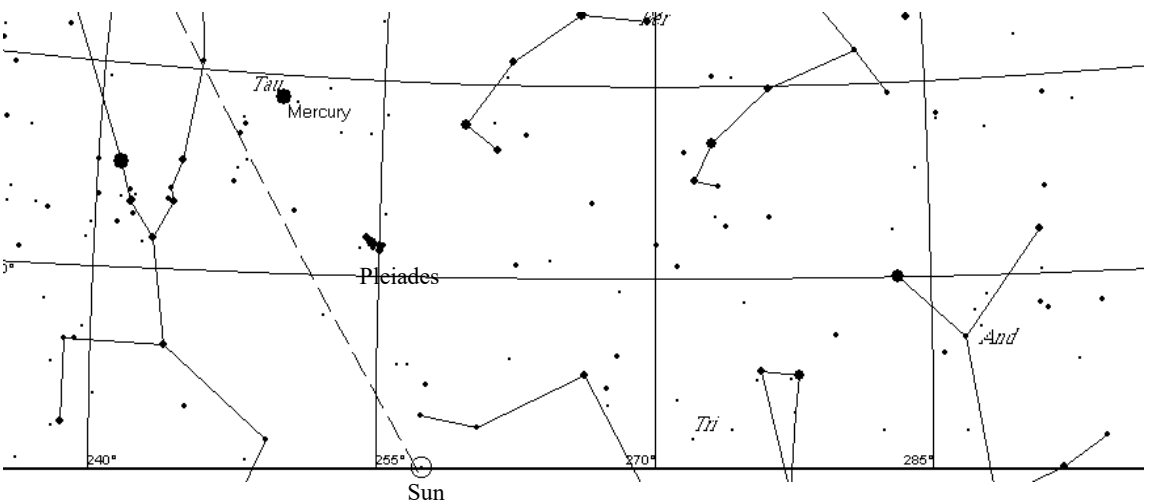


Fig. 8.27 Pleiades with setting sun 2950BC 20 days before vernal equinox. Pleiades 12 degrees above the sun and sets at the due west position of 270 degrees one hour twenty minutes after the sun. The Pleiades set was clearly visible here and was almost certainly visible for other two or three days toward the equinox making the 20 days a lesser 17 or 18 days. However the tradition is for 20 days [half of 40 days] so we shall work with that value.

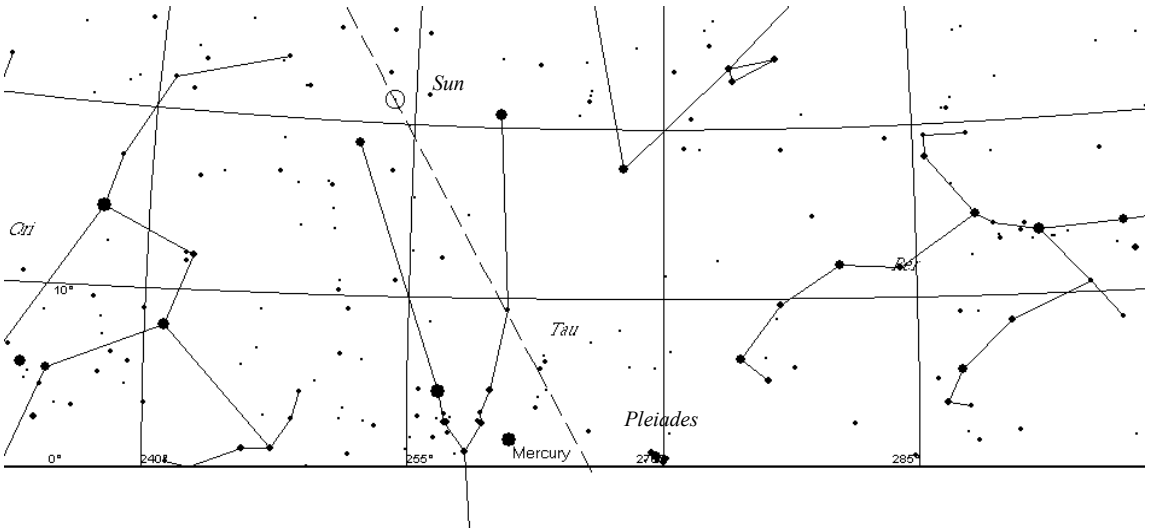


Fig 8.28 Pleiades setting 20 days after the vernal equinox 2950 BC two hours twenty minutes before the sun and hence invisible due to sunlight.

Fig. 8.29 Sun setting over high spot of Twmbarlwm as seen 20 days *after* spring equinox 2950BC-viewed here at spring equinox from a location just below Llanhennock village 2001AD- due east of Twmbarlwm. The visual representation is virtually identical.[Note the apparent size of the sun on the hill top.]

This view of the sunset seen here applied virtually exactly to the view of the sun from the *direction of* Llanfihangel Rogiet Standing Stone in 2950BC at exactly 20 days after the vernal or before autumn equinox…or it would if the stone were few feet higher but in fact this was probably viewed from a rise in the land at Knollbury just under a mile along the line. The sun set over the high spot of Twmbarlwm marked by the viewpoint on the map in Fig 8.16.

Calculation and experimentation with astronomy programs indicates that 2950BC was the more accurate era for the Pleiades 40 days disappearance scenario, the 20 days either side of the equinox in reality means that the Pleiades at those junctures were visible…just…at those points. In between due to their proximity to the sun they remained invisible.

This scenario is perhaps best known from the poet Hesiod's *Works and Days.* Hesiod lived circa 700BC, there is no accurate record of his birth or death. Hesiod wrote:-
'When the Pleiades, daughters of Atlas, are rising begin your harvest, and your ploughing when they are going to set. Forty nights and days they are hidden and appear again as the year moves round, when first you sharpen your sickle.

So we need discover the era when this applied. Perhaps other sources will reveal a clue to this dating.

After Hesiod, the Greek astronomer *Euctenom* listed the dates of the year involved, as indeed did the early Babylonians where the forty days in association with the Pleiades is also seen in the *Mul.Apin* texts from Mesopotamia revealing astronomical thinking of between 1300 and 1000BC. However, the dates of the year from Euctemon differ to the Mesopotamian dates, as they should, the variation corresponds to the differences created by the shift over the period by precession, confirming the accuracy of observation at the time.

Nevertheless, let us examine what does happen in the skies.

The skies at the time of Hesiod require an examination. At 700BC, 20 days before the vernal equinox, the Pleiades were not seen rising; but the set certainly was visible as it had been for months and would be for a further month. 40 days later the Pleiades would be invisible due to proximity with the visual sun.

At autumn we discover that the rise was set was invisible at the 20 days before equinox date and at 40 days later the Pleiades may have been seen shortly before their set but the sun was too high to allow the view of the actual set.

To explain a little further the view of the Pleiades was a heliacal rise which means that we only get a brief glimpse of the star as the sun rises. As a rule of thumb this means that the star involved [in this case a tight collection of stars] needs be at the very bare minimum 7 degrees vertically above the sun, in reality 10 degrees is a more suitable measure for naked eye observations of that brief view before the sun's brightness blocks the view of the target star. We note that this is for the star at the horizon with the sun below that horizon by 10 degrees. Of course cloud is a problem here but visibility without cloud is assumed.

Hence we are looking for a time when the brief visibility of the Pleiades was that viewed at the 40 day span indicated. From the above observations at 700BC it is apparent that while the Pleiades were seen as noted, the visions fail to meet the criterion of the heliacal rising with a brief view of the object, the Pleiades. Hence Hesiod was repeating what had become a tradition. While the observations in this text relate specifically to South Wales, there would not

be sufficient difference at the location of Greece to alter the results noted, merely a small difference in times and visual spacing as is seen below.

The Biblical use of this 40 days tradition at 2300BC requires examination.

Vernal equinox at 2300BC had the Pleiades at 2 degrees latitude above the sun with a 3 degree azimuth separation. Note below the variation of the swing in the ecliptic between morning and evening at different latitudes.

20 days later than the equinox the sun rose 7.5 degrees behind the Pleiades and hence the Pleiades were probably [although not certainly] invisible. However that is for the latitude of South Wales, at 30 degrees latitude a 13 degree difference is apparent. This is due to the greater apparent 'swing' of the ecliptic line at a lower altitude. Latitude is important in this regard. The set here would not be visible as with the Pleiades leading the sun across the sky they would set before the sun.

20 days before the equinox the situation was reversed with the sun rising 13 degrees above the Pleiades making Pleiades invisible. We start in the morning with the sun leading the Pleiades by circa 1.5 degrees vertical and circa 23.5 degrees horizontal separation. By the time of set in the evening the ecliptic line has moved to nearly vertical and the separation between sun and Pleiades is vertically circa 21 degrees… in the favour of visible Pleiades as the sun sets first.

However this does not comply with the 20 days relationship to the vernal equinox as that 13 degrees requires decreasing to arrive at a briefer glimpse of the heliacal rising Pleiades.

The setting of Pleiades works for the 20 days before the vernal equinox at circa 3200BC with 8 degrees of separation which may not be quite sufficient. If we allow 11 degrees of separation which should certainly be effective we are looking at 2950BC for <u>the set</u> of Pleiades 20 days before the vernal equinox. At the latitude of South Wales UK this gives a 12 degree latitude separation between the setting sun and the following Pleiades allowing that brief glimpse.

At 20 days after the vernal equinox at 2950BC viewed from South Wales the rise of Pleiades was between 9.5 and 10 degrees above that of the sun with a 25 degree lateral separation. Hence the Pleiades should have been briefly visible, while at the set the Pleiades were below the horizon long before the sun and hence they were invisible.

However at the autumn,20 days before the autumn equinox we have a rise of Pleiades due east while the sun was to set 9 minutes later at 14 degrees north of west. Hence here Pleiades visibility may be said to be debatable, the sunlight from the opposite side of the sky may have been too bright for the Pleiades to be seen. However, as the sun was on opposite sides of the sky and both sun and Pleiades close to the horizon the horizon it seems highly probable that the Pleiades rise would be seen just as the sun was setting. Further, by correctly allowing for refraction the sun would in fact be visibly almost behind the horizon allowing that the Pleiades would indeed be visible as they rose above the opposite horizon. Hence we can state the Pleiades would be visible at this point. At 40 days later, 20 days after the autumn equinox we once more have Pleiades rising due east but here at 92 minutes before sunset and hence Pleiades would be invisible.

In summary it seems that the closest to an equal 20 days each side of the equinox, vernal and autumn, when brief visibility was reasonably assured, would appear to be circa

2950BC. However the rise only seems to be the viable entity at 2950BC whereas at 700BC rise and set play a part as denoted at that era by Hesiod, here though the views are not necessarily brief. Hence the Hesiod description is a little short on accuracy and does not comply with the 2950BC views. The Biblical version is only to give the 20 days before the vernal equinox at 2300BC.

The description [apart from the use of rise and set] appears to apply to the era of 2950 better than any other and by the Roman era the whole edifice was meaningless. Hesiod was using what had by then become a tradition as were the authors of Genesis.

This 20 days in relation to the equinox was applied to the flood story of Genesis where the year commenced at that time at the first new moon after the winter solstice and the count of days given in the text gave 20 days before the vernal equinox. The date here was 2300BC [detailed in the book *Deluge from Genesis to Atlantis*] but as notede above this was not strictly accurate for the Pleiades visibility even though the count of days is perfect uin reltiontothe vernal equinox. Hence it can be seen from this that a tradition had already been established by the time of the creation of the Biblical flood epic [written circa 800BC] and was being applied to situations where it did not strictly work. Nonetheless, as the 20 days was applied to the equinox it is apparent that the tradition stems from the era circa 2950 BC as applies to South Gwent. The 20 days either side of the equinox was exclusive to the era of 2950BC and as seen applies at that date to the setting out here in Gwent.

8.4 The Roman Copyists.

Introduction

Roman remains are of perpetual interest, specifically in Gwent where we have the fort of Isca, known otherwise as Caerleon, a couple of miles up the River Usk from Newport town centre. The region was a Roman stronghold and unfortunately Roman history and archaeology seems to take precedence in the area. Here at Caerwent we have a ‘citivas’ where the local tribes were involved with the running of the metropolis although of course the Romans were in charge.

While much has been learned regarding this township, we find that the layout of town, its orientation and dimensions have not been discussed, or at least not in any paper that the research has unearthed.

The town is set at an odd angle. It is set atop of a small hill, perhaps a rise in the ground would be a more apt description, it could hardly be called a hill except for one short section to the east. So what denoted the angle of its axis? Why was it built at this precise location when other adjacent sites would have served just as well? Apart from the large stone walls surrounding the precinct there is little of a defensive nature, certainly not the location.

The question arose of paying some sort of respect to the conquered tribe of the locality, could the site, or perhaps the angle of axis been determined by the locals and not the Romans? Perhaps a novel idea but at least it would have been a peaceable suggestion from the Roman

viewpoint. This was investigated and the results were very surprising as the illustrations and descriptions reveal.

8.4.1 Explanations

Venta Silurum

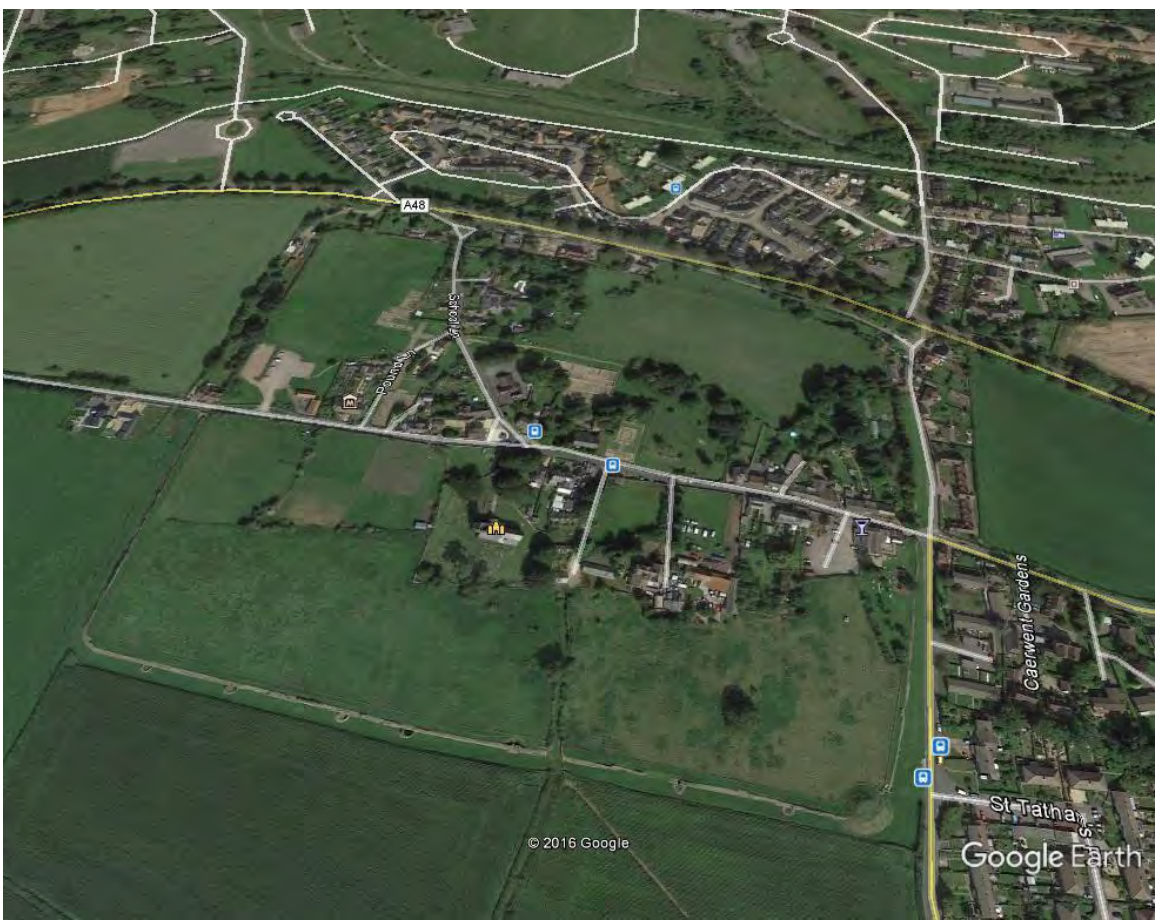


Fig 8.30. Caerwent Roman Civitas –Venta Silurum. [Google Earth] Note the Norman motte at the south east corner

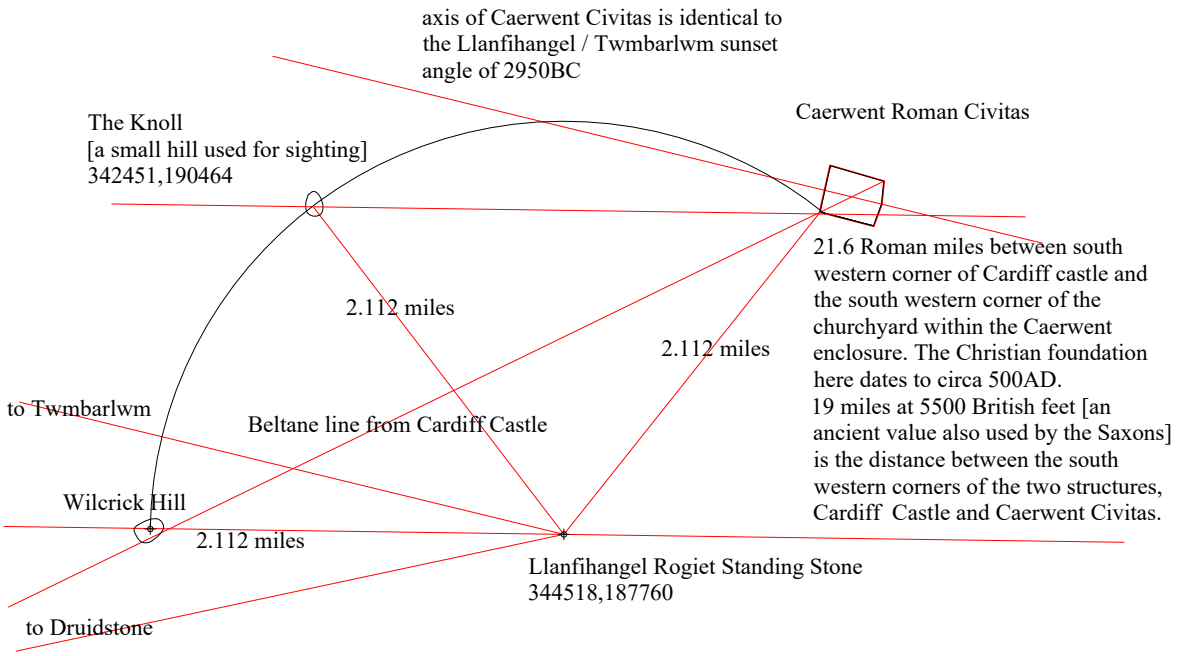


Fig 8.31 Setting out of Venta Silurum

Important here is the axis of the Civitas. This is identical to the angle between Llanfihangel Rogiet Standing Stone and the top of Twmbarlwm Mountain, the sunset at 20 days after the vernal equinox, 12.85763826 degrees above the equinox line as set out circa 2950BC or perhaps later , but with the correct criterion for that era. Cardiff Castle is the mirror image in terms of axis and this one's angle is identical to the Llanfihangel Rogiet Standing Stone to Druidstone Standing Stone angle.

Civitas internal dimensions appear to be very close to 1535 x 1303 British feet measured internally as near as one can ascertain. This will be a conceptual value as the perimeter is not quite straight and angular. The same criterion applies to Cardiff Castle.

Making some calculations we then arrive at the conclusion that the measures were intended to represent 1532.80512 x 1305.074071 British feet. This gives 175 x 149 Roman reeds of 9 feet at 0.9732096 British feet, a perimeter of 648 Roman reeds. Area is 2000424.222 square British feet .

The Roman foot of 0.9732096 British feet when squared results in 0.947136926 square British feet and 2112000 square Roman feet = 2000353.187 square British feet. This is 71.0352 square British feet less than the 2000424.222 square British feet calculated for the area. Dividing this remainder of 71.0352 square feet by the perimeter of 648 Roman reeds of 8.7588864 British feet we find that the difference to each face of the perimeter is a tiny 0.15432

of a British inch. For all practical purposes this 2112000 square Roman feet could feasibly be seen as an intentional representation.

This numerical value of 2112 will be seen frequently and it represents the inches in the cubit of 1.76 feet. This is seen at Stonehenge and is 1/6 of the reed value of 10.56 feet. Therefore there are 180 cubits at 1.76 feet or 21.12 inches in the centreline sarsen lintel circumference. While here we have a count of 2112000 it will shortly become apparent that the distance of 2.112 miles British is important in terms of setting out across the landscape. This is seen linking Llanfihangel Rogiet standing stone to Caerwent Roman Civitas.

Cardiff Roman Castle

The castle seen today in the centre of Cardiff City is a Norman construction which has been amended in more recent Victorian times and was built over Roman foundations and incorporated some Roman walling into its structure. It was the fourth built on the site. The first, which covered a larger area than that visible today was built and occupied between AD 55 and 80. As resistance from the local tribes eased and the conquered region expanded this was superseded by two smaller units to the north of the castle we are examining. This castle was built during the middle period of the third century. [Info from well referenced Wikipedia article.]

Importantly here is the axis of the castle; this, as at Caerwent, emulates exactly the angle of sunset associated with the loss of view of the Pleiades at 2950BC. Here the angle is that of Druidstone to Llanfihangel Rogiet. Further, the angular relationship between this castle and Caerwent Civitas is that of Beltane, the sunrise Beltane angle from the south western corner of Cardiff Castle leads one to the south western corner of Caerwent Civitas very accurately. Note this is not the commonly assumed Mayday but the half way mark between vernal equinox and midsummer. Within nine feet of the internal face of the southwestern corner we have 19 miles at 5500 feet from the south western external corner of Cardiff Castle. This has been seen as the Saxon mile but in reality is another ancient unit with its step value of 2.75 feet being found in ancient India, Sumeria etc.

The castle is close to square in plan and it is thought that the Taff river was alongside the building at the era of building and in fact denoted the not quite straight shape of the western wall. The river would have been navigable to here from the Bristol Channel to the south.

But given the ability of the Roman engineers this would not have been a problem, the walls could have been straight and the river bank dug out relatively easily to accommodate small craft arriving with supplies; an annex to the castle could have provided access to the river. However the shape of Caerwent is also a little off true on the north face leading one to ponder whether this ‘wobbly’ one side was a deliberate trait, maybe a showing to the gods that only they were perfect, an obvious inbuilt flaw? This occurs in Islamic art and perhaps the concept is much older? Alternatively perhaps pre-existing tracks and / or river banks were seen as inviolate? In which case why not built a few feet to one side? We do not as yet have an answer supported by firm evidence for these odd shapes.

While the plan view is 'not quite but nearly' square, its approximate dimensions are given in length and breadth internally and effectively the produced values will almost certainly be the values applied as occurred at Caerwent, in a conceptual fashion.

Calculation indicates that the desired value was almost certain to be:-

Internal perimeter = 2534.4 x 0.97777777 feet. [Foot explanation below]

Published approximation is for 635 feet x 603 British feet, a total internal perimeter of 2476 feet. It is unlikely to have been accurately constructed in British feet however and the total perimeter has no apparent numerical connection to anything else hence we assume that a measure very near to the published approximation will be correct.

The nearest length and breadth values that comply are 650 x 0.977777 by 617.2 x 0.9777777 This makes the perimeter 635.5555505 x 603.484444 British feet hence the total internal perimeter is calculated at 2478.08. Therefore over the distance of 2476 we gain 2.08 feet which is 1/1190 of the original approximate total. The mean difference to the published approximate internal perimeter is of 3.113 inches to each face. This is realistic.

In explanation of the applied measure 0.9777777 feet is 11.73333333 inches where 1.17333333 feet is the foot value associated with the reed measure of 10.56 feet seen as the sarsen lintel support centres and indeed the centreline length of the lintels of which 30 make the circle of lintels. Hence this being the case it is a small matter of dividing 1.1733333by 1.2 [12] to find 0.97777777. 1.17333333 feet is 14.08 inches and its cubit [x1.5] = 1.76 feet or 21.12 inches. These values have been seen in the vicinity of Caerwent. The mile value is already apparent in the sketch showing the relationship between Caerwent and Llanfihangel Rogiet stone.

Fig 8.32 Cardiff Castle [Google Earth] Note the Norman Motte and Bailey castle within.

8.4.2 Conclusion

It is apparent that the uses of sun and moon [and elements such as the Pleiades] are insufficiently explored by the professional researchers of old sites when in reality these may have been of paramount importance. Even the archeo astronomers do not appear to take note of such arrangements regarding buildings, or if they do the results of their works are certainly not published as they should be.

These explorations are open to anyone with a computer and astronomy program and some maps along with a compass and knowledge of obtaining true from compass bearings.

Aligning objects to points easily found on maps on distant horizons are a more accurate way of aligning things however and this also eliminates some chances of error.

Findings are liable to be valid in any location with visible hills and some ancient standing stones. Proving intent is far more problematic and that is where things tend to fall apart as coincidences do indeed happen. However, there is a vast amount awaiting investigation, research that does not require digging or expensive scientific analysis but which can be successfully accomplished by the amateur in their own home. It certainly makes life that much more interesting and rewarding! Later we shall reveal some of that which is hidden in buildings, and these are even easier to investigate.

CHAPTER 9

Silurian Country-Sun, Stones and Burials

'The telescope of early times was the line of the horizon.'
Sir Norman Lockyer

9.1 Gray Hill (Wentwood) Silurian Country: Sun, Stones and Burials

To the east of Newport, above the Roman town of Caerwent and the valley of the Severn Estuary as it broadens out into the Bristol Channel is Gray Hill. This upland region commands panoramic views of the estuary, the two road bridges and all the land between, and indeed the land on the other side of the river. One can view England to the east of the first Severn Bridge and from the same viewpoint see North Devon. One can view the hills of South Wales. This is place of visions. It is a favoured place of Gillian and Harry Sivertsen who have walked this hill many times over the years. It was the home of the Silurian Celtic peoples, as was the remainder of Gwent, Glamorgan and part of Breconshire.

It is a place of burials; it is a place of astronomy. At Gray Hill we find a stone circle, [or more probably the remains of a cairn] a solar/lunar alignment, what is left of a large cairn and recently archaeological investigation has revealed the existence of more cairns. In fact much more remains to be ascertained regarding this region as the remnants of what may well be hut circles and enclosures have been unearthed on the hillside. There is a medieval field system, the stone for the walls of which probably denuded the cairns. It is a region which has not been exposed to intensive agriculture, as far as research has indicated, merely used for upland grazing without any ploughing but some quarrying activity was ongoing in the not too distant past.

Here, regarding the quarrying, we shall reveal the comments of archaeologists Children and Nash because these are typical of what was written until very recently regarding the region. There is a stone astronomical alignment here. According to Children and Nash it was a 'processional way' leading to a group of cairns at the top of the ridge.[1] No such cairns existed. If this were the case then the sun, or as we shall see, derived lunar alignment, coupled with the lean and shape of the involved stones would be meaningless as neither the sun nor the moon would be seen as intended. In fact what Children and Nash perceive to be the remnants of cairns is the remains of quarrying just below the ridge of the hill that took place in 1917 for stone to build Llanfair Discoed School. Here outcroppings of stones of a convenient size for building were discovered, some of which are still visible today. Gillian has an acquaintance living in the village who not only attended the school as a child, but was told of this quarrying by one of the men who worked on the hill, bringing stone to the village from this specific location with a horse and cart. In all probability the stone of the mediaeval walls which likely came in part from the earlier cairns was probably reused on the school along with that quarried as noted. As the location under discussion is less than a mile from the village where he has

lived most of his life and as a child he played on Gray Hill, shortly after the said small scale quarrying, Gillian's friend was very familiar with the area. The remnants of the diggings were pointed out when on a group walk around the region. Children and Nash have not only failed to check the more recent local history of the area as any respectable archaeologist should do, but have completely disregarded the shapes and angles of the stones and the angle of the alignment in their analysis. Their ideas are totally misleading and unfounded. Unfortunately, Aubrey Burl has referenced the description by Children and Nash and utilised it his work *The Stone Circles of Britain Ireland and Brittany* p.176 and hence numerous people will now erroneously assume that this is the case. It is clear that the 'authorities' are only as good as their sources and in this case the source was unreliable.

Fig 9.1 Apparent cairn remains at Gray Hill [according to Children and Nash] but in fact the remains of surface quarrying of the early 20th century. Photograph by Gillian Sivertsen

On the map we see a large cairn at the western end of the ridge. This would have been visible for a great distance. The stone circle is more probably the remains of another, smaller cairn, and is located to the east of this larger version. Recent research has unearthed other cairns to the south east of the stone circle. [We shall continue to term it a circle although evidence is for a cairn.] This has been termed a 'kerbstone circle' due to the formation around its perimeter and assuming it was a burial chamber, possibly had a light box facing midwinter sunrise or perhaps more appropriately here, the equinox sunrise, as there were upright stones, probably some 3-4 feet high above ground which are now laying prone within its boundaries

and it is known that another other similar stone of a comparable height was standing within the circle during the 19th century but has since disappeared. Between the large cairn and the 'stone circle' is the mediaeval field system. The standing stone marked on the map is what we have termed the 'top stone' of the alignment as it is uphill of the lower stone, a prone middle stone is in line but flat on the ground.

Fig 9.2. Gray Hill at 1:25000. Note the steep slope indicated by the contours at the West end of the ridge beneath the Cairn.

Fig 9.3 Large cairn remains at extreme western end of ridge at Gray Hill (Looking south west).

There is a solar alignment at Gray Hill, an equinoctial line. This involves the northern edge of the stone circle or more likely, kerbed cairn and the southern extremity of the large cairn at the western extremity of Gay Hill. These are not visible one to the other today as both have been denuded of stone but when fully standing certainly would have been seen as being related via the equinox one to the other.

There is an additional alignment that has been thought to be solar and in previous editions of this work was denoted as such. In fact further investigation and refinement by the author makes it plain that this is a lunar alignment but that the setting out on ground was, as previously stated, that of the midsummer sunset. The difference is seen in the rise in the hillside, a small but perceptible inclination that was not given sufficient attention in the past.

While midwinter sunrise is locally frequently stated by local observers to be the purpose of the alignment, [see photograph by Colin Titcombe] the stones are ill placed to view this phenomenon, and the midsummer sunset, NOTE, at a level horizon, was the important position. This gave the relevant angle. The midwinter sunrise concept was first publicised in the middle of the 20th century by Fred Hando, a local historian and well respected popular school master. In the winter the stones do not tell one to look at the point where the sun will rise because as can be seen in the photograph only the top stone is visible and the view could be in any direction contained with the square cut out of the stone.

This is evident on site because of the alignment of the tops of the stones. Looking at the sunrise there is no second stone for alignment; one is looking above the lower stone to the distant horizon and not at the stone's top. On the other side of the Severn there is a slight dip in the horizon to which one has to sight to see the effect of the sunrise but one does not have to stand at the position of the stone to see this hence the stone and the sunrise are not connected, it is stressed that the lower stone is well below ones sight line here and therefore plays no part except for an approximate directional guide which is only apparent *after* the sun has risen. *However, looking up the slight slope and sighting the centres of the tops of the stones we have a perfect correlation with the horizon, at the point* ***above*** *that at which the sun descends at midsummer's day.* Unfortunately, there is a thick copse of birch blocking the view nowadays and the midsummer sunset, dramatic as it may be, simply cannot be clearly seen to photograph.

Fig 9.4 Midwinter Sunrise looking over top stone of Gary Hill alignment [Colin Titcombe]

Fig 9.5 Top stone of solar alignment viewed in reverse showing top of bottom stone in the cleft formed in the top stone. It is clear from this illustration that no sunrise alignment could be accurately observed from this position and therefore the sunset would have been the phenomenon viewed. The second Severn Bridge is just visible in the distance giving a further indication of location.

The square sectioned bottom stone of this alignment which orientated to the cardinal points, is immediately adjacent to the stone circle/cairn. There are two fallen stones within the circle which local legend claims were standing during the early part of the twentieth century with a third having disappeared during the century before. This is suggestive of the construction of a chamber. Possibly this was a small chambered tomb of cairn type construction

with a light entrance for midwinter sunrise; this idea would comply with the existence of the taller remaining stones.

Fig 9.6 Recumbent stone within circle

Fig 9.7 Part of Stone Circle remains at Gray Hill [OS ref 343794, 193533] with bottom stone [OS ref 343802, 193538] of solar alignment.

The diameter of the circle complies with the value of the 'megalithic yard' devised [or discovered] by Alexander Thom, and extended from its suggested value of 2.72 feet to 2.7272727. Here Gillian and Harry discovered that there are 11 of these measures to the inner circle and 12 to the outer making the thickness of the kerb stones of its perimeter half a megalithic yard. In fact, in terms of ancient measures, this would be a step value of 2.5 feet where a cubit was 1.5 feet and hence a foot associated with this unit would be 1.090909 feet. While few stones are extant, sufficient does remain of the circle to envisage that there were 15 stones in the perimeter of the circle. Possibly this represented the 'dark fortnight' of the month which in some cultures is seen as being associated with the ancestors…the dead...quite fitting for a tomb.

The scattering of stones to the east of the circle suggests that perhaps an entrance region perhaps with a 'light box' had originally been constructed here, possibly extending on its northern edge to the stone D in the illustration. The distance from the circle to the large cairn is some 415 metres, virtually exactly 500 megalithic yards [steps].

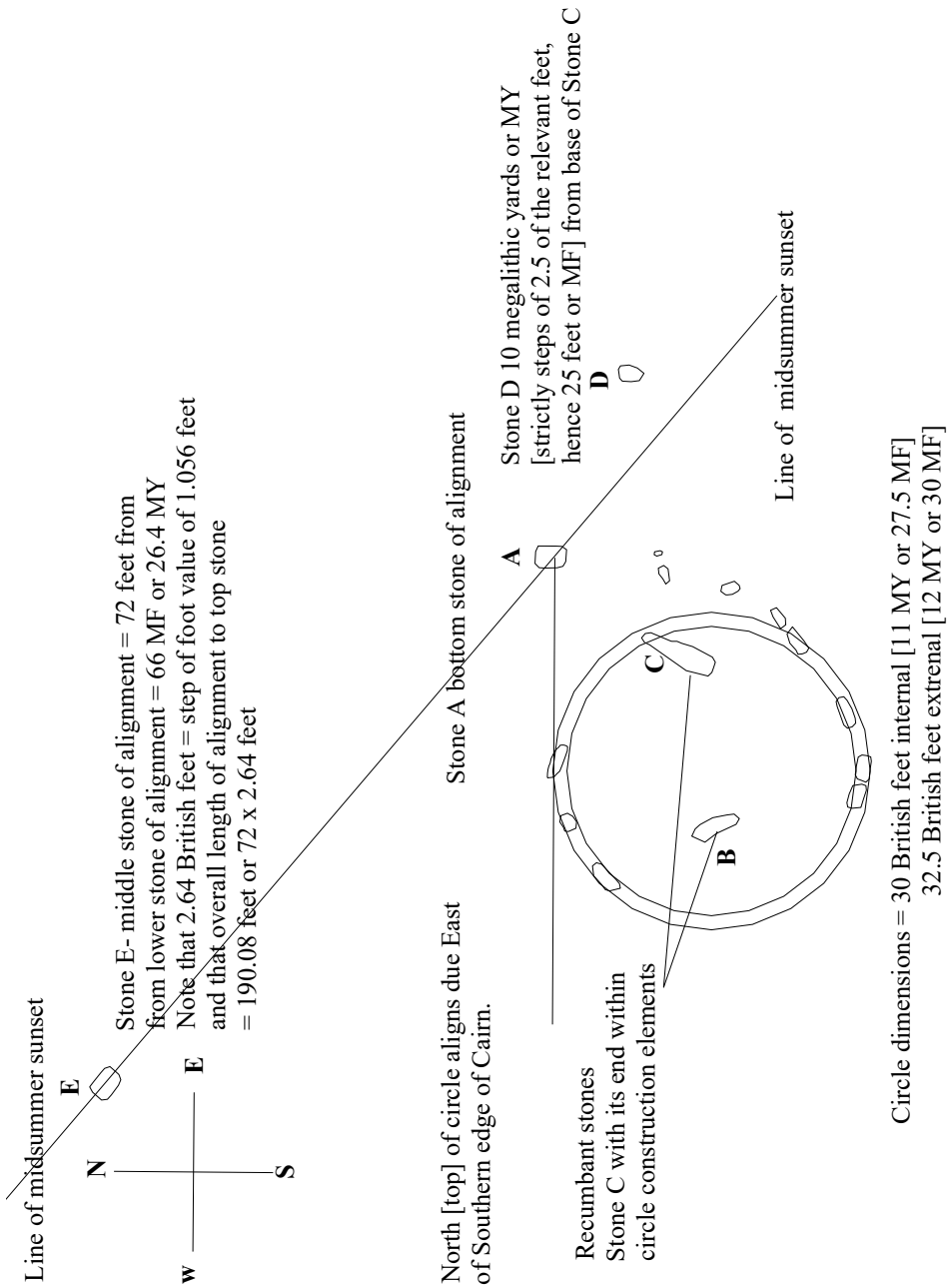


Fig 9.8 Stone Circle at Gray Hill: Details with some dimensions [Drawing by Gillian Sivertsen from survey by Gillian and Harry Sivertsen]

Fig 9.9 Bottom Stone [OS ref 343802, 193538] of alignment, Southern face

Fig 9.10 Alignment of bottom stone East /West shown on compass [Southern face]

Fig 9.11 Middle Stone of alignment [OS ref 343785, 193552] following the alignment along its prone length

Fig 9.12 Top stone of solar alignment [OS ref 343758, 193576] viewed from part way along the alignment.

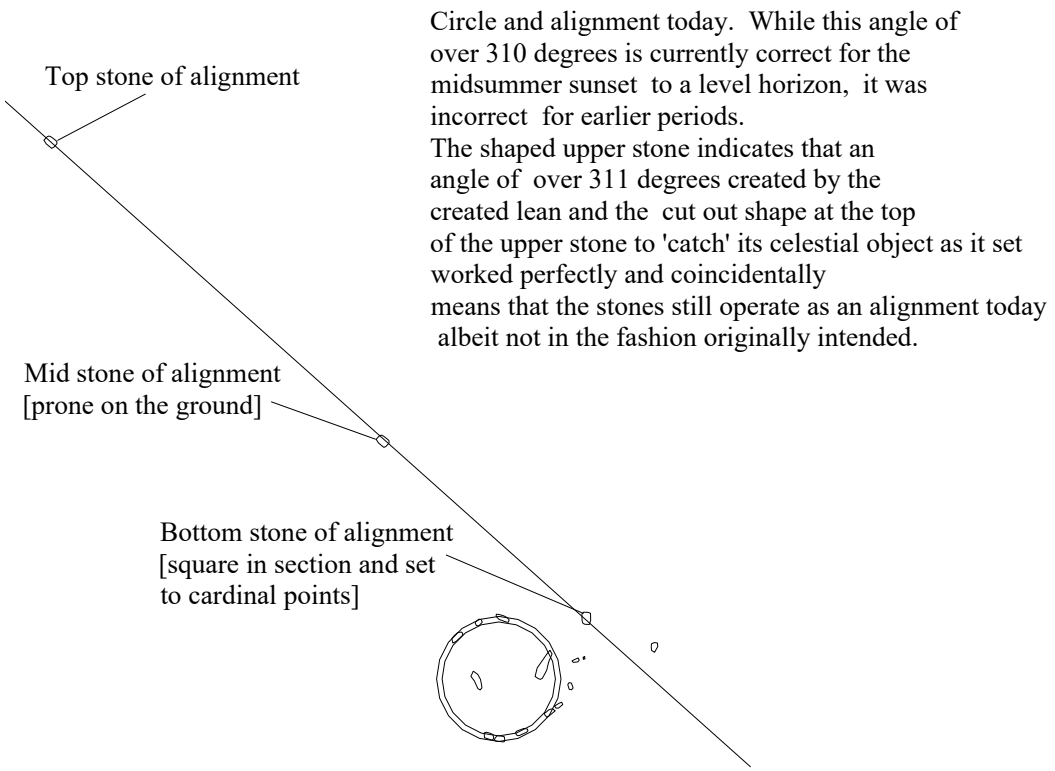


Fig 9.13Layout of stones and Circle [small cairn]at Gray Hill. The origination of the circle or cairn is unknown. By comparison to Trellech [date here guessed by archaeologists] we have a date of circle 1400BC. Below is a replication of the view seen when this alignment was fully operational.

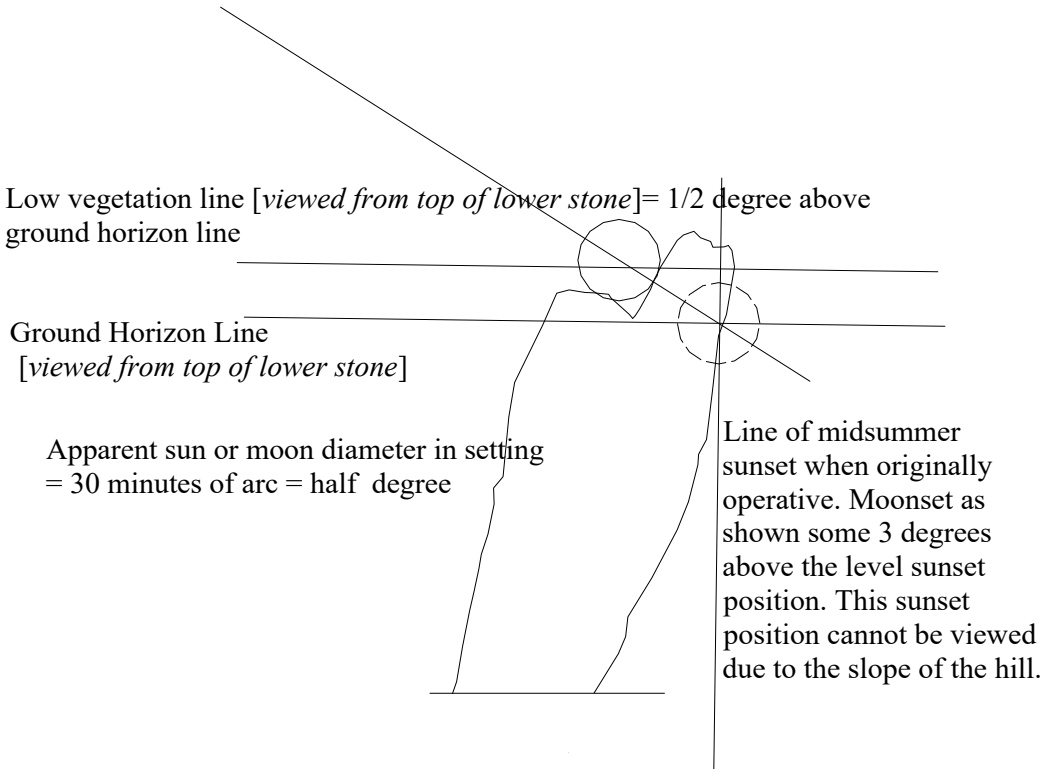


Fig 9.14 Top Stone at Gray Hill in operation.

Here we deviate somewhat from the original interpretation of this alignment because the term used above…level horizon…plays a very important role. This is the position of the sunset certainly but as noted above, there is an inclination to take into account and this means that the horizon is in fact a couple of degrees above that indicated here. If the sun was the target then the stone would be set a few feet to the west of the position that we view it.

What in fact we are looking at is moonset at midwinter at, or very close to the major standstill. This is an infrequent occasion and to make even less of a common event, it is the full moon that was observed.

So while the local idea has been for a midwinter sunrise it was the midwinter moonset that was the target. However, the sunrise as depicted in Colin Titcombe's photograph [Fig.9.4] is highly relevant because this sunrise was observed at the same time as the full moon was setting.

The following text and illustrations reveal what has recently been discovered. The whole sequence of events covers the period from1732 BC to 1271 BC.

9.2 The stone alignment of Gray Hill, Gwent, UK.

Gray Hill Stone alignment angle is that of midsummer sun at a level horizon for the year 1547BC at azimuth of circa 311d 40 m38s. However this is not a level horizon and using the height and distance values extracted from Google Earth of 864 feet [top of slope] less 826[lower stone] there is a difference in level of 38 feet over a distance of 686 feet. When evaluated this gives an angle of 3.1799184 or 3d 10m 47.7s.

The values given here are fine and are derived from astronomy programs. Of course man was not able to measure seconds of arc or time accurately during the period under discussion but he understood the implications of such small units.

Refraction implies an increase in elevation of some 30 minutes of arc at this latitude from the precise astronomy program position of the sun or moon to its visible position. It is often stated then when the sun is just touching the horizon it has already set. This is similar to the optical illusion of a straw in a glass of water appearing to be bent when it is straight. Hence the 'real' positions denoted in the astronomy programs need to be revised to give 'apparent' positions as were observed and to which the stones were set up.

The moon follows the same path, the ecliptic line, as the sun but unlike the sun varies circa 5 degrees each side of this line. The maximum deviation gives the lunar positions termed standstills.

At Gray Hill we observe that the sun will not be seen at level horizon position although the stones of the alignment give this angle. As seen above, the elevation of the slope as denoted by Google Earth is 3d 10m 47.7s and at full moon at moon set on midwinter's day, within a minute [in time] of sunrise diagonally opposite on the horizon, the actual elevation of the moon was 2d 37m38s above the midsummer sunset position on a level horizon. To this we need add 30 minutes of arc for the refraction error making the moonset [horizontal centreline of moon] at an elevation above level horizon at 3d 07m 38s. The centre of the moon was, however, now invisible at 3m 9s above the level horizon. The natural horizon here as denoted by Google Earth is 1m 38s above this position hence moon centre is 1m 28s below the visible horizon.

This elevation, following the line of moonset, occurs behind the upper limb, the protruding finger of the stone and in fact if there were no low level vegetation the moon would just be visible as it began to sink behind the hill to the right side of the stone [lunar position 3] on drawing. The time here was 09:26:39.

The moon was visible half behind the finger of the stone [lunar position 2] on the drawing at 30m of azimuth earlier. The time here was 09:23:54AM. Again, 15 minutes of azimuth before that [lunar position 1] the whole moon would have been seen in the square formed by the shape of the stone. Time here was [09:22:31]

Sun rise time diagonally opposite the full moon set on midwinter's day here was 09:27:34AM.

Hence we have a sequence of full moon in the 'hand' of the stone, the moon half hidden behind the stone 1 minute 22 seconds of time later, then the moon with a quarter visible unless hidden by low level vegetation 2 minutes 45 seconds after this, a total from the stone

'catching' the moon to the moon set of 4 minutes 7 seconds and then 55 seconds later the sun is seen risen diagonally opposite around the horizon.

This was quite a spectacle as the first visible glimpse of the sun would have been as the stone was 'catching' the moon and as the moon was sinking behind the stone the sun was rising diagonally opposite around the circle of the horizon. Both rising and setting movements could be seen simultaneously.

Consequently it appears that the civil engineers of 1547 BC or earlier in Gwent managed to 'catch' the full moon as it set at sunrise on midwinter's day of that year. This was not at the full major standstill but the deviation from the ecliptic by the moon at that time enabled the full lunar orb to be observed setting as the midwinter's day sun was rising.

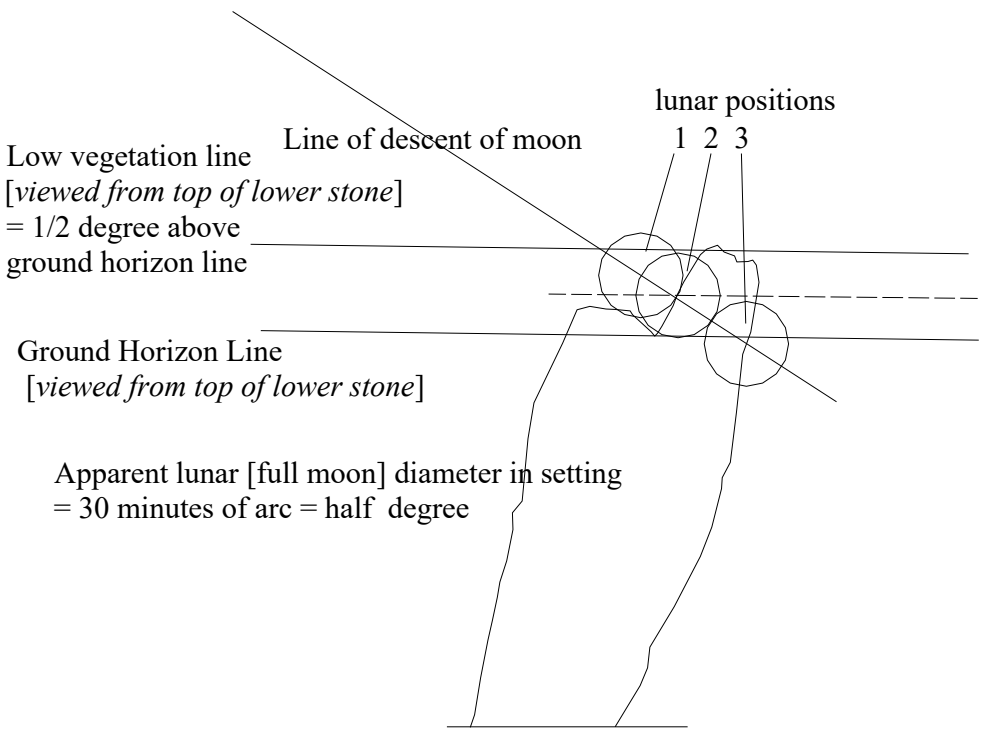


Fig 9.15 Midwinter's day full moon setting at Gray Hill 1547BC

This is the best of a number of very similar associations. In fact this construction was almost certainly set up a while earlier as the next illustration implies.

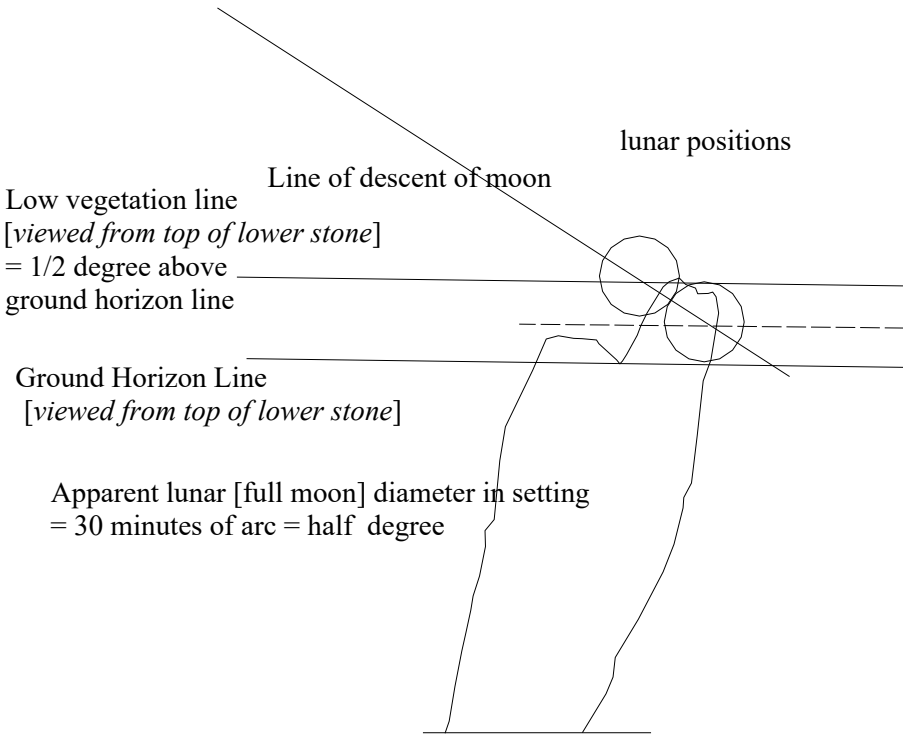


Fig 9.16 Midwinter's day moonset 3 days after full moon at Gray Hill 1732BC

This occurrence is 185 years prior to that seen above. If these alignments were exactly following the major standstill cycle then their spacing would be a multiple of 18.6 years. Due to the difference between lunar and solar orbits however things are not that simple.

The standstills occur at five degrees both sides of the ecliptic with the upper position being classed as the major and lower version being the minor. Add to this that the lunar position is altering rapidly due to the 354 days of the lunar year compared to the 365 of the solar and it can be seen that deviations are extremely common. The moon, which sets Leo in 1547 as was the case with the midwinter day full moon of that year, will set in Pisces a solar year later and far from being full it will be two days past its first quarter. The moon has 'gained' five constellations in its race around the zodiac in the course of twelve solar months. As the rise and set positions are continually moving repetitions of position are far from as common as one may initially imagine.

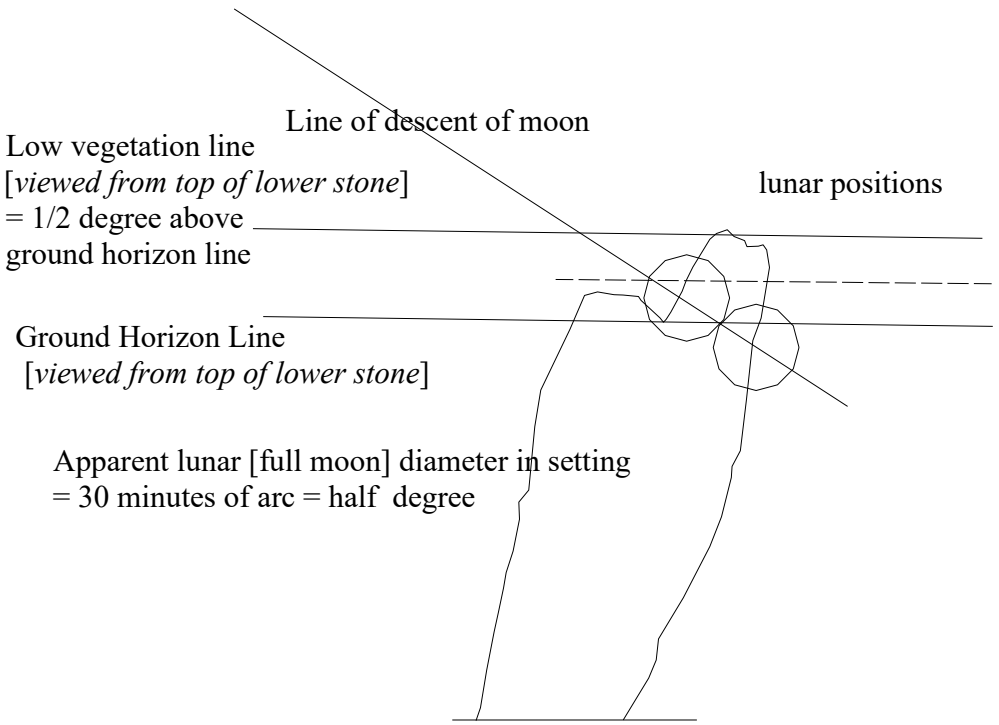
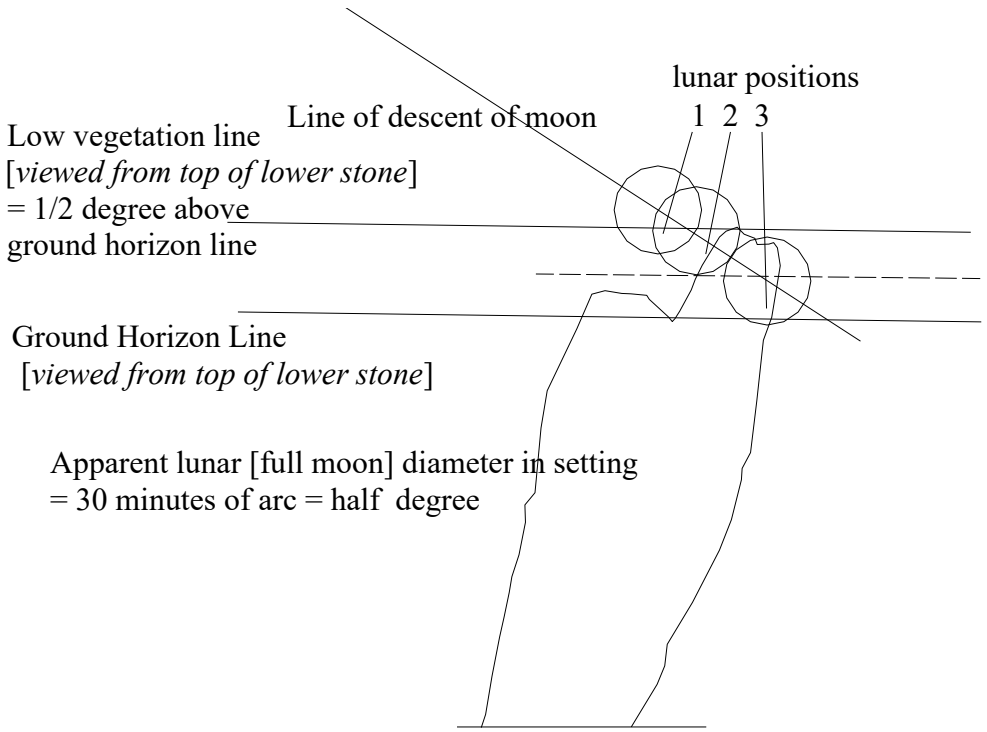


Fig 9.17 Midwinter's day moonset 2 days after full moon at Gray Hill 1824BC

It would seem that it was the observation of moon set at this time that prompted the erection of the stones at Gray Hill. It would have been realised that the moon in its midwinter full condition was setting immediately over the sunset position for midsummer and that its elevation was increasing.

The increase eventually meant that the alignment was again lost however as it became too high at the end of this sequence of events when the stone literally 'caught' the moon its descent.

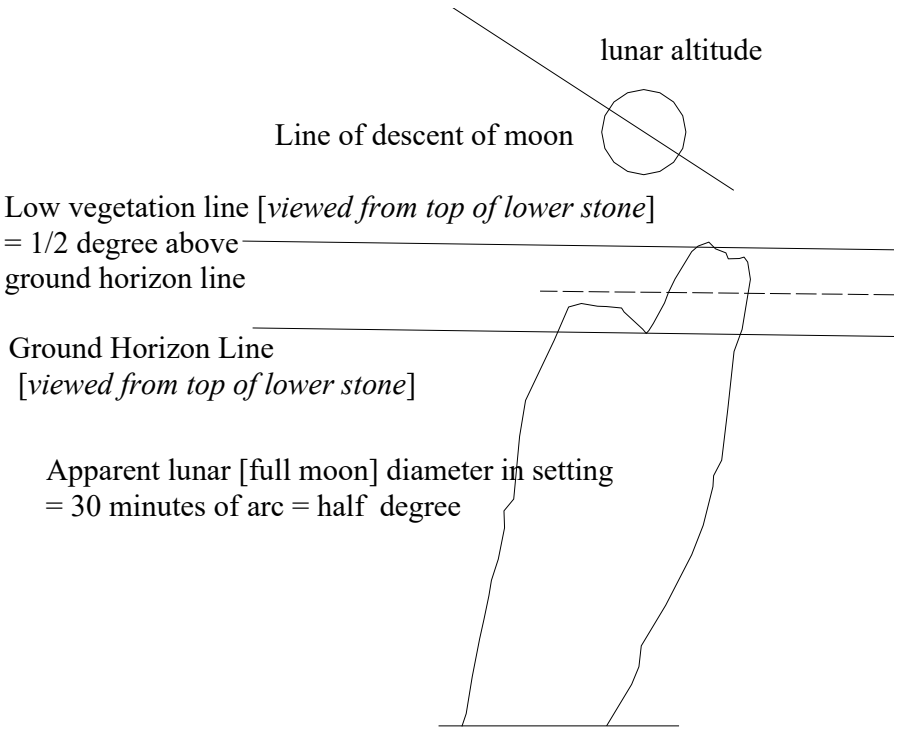
From the near perfect 1547 moon catching we look to the next time that all was in position and it can be seen that there are differences developing. Here we again show the three lunar positions as a comparison to the 1547 BC event.



Midwinter's day full moon setting at Gray Hill 1365BC
This is the day after the full moon and the sun rose
at 09:26:47 some 56 minutes before the moon set time seen here.
Given that this is midwinter and the positions are diagonally opposite,
the suns brightness would not hide the vision of the moon in this case.

Fig 9.18 Midwinter's day moonset, full moon at Gray Hill 1365BC

This upwards creep continues and by 1271 all is about lost as an accurate setting position and the stone is no longer able to 'catch' the moon.



Midwinter's day full moon setting at Gray Hill 1271BC
Clearly the moon is too high here for the stone set up
to be operative.

Fig 9.19 Midwinter's day moonset, full moon at Gray Hill 1271BC

Here we therefore have the full sequence of the times when the stones worked and 'caught' the moon in its decent at full moon at midwinter just as the sun was rising at the opposite viewpoint of the alignment; a beautiful combination that was not viewed often but made a great impact when it did occur.

However, the question of location still remains. Why were the lesser cairn and the solar/lunar alignment located at just this spot on the hillside?

Recent discoveries by Adrian Chadwick, Joshua Pollard, Rick Peterson and Mike Hamilton of the University of Wales College Newport along with Helen Wickstead of University College London[2] may eventually reveal much more that assists in the evaluation of this site. The remains of a number of other cairns have been discovered along with what probably will emerge to be ancient enclosure boundaries and perhaps some dwellings. These are all on Gray Hill but to the south east of the kerb cairn and solar alignment.

As is becoming apparent, some of our little known sites can be very revealing when examined with an open mind and the application of some astronomy. This concept is extended a little further with a new evaluation of the Harold Stones of Trellech. Here a great similarity to Gray Hill will be seen, the sun rises at the stones of Trellech in similar manner to the way the moon set at Gray Hill.

9.3 Harold Stones Trellech

At Trellech we find the three Harold Stones. This familiar and well known stone row has had a number of unfounded interpretations attached but it would appear logical once again that it would have an association with the sun. Archaeology dates the erection of this monument to roughly circa 1400BC-1500BC. Whenever the stones were erected, there are commonalities of method between these and those of Gray Hill. It is likely, therefore, that they were erected during the same era and probably by the same artisans.

In the illustrations, note the very large stone with its considerable lean one way [to the south] with the two lesser, but still considerably sized monoliths with a lesser lean to the north. The stone's height measures vary according to the source consulted. Of course as occasionally happens cattle graze the field and rub against the stones, trampling down the ground at the stone's bases and making the protruding height a little greater. The measures obtained during the survey for this work complied with the approximations of 14feet, 10feet and 8feet which agree with existing records.

Fig 9.20 The Harold Stones at Trellech. [OS ref 349916, 205133]

Fig 9.21 Harold Stones at Trellech. View to the South West showing the alignment of the two lesser stones and the difference in height of these stones. Burl implies this is a midwinter sun alignment.

The alignment, as seen below, is correct for mid summer sunrise. Yet this alignment, which could also be utilised for the winter solstice only requires two of the stones, and even these are of different heights, so why the third larger stone? This erroneously appears to have been assumed to be a normal part of the alignment for most investigators yet an examination of the illustrations of the site clearly shows that this is not the case, at least in the way normally portrayed. This is classified as a stone row and stone rows are aligned to something, hence all three stones will have the same reference…humph…It will soon be seen that this has not previously been sufficiently thought through.

There obviously has been no clear, definitive explanation to date for the existence of these stones in the layout and in postures that we see them. The lean of the large stone is commonly supposed to be due to subsidence and yet the other two stones which in reality are not a great deal smaller are in almost perfect alignment on the north face and lean in that direction. Again, according to Children and Nash

Once erect, all three stones are now leaning[3].

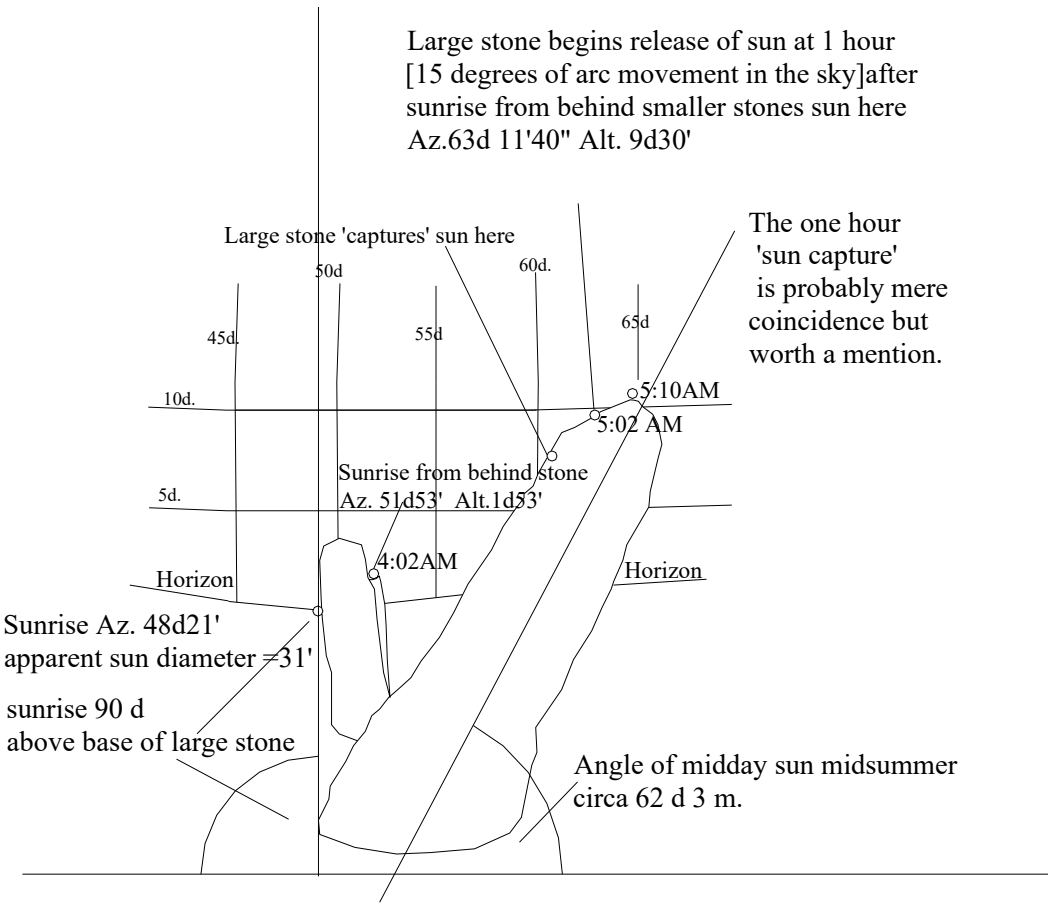
This subsidence argument seems to be a little weak when the site is physically examined for astronomical connections. This becomes even clearer when the angle formed at the top of the large stone is examined. The splay here is no accident, it seems to have had a deliberate purpose and these stones, as seen below, were never erect. The explanation is really quite simple, requiring just a little thought to evaluate. It is also easy to understand from where the notion of the 'upright stones of Trellech' was derived. Below is seen a section of a sundial in the village church. The sundial dates to 1689 and is the only illustration discovered showing

these stones in anything near an upright position. The earliest known record in writing of them is from 1698[4] and there appears to be no mention of them being in any position other than that in which they can currently be viewed. Certainly, no later documentation, other than modern writings such as that of Children and Nash makes such statements.

Fig. 9.22 The stones of Trellech as seen on sundial in the Trellech Church. [after Children and Nash] Note the numbers marked on the stones that correspond to the heights of 8, 10 and 14 feet. If these stones had leaned from the vertical to the angles that they lean today the height values would have changed considerably and yet they have not. The artisan who carved this in the 17th century, actually depicted the stones almost exactly as they are to be seen today and given the limitations of the space with which he had to work and still adequately show the stones, he couldn't have done much better. So from where did Children and Nash obtain the imaginative idea that the stones have moved since erection when they had no idea of how they originally appeared…obviously they misunderstood the carving seen here as it was utilised by them as evidence that the stones were originally set an upright manner…why else use the depiction when a photograph would be more effective?

Fig 9.23 Photograph of stones from same viewpoint as utilised by the sun dial creator, here in 2009. The slight lean of the larger stones toward each other seen in the sundial carving is apparent, the artist had to lessen this to maintain proportion on his work. The lean of the large stone toward the south is not apparent either on the artistic representation or in the view seen in the photograph. Why should Children and Nash make the grand assumption that the stones were all originally vertical without any evidence whatever? The only evidence is the view seen in the above photograph depicted on the sundial… so much for valid research and evaluation…

Fig 9.24 Here is a critical view of the stones from the South West indicating the dominance of the larger stone and the fact that it is somewhat twisted in its location in comparison with the other two. It should be noted that the further, eastern stone, while being in line at its lower end with the mid stone, can be seen to protrude into view at its top. The compass reveals this protrusion as a distance of circa 30 minutes of arc.



The large stone is inclined south, south east
and hence while clearly indicating the midday midsummer
sun in altitude is slightly pointing to the east and therebye
at midday is creating a small shadow that had this eastward angle
not been there would not have existed. It is thought that this was
an accidental twist that occurred during erection that was not rectified.

Fig 9.25 Midsummer Sunrise at Harold Stones Trellech as originally observed.
The modern horizon is hidden by trees in the photograph and the horizon line here is the result of the examination of a number of photographs from different angles, checking contours on OS maps and the examination of 3D satellite photographs.
Note: the northern edge of the base of the large stone and northern edge of the top of the middle stone are in line with sunrise over the natural horizon.

The above line illustration indicates how the Harold Stones were operated and why they were set up in the manner that is still apparent today. Here the midsummer sunrise and sun elevation at midsummer midday is demonstrated and we follow the line of the ascent of the sun from rising to its passing the upper tip of the large South Western stone.

As at the moonset creation at Gray Hill, all is not immediately apparent. There the moon was 'caught' in the recess in the stone and the operative sighting line here at Trellech is the rise of the sun *over* the furthest lower stone as the sun emerges *from behind* the middle stone. This in fact occurred 18 minutes after the sun has risen above the horizon. For that period, the Sun was hidden behind the two smaller stones. The location to stand to view this is that from which the photograph was taken. When the line of the southern sides of the two lesser stones coincide with the bulge on the north eastern edge of the large stone, and the northern edge of the middle stone is above the base of the large stone all becomes apparent. This denotes the viewing position for the sunrise of 1400BC [assuming the dating from archaeology is correct].

It was the top of the far stone, the lower one, which is seen as critical here. The sun emerges from behind the mid stone on top of the smaller far stone, its angle of rise previously being hidden. Here we see not only stones put in place to note the sun's activities on the horizon, but a conscious and geometrically correct construction that controls the viewing of the sun.

At midday midsummer the largest stone's angle of lean toward the south is indicating elevation of the sun; it is orientated to and points to the solar position. The stone is also twisted toward the south east and midwinter sunrise position and hence while if it only pointed southwards toward the midday sun it would create no shadow at that point,but the twist toward midwinter sunrise ensures that a small shadow in fact is formed to the east of the base of the stone. We should note that this stone does indicate a time when the sun was at what without some form of erected location and direction giving structure would be an indeterminate point in the heavens. This was difficult to set up and yet it is accurate, it is correct and it gives a position of the sun in the sky exactly halfway through the suns traverse of the heavens at midday. Additionally, and this surely must be coincidence, the stone also gives a time one hour after the sun rose from behind the middle stone over the lesser eastern stone.

It is certain that the concept of this set up existed for some time before any preparation work was attempted and that the preparation involved noting the angle of the ascent of the sun at this latitude. The slope of the top of the stone as it appears today loosely followed the ascent line of the sun and indeed, the masons who erected this monolith could have cut this to have the sun sliding along its top edge if so desired. The fact that this is not the case and the lower edge of the stone is higher than the sun at the meeting point of stone and sun appears to confirm that this was the desired effect and that the sun had to be 'captured' and released at a point halfway along this sloping edge. The sun was freed once more at precisely one hour after being originally released from behind the lower stones. One wonders why this particular spot on the large stone was chosen, a location that gives a time of precisely an hour after the sun first emerged from behind the mid stone. While this almost certainly is coincidence, it does raise a question regarding the knowledge and abilities of the engineers who designed and erected these

stones. Unfortunately, in From *Carnac to Callenish* p159 Aubrey Burl claimed this was a midwinter solar alignment of 229degrees. As seen above, this is not the case; it was a very accurate depiction of the sun *after* it's rising at midsummer.

Here, then, we find the mechanics of the Harold Stones of Trellech and their function at mid summer sunrise. The sun, after being timed in its movements, was finally set free from the shackles of the stone machine after initially rising at 3.42 AM; it traversed the summer sky only to be located again at midday. If the slope at Gray Hill were not there then the sun would have been captured once more at 20:28 PM in a somewhat similar manner to the way to that with which it was released from Trellech on the longest day of the year in the era around 1400BC. As it happens of course the moon was caught at Gray Hill on the shortest day of the year of between 1824BC and 1365BC with the optimum effect being at 1547BC. These two sites must have been constructed by the same engineers or at least by people using the same techniques, the release and catch mechanisms are very similar. As is clearly apparent, these were people who were highly intelligent and the forunners to modern civil engineers and surveyors.

So we have discovered an accurate astronomical device constructed by heavy labour but constrained by the results of repeated accurate observations. Of course, the question of instrumentation arises because the stones were erected with specific leans at equally specific heights, the largest being 14 foot with an accurate angle cut on its top, middle stone 10 foot and the smaller eastern stone 8 foot. Possibly a timber mock up was created before the stone version was erected, a model or pattern. All such sites must have been very carefully planned after much observation and record taking via instrumentation that has long since been lost and of which we have no record whatever; and yet it had to have existed or quite simply, these great achievements would not have happened. It is an unfortunate fact that many such sites have been lost over the millennia. Luckily we have these two locations that clearly demonstrate the abilities of our forebears; at Gray Hill we find a mechanism for catching the Sun at its set in midsummer and we have to travel all the way to Trellech, over eight miles as the crow flies we discover a similar method for viewings its rise.

A truism developed during these investigations is that *It was the horizon line, <u>whether natural or man made, at a suitable elevation for the purpose</u>, against which stellar movement would have been measured in the early days of astronomy.* On that basis, at Trellech we can observe a development later than the 'early days' of astronomy as here we see points in the sky above the horizon being indicated. Astronomy was advancing in Britain.

To extend the concept of ancient abilities in Britain, not only astronomy but concepts of measure are evident in many places including the site at which we shall finish this essay.

9.4 Llangenny- Brecon

Here we discover an oddity. The hill that the sun was evidently viewed over is seen from this direction a gently rounded mound and not really of any value as a sighting entity. However, the setting out of the stones indicates an affinity with measure…

At Llangenny, Brecon the map shows two standing stones due north / south of each other [investigation shows that the northern stone is no longer extant] and the centre of the space between the stones is 2.2 miles due west of the peak of the Sugar Loaf Mountain. The

sun is visually 30 minutes of arc in diameter. At distance of 2.2 miles, the CAD program informs us that 30 minutes of arc equates with a distance of circa 120 feet. As seen from the location of the stones, this distance straddles the high peak of the hill including the Triangulation Pillar at 1920 feet above sea level. If we reverse the position, the stones would be seen as 30 minutes of arc apart…hence the stones are set the same distance apart [121 feet as scaled from the OS map] as the sun appears to cover on the top of the hill. The evidence indicates that the top of the hill was marked for the edge of sun position and this denoted the distance apart of the stones in the valley to the west. What is puzzling is that these stones are in a valley when there is a suitable hill top immediately behind them for such a view of the sun. Why set them up partway down a steep valley? There are other sun alignments to the northeast over Partrishow Hill and Hatterall Hill but again, logic dictates that the relatively the flat region above the stone position should have been utilised and not the steep side of the valley, which is now covered in second growth forestry.

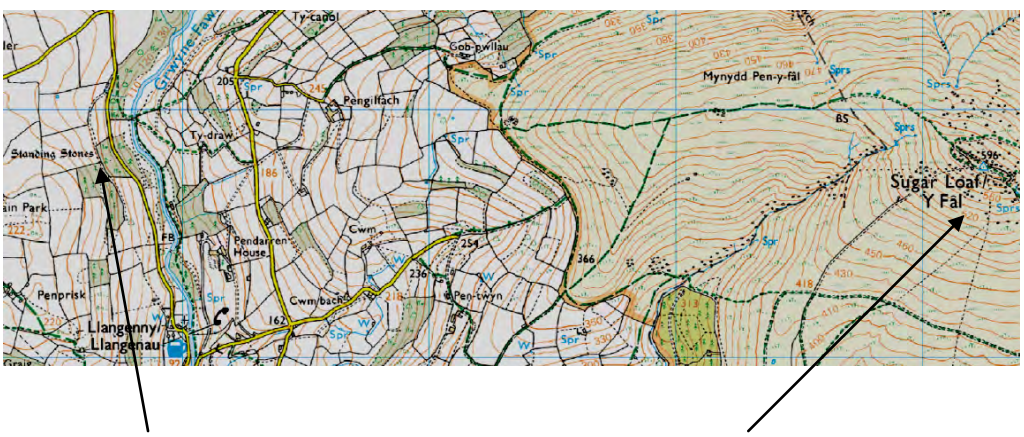


Fig 9.26 Standing stones, now in woodland….peak of Sugar Loaf Mountain

Fig 9.27 Peak of the Sugar Loaf from above the stone position.

This does not appear to be a very specific sighting place but the layout is as described here. The stone's positions on the side of a hill also raise queries yet their spacing complies, as the text relates, with the visual diameter of the sun over this hill. Coincidence or design? If coincidence we have failed to discover any other relationship to the stones and their existence remains a mystery.

Fig 9.28 Southern of the pair of stones at Llangenny. The northern stone is either lost or buried. This stone additionally does not appear to be very old, looking more like a roadside

mile stone but appearances may well be deceptive and certainly the road is below this stone at a far more convenient level and any earlier track is unlikely to have been at this location.

Given that the location of the northern stone is clearly marked on the map and the computerised system allows us to zoom in very close [600%] we have no doubt of the accuracy here and the stone's spacing was scaled to 121 feet which is the visual width of the 30 minutes of sun diameter at the distance of 2.2 miles as seen over the top of the Sugar Loaf from the position of the stones. Here we have a visual representation of the diameter of the sun…all 120 feet of it… a little Silurian sophistication…or, perhaps, given that the stone is in very good condition, a much later stone? If so then set up by whom? Normans perhaps? But why?

There are, of course, other ancient sites in the region and some interesting information regarding these has emerged from the investigation. One of these, Maen Llia is a large flat stone that is orientated due north / south with the southern top edge angled directly to the pole star position [thereby dating it to circa 2800BC] and the angle of the northern top edge aligned to midday sun at the equinox. Thanks for this info [and much more regarding the site] to Andrew Davies whom Harry met at the site purely by accident.

There of course is much more that could be added regarding other sites but sufficient has been included it is felt to show that our forebears were far more intelligent than is generally believed.

The next chapter deals with site spacing and has further referral to the northern skies.

CHAPTER 10

Metrology in the Landscape

I have grasped the stake…I take the measuring cord in the company of Seshat. I consider the progressive movements of the stars. My eye is fixed upon the Bulls Thigh [Ursa Major]. I count off time…and establish the corners of the Temple.

[An inscription at the Temple of Horus at Edfu which accompanies a relief showing the 'Stretching of the Cord' ceremony.]

Who hath laid the measures thereof, if thou knowest? Or who hath stretched the line upon it?

Job 38:5

10.1 British Land Measure: A Puzzle

We begin here by reiterating a little information that was revealed in earlier chapters:

'About the year 1500 the "old London" mile was defined as eight furlongs. At the time, the furlong, measured by a larger northern (German) foot, was 625 feet and thus the mile equalled 5,000 feet. During the reign of Queen Elizabeth I, the mile gained an additional 280 feet--to 5,280--under a statute of 1593 that confirmed the use of a shorter foot that made the length of the furlong 660 feet.' [1]

As can be seen, the value of a furlong, 1/8 of a mile, altered via a change in foot value. The mile did not change, only the number of its divisions. An alteration of the furlong from 625 to 660 feet meant that in terms of the foot value there was an alteration by the [now familiar] factor 1.056. Of course we are now looking at this with the British foot being the base of '1' simply to give us a reference point but the factor for change cannot be denied. Yet this period around 1500AD was not the commencement of such standardisation, because Britannica also relates that the movement for refinement of measure started with Edward I and:

'… the linear units as the yard, foot, and inch--begun in Edward I's statute of 1303--recognized the traditional sizes of rods, furlongs, and acres as fixed and therefore simply redefined them in terms of the newly standardized units…

…Thus, the furlong, often measured as 625 northern (German) feet, became 660 Standard English feet, and the mile, always 8 furlongs, became 5,280 feet. Today, the furlong is used almost exclusively in horse racing.' [2]

Here it is found that the original foot in Britain was 1.056 of the later shorter version. This is easily discovered via the information from Britannica, as one merely has to divide the

furlong length of 660 by that of 625 to appreciate the difference. Just from a measurement standpoint alone, the numerical value or generic *factor* of *1056* certainly appears to have importance and predates the era of Edward I, thereby raising further questions in relation to Neal's interpretation on all being based upon a reduction from the Greek measures to a base of one.

The history of the English measurement system, however, is actually said to stem from before Edward I to King *Athelstan* or *Æþelstān* C.895-939AD, frequently termed *The Glorious*, [who ruled from 924AD]. One of his laws relating to land measurement stated that:-

'The King's girth shall extend from the centre: 3 miles, 3 furlongs, 9 acres, 9 palms, 9 barley corns'.

This implies that the measurement units were in use long before the time of King Athelstan and therefore these laws do not indicate a source but are merely part of an organising process.

The description may well apply to the royal residence whereby anyone not appointed within the so formed boundaries would be seen as trespassing, effectively a Royal Estate and on the other hand, as Athelstan was known for being fair in his dealings, it may have been a limitation upon the kings of other lesser regions such as the Shires. We cannot currently confirm what is actually meant by the directive.

Regarding the values we shall accept the mile at 5280 feet [5000 at 1.056feet], and the furlong at 660 feet [625 at 1.056feet].

The acre is generally taken to be a unit of square measure, that of 43560 square feet, 4840 square yards. As 1.056 feet squared divides into 43560 a count of 39062.5 times this obviously is not applied and the singular British foot initially appears to appertain here. However, if we apply the foot that relates to the rod, other wise known as pole or perch of 16.5 feet, that of 1.1 British feet, we find a very neat count of 36000.

The acre in fact is an area of 660 feet [furlong] by 66 feet [chain]. In fact, this is confirmed by the old linear measure of 40 perch [also rod or pole] of 16.5 British feet [660 feet] being termed an acre. However, if the length of the area can be termed the same as the whole then there is no reason why the width cannot be termed in the same fashion.

Hence as the chain is not mentioned but the furlong is the same numerical length as the acre, it is logical to take the 66 foot width of the area as that intended in this instance by the use of the term 'acre'. We should remember however, that according to the historical notes from Britannica at this period we should be dealing with the old foot value of 1.056 of the later feet known to us as British and therefore there would be 5000 to the mile, 625 to the furlong and 62.5 to the chain. Having made that announcement we also should take into account the fact that Saxon measures utilised the 1.1 British foot unit…so just where do we start to unravel this conundrum?

It would appear that there is some confusion here in that, as seen above, if the 1.056 foot value is applied to the acre, a count of 39062.5 square feet is seen which appears to be a rather odd, cumbersome and doubtful value against the very neat correlation of 36000 of the 1.1 foot unit. Nonetheless, the mile of this foot is 5500 British feet and hence we appear to have a correlation of the use of two different foot values in Saxon and early Norman Britain.

Regarding length the furlong and acre do not pose problems as they are consistent with both the 1.056 foot and the 1.1 foot unit; the mile at 5000 feet of 1.056 British feet fits the more modern British unit and the same modern mile contains 4800 feet at 1.1 basic British feet. It is the 9 feet, 9 palms, 9 barley corns that create a problem. From which foot value were these units derived? Logically, given the 36,000 square feet to the measurement unit of an acre, with the unit parts of the acre being divisible by 1.056, it would appear that the relevant unit here would be that of 1.1 British feet with its cubit of 1.65 feet [emulating the rod pole or perch of 16.5 feet] and yet the historical notes remind us that the foot value was 660 / 625 or 1.056 or again, 5280 / 5000 producing the same result. Hence two values that are very close to each other can be derived from the information with which we are presented.

Table 10.1: Using all 1.056 Using 1.1 for the smaller units

3 miles	15840	3 miles	15840
3 furlongs	1980	3 furlongs	1980
9 acres	594	9 acres	594
9 feet	9.504	9 feet	9.9
9 palms [handbreadths]	2.376	9 palms[handbreadths]	2.475
9 barley corns [3 inches]	0.264	9 barley corns[3 inches]	0.275
	18426.144		18426.65

If we look a little deeper it can be seen that there is a value that divides virtually exactly into the measurement value calculated above. Here we find that the *Short Greek* foot of 1.008 British feet x 18280 =18426.24feet; but unfortunately the acre, furlong etc do not apply to this value and hence it does not apply. If the 1.1 foot value is applied throughout the calculation, the result is equally as confusing.

All these slight variations have one thing in common. When the values are doubled for diameter of the supposed circle of land implied and multiplied by pi value 3.14181818 [see Chapter 6] for the circumference of the so formed circle they reveal 316.8 x a value varying slightly around 365.5.

[18426.144 x 2]
= 36852.288 [36852.288 x 3.14181818] = 115783.1885 = 316.8 x 365.4772364
[18426.65 x 2]
= 36853.33 [36853.33 x 3.14181818] =115786.368=316.8 x 365.48

It would appear that perhaps an approximation of the year [all time] coupled with the value that represents the square of the Earth [all land] may have been in use as we have discovered nothing else that is precise and this would be a good symbolic value for the power of royalty in those days. The girth or circumference is somewhere between 21 and 22 miles.

Another extract from Encyclopaedia Britannica relates that:

'Elsewhere in the British Isles, longer miles were used, including the Irish mile of 6,720 feet and the Scottish mile of 5,940 feet.'

The Irish mile as defined here will give a foot value of 6720 / 5000 = 1.344 of our familiar British feet. We then discover a cubit of 2.016 feet and a step of 3.36 feet with a reed of 12.096 feet. These values arise across the ancient world. However, if we apply the barleycorn criterion it is seen that there are not 36 barleycorns to the foot as would be the case at the 3 per inch value but in fact 48.384! We ideally here require barley corns that measure 0.448 of an inch and not 0.3333 of an inch!! This barleycorn idea does not appear to be entirely consistent but was possibly utilised as a rule of thumb. However, as we cannot have parts of a barleycorn obviously this seed idea is not applicable to the relationships between measures because again, when applied to the 5940 feet of the Scottish mile we have 42.768 of the standard Barleycorn per foot…

It appears that the barleycorn measure was utilised by the Saxons and was made an official definition by the Normans…this of course only applicable in Britain and in the home countries of these invaders.

Noted above was that the British measures were fixed by statute of Edward I in 1303. This was reinforced in 1324 by Edward II. The barleycorn was stated to be a base unit in both cases and even later this was further restated in statute of Elisabeth I. This also applied to Wales and the *Laws of Hywell Dda* made the same claim of an inch being three barleycorns. This being the case we can safely assume that the references are to a set of values that date to after the alteration in English measure when the foot was shortened from 12.672 inches to 12 inches and the mile gained 280 feet but stayed exactly the same length! Mile of 5280 / 1.056 = 5000 which was the former count of feet in the mile.

The *Laws of Hywell Dda* were developed in the 10th century but the version available for study today is from the 14th century documentation. Traditionally *Hywell Dda* who became king in 942 brought the various laws together into a coherent set of rules. However many of these were old rules and the measures come under this category as they were attributed by *Hywell Dda* to the ruler of circa 450BC, one Dyfnwal Moelmud or in the Latin, Dunvallo Molmuteus. While there is some useful information regarding measures in use in Wales at that period it appears that in fact there is an error in translation, or perhaps the documentation with which the translators have worked has an error. This involves the mile.

The *Laws of Hywell Dda* claim that :-

Three lengths of the barleycorn is the inch.
Three inches is the palmbreadth
Three palmbreadths is the foot
Three feet is the step
Three steps is the leap
Three leaps is the land
A thousand lands is the mile.

[Dafydd Jenkins translation 1990 Gomer Press]

Complying with the above 12 inch foot of modern times and not the earlier 12.672 count of the inch to the foot [confusing as the earlier inch was 1.056 of the later inch length] We remember that the mile was 5000 feet of whatever the foot length may have been. This was always the case…with the later exception of the conversion of the British mile to 5280 feet [an evaluation that was well understood with the base foot value being utilised long before the Norman rulers decided upon this change.]

So the Welsh measure gives us the familiar third of an inch for a barley corn and three inches to the palmbreadth or handbreadth of which three made the foot. This means that the foot was not 12 inches but only nine.

Following the list above we see that leap is nine feet and the land is three leaps making it 27 feet. As there are, according to this statement, 1000 lands to the mile we have a mile of 27000 feet! As an earlier paragraph in the text of the *Laws of Hywell Dda* states that the length of Britian is 900 miles, then as this is reasonably close to the real value, there is no way that the mile in use was 27000 feet. In fact the straight line measure from Penrith in Cornwall as stated in the *Laws* to the far distant extremity of mainland Scotland is just over 600 miles. However, if we keep in mind that the Welsh foot was 9 British inches in length and the mile in fact would have had 5000 of these feet, we then see that this value of , for arguments sake we shall call 610 miles, British is calculated as 813 Welsh. So given that the measures could not have been taken in straight line [No Google Earth in those days!] this estimation of 900 miles in fact is a very reasonable assessment…and confirmation that no, there were not 27000 feet in the Welsh mile but there were 5000 and those feet were 9 inches in length, 0.75 of the British foot. This means that the Welsh mile was 3960 British feet in length or, in terms of the earlier 1.056 foot of which 5000 made the British mile, a count of 3750.

So we see here a mile of 3960 of our familiar feet which divided by the traditional 5000 had a foot length of 0.792 or 9.504 inches.

British mile = 5280 feet at 12 inches

Welsh mile = 0.75 of British mile = 3960 feet which is divided by 5000 to obtain the value of the Welsh foot.

3960/5000 = 0.792 British feet = Welsh foot.

Welsh inch = Welsh foot / 9 = 0.792 ft. or 9.504/9 = 1.056ins

Hence the Welsh inch was that of the British measure before the alterations to the foot value. The Welsh foot, as is obvious, did not follow the pattern but it is directly related to the measures of the ancient world.

So we can now evaluate further and translate the Welsh table into British measure

Three lengths of the barleycorn is the inch = 0.792ft./ 9 =0.88ft = 1.056 inches
Three inches is the palmbreadth = 1.056 x 3 = 3.168ins.
Three palmbreadths is the foot = 3.168 x 3 = 9.504ins
Three feet is the step = 9.504 x 3 = 28.512 ins = 2.376 ft.
Three steps is the leap = 2.376 x 3 = 7.128ft.
Three leaps is the land = 21.384 ft.

If we divide the 3960 feet of the mile by 1000 for 3.96 we have not a 'land' but what can be seen as a step not of 3 feet but a more conventional 2.5 feet at 0.792 of our English feet which is doubled. Hence 9 Welsh inches or 0.792 English feet x 2.5 = 1.98 and double this and we have the elusive 3.96 feet.

So there is a clear error in the listing [repeated in other translations] where the 1000 lands is seen as a mile instead of a double step of 2.5 feet per step.

Square area is also seen in the *Laws of Hywell Dda.*

Four feet is a short joke	= 3.168 feet
Eight feet is mid yoke	= 6.336 feet
Twelve feet is an armpit yoke	= 9.504 feet
Sixteen feet is the long yoke	= 12.672 feet

Via a description of a man holding the long yoke it is clearly seen that this gives the width of the legal acre = rod with the acre's length being 30 times its breadth. Hence the acre is:-
12.672 x 380.16 = 4817.38752 square feet. This odd number is significant because what is seen is a count of 4320 x 1.115136 where 1.115136 = 1.056 [length of Welsh inch] squared.4320 is used extensively in sexagismal counts, it is 360 x 12.

To show what was achieved here we understand that the basic Welsh units were ¾ of the length of the British variety. Hence to obtain the same length in the longer British measure the count of the Welsh units would need be reduced by ¼. Hence the 16 feet of the long yoke is reduced to 12 and the 30 times 16 at 480 is reduced to 360. So we see the use of 12 and 360…i.e.12 x 360 =432.

By such a method the familiar 432 is kept in use although it is not immediately apparent.

The area measures increase into larger regions.

Four acres is a toft	= 4320 x 4	= 17280 acres
Four tofts a shareland	= 16 acres	= 4320 x 16 = 69120
Four sharelands a holding	= 64 acres	= 4320 x 16 = 276480
Four holdings a townland	= 256 acres	= 4320 x 256 = 1105920
Four townlands a maenol	= 1024 acres	= 4320 x 1024 = 4423680

12 maenol plus two townlands make a commote = 128000 acres = 552960000sq.ft.

Most of the numbers here have connections across the board in conjunction with ancient measures which as the same sexagismal system was in use is not at all surprising.

However, here is seen a curious commonality. In the chapter of Measurements of the Gods relating to weights and volumes it emerges that a regular feature of ancient Indian weight systems was the top value being 128 of the smallest in the series. Other connections can also be found here but are probably coincidental, created by the very system in use.

In confirmation of the validity of the evaluation in terms of connectivity, and here the example is later as the more modern inch has been applied, a milking vessel was described as three inches wide at its base, six inches wide in the middle and nine inches wide at its mouth. Diagonally it was nine inches in length. Volume here was 189.7463398 cubic inches.

A pint of water has 34 .677625 cubic inches hence this contains 5.3333r pints when filled to within 0.1696 of an inch of its rim, fractionally over 1/6th of an inch or 4.3 mm. Therefore one and half of these volumes make up the English gallon of eight pints. The container held 2/3 of a gallon. This is therefore compatible with other historical units of liquid volume.

So effectively, given the numerical correlations above, we can see that the Welsh values were compatible with what were termed the English measures and hence ultimately will be connected to other units in use across a wide region.

The English Hundreds and Measurement of Area

During the period spanning between around 613 and 1017AD, the concept of dividing land into regions known as 'hundreds' was introduced into Britain by the Saxons. While such a division had been in use by the Romans previously, being described as the *centeni* by Tacitus as early as 78AD, it appears that it was a latecomer to these islands. The original idea was that a hundred was a plot of land sufficiently large enough to support 100 families.

Of course, a sort of provincial leader was known as the *hundredman*. His duties included ensuring that able-bodied men were available for military duties, and to perform administrative tasks. Smaller divisions of hundred were also in use, there were 'half hundreds' and 'tenths of a hundred'. The old unit of a hide, a variable measure of between 60 and 120 acres was seen as sufficient to support a single family. At 120 acres, 43560 x 120 = 5227200 square feet or 580800 square yards, a measure of 7920 x 660 feet which seems a reasonable sized plot for a large family; a small family should have managed reasonably well on the 60-acre version. The soil quality was also taken into consideration hence top quality soil meant a smaller plot, this presumably decided by the hundredman. However, this is not taking the vagaries of climate into consideration and hence was not necessarily ideal at the time.

Interestingly, while shires or counties were in existence in that era, their boundaries did not have to comply with hundred boundaries, or vice versa, although for convenience there was little overlap. While the hundred as an administrative area has long since been abandoned [other than a modern political convenience], many of the associated names still denote the districts that formally would have been a designated hundred.

There is a little numerical interest here once more in that if we take the square foot that Neal refers to as Saxon, which evidence indicates he is correct, despite its much earlier far more widespread use, that of 1.1 British feet, [1.21 when squared] we find that there are 4320000 in the 120 acre hide and as seen above, 36000 in the acre. It is apparent that the land measurement units utilized this foot value in a consistent manner as 660 feet for the furlong equate with 600 of these feet as the chain has 60 of the same. Yet, as has been seen in previous chapters, there is a precise relationship between this foot value and that of 1.056, that of 0.96 or 24/25, a relationship between other dimension sets discovered by Michell. Given that there are

640 acres to the square mile we find that there are 23040000 of these square feet in a square British mile. Furthermore, there are 6250 square steps at 2.64 feet per step [6.9696 when squared] to the acre. It appears to be numerically convenient to utilize the British mile in conjunction with these values. This is because while there are 640 acres [4000000 square steps as above] to the square British mile, in the square Saxon mile which is an increase from the British by 25/24 there are 694.4444r acres.

Looking in the opposite direction, decreasing by 24/25 to the Greek we find that there are 589.824 acres. So, here is a neat correlation where we move from Greek measurement units to British and find that the Saxon unit fits extremely well. The British units literally appear to comprise a set of measurement units '*for all seasons*'.

Other Geographical Areas: A Comment

Given that we have been exploring the vagaries of English landscape measure we note here that parishes varied enormously in their area. For example as W. G. Hoskins [3] points out, in areas near Norwich a parish may have held less than 500 acres while Halifax held in the region of 76000 acres.

Lancashire appears to have fared very well in that from early mediaeval times until the 19th century it could boast a region that was 30 miles long by 15 wide containing 288000 acres. The hide contained 750000 square steps at 2.64 feet or 2.5 x 1.056 feet.

10.2 South-East Monmouthshire [Gwent] UK

Landscape has also to be examined in a different context to that discussed above and ongoing research has revealed much of interest. There appears to be a commonality of measurement units between numerous sites in specific areas from the North to the South of Britain. We shall examine one example in some depth in this chapter and further similar information is revealed a later chapter.

As seen below in Figures10.2 [and explained in Figure 10.3], a circle of church and other sites has been discovered by Gill and Harry Sivertsen around Newport, South Wales, where the authors live. While this is the only well defined circle discovered in the region to date with so many sites on its periphery [others with lesser counts of sites have been found], the concept is far from being unique in Britain as other researchers have discovered. The unit length here has yet, however, to be seen in the reports of work from any other source.

In this particular case there are five interlinked churches along with one no- longer extant standing stone [position obtained from old Ordnance Survey maps plus an onsite investigation to ascertain precise position], a *motte* that is of ancient origin and an iron age hill fort, with the intersection point at the south western extremity, a position that complies with other similar findings elsewhere. Additionally there is a farm that is marked as an *antiquity* on the maps.

The connecting factor here is directly related to the Ark / Stonehenge / Great Pyramid configurations seen earlier. The value in inches of the 1.76 foot cubit is 21.12 and the radius of this circle, denoted by computerised mapping and GPS is 2.112 miles exactly. This could also

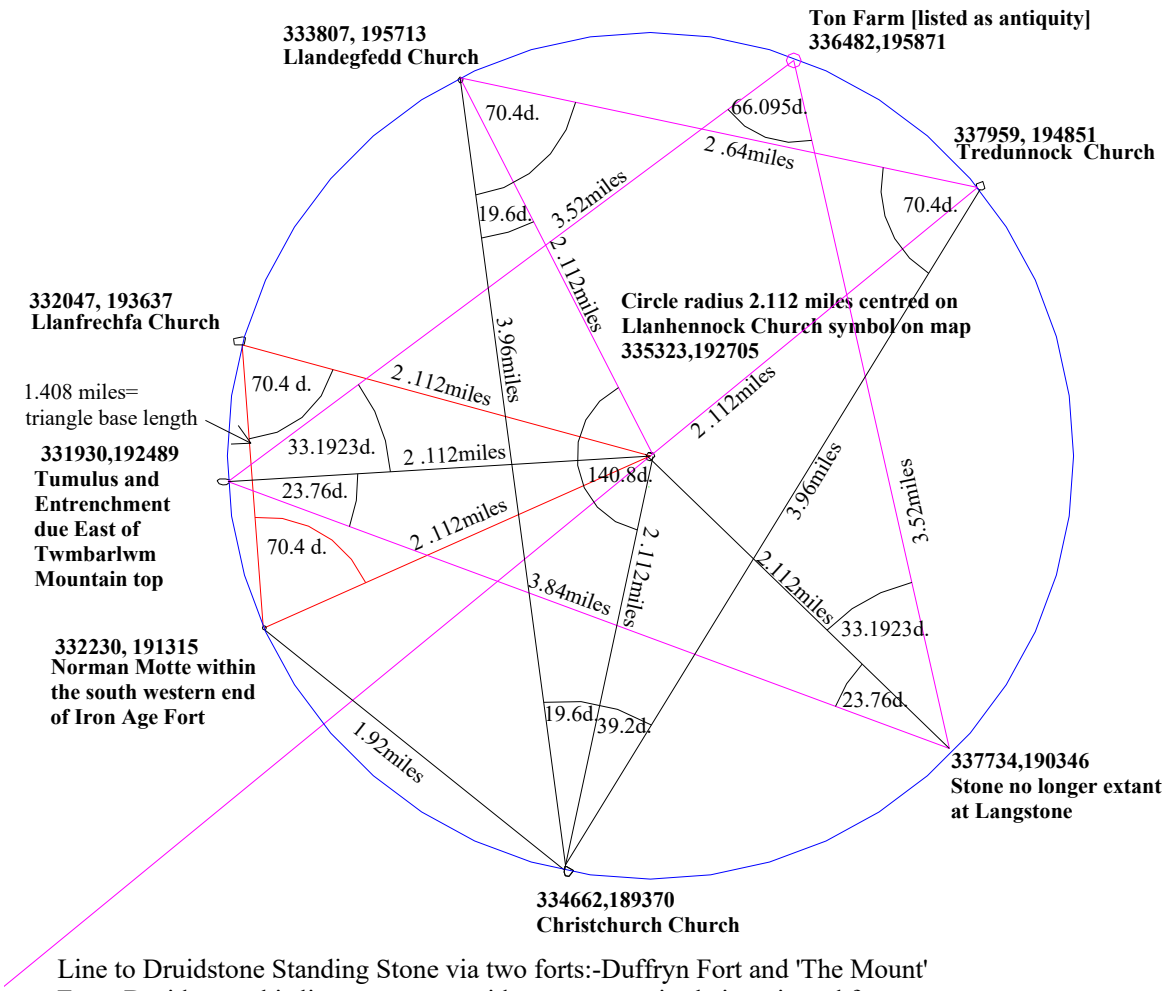
be seen as 1.056 miles x 2 or 1056 feet x 10.56. 2.112 miles and its associated now familiar factors are specific spacings between ancient sites and churches and is a widespread occurrence in Britain.

Fig 10.1 Circle of sites

It is clear that the numerical element of the Biblical flood story [or the value derived from the 30 day month] is associated with these numbers although the flood myth of Eastern regions seems to play no part in Britain except for the use of the same Pleiades associated calendar sequence seen in Chapter 8 of this book. Yet 1.056, the original 'British' foot, increased by $^{1}/_{9}$ i.e 1.056 x 1.111r = 1.17333r which is the foot of the cubit of 1.76 feet, that directly associated with Noah who according to Genesis was born in the year 1056 after creation. Rather a strange numerical coincidence.

We explained in Chapters 6 and 7 how the specific value of 1056 has been derived and how it related to the character of Noah [further information in *Deluge*] but we cannot categorically state why it was incorporated into the British measure, or to be more precise, why this set of measure was adopted over, say, that which following Michell, we have termed as Greek.

There is much more to be learnt yet in this numbers game and the mathematical manipulations of Neal are only a part of the solution. The specific values revealed in this work but not seen in Neal's *All Done With Mirrors* but have actually been utilised in a symbolic fashion in numerous places.



Line to Druidstone Standing Stone via two forts:-Duffryn Fort and 'The Mount' From Druidstone this line represents mid summer sunrise being viewed from the stone to the Mount and hence Duffryn Fort and from there to Llanhennock. Tredunnock and Llanhenock are hidden from each other due to rise in the land elevation in between their locations but both would have viewed the sun over the hill adjacent to Cefn-henllan, from Llanhennock at midsummer sunrise and from Tredunnock mid winter sunset. Distance from Druidstone to Llanhennock is 9 miles to circa one third of the way across Llanhennock churchyard.

Fig 10.2 Circle of sites with absolute positions to within a metre according to OS computerised plotting. The Iron Age fort in fact had a Norman Motte at precisely the position indicated on the drawing.

As it is located on the circle, Ton Farm, which is listed on the maps as an 'antiquity' has been added to the circle and to the list in Table 10.2 below. We have no evidence to place any importance to this location but it is extremely doubtful if this choice of location was the result of accident.

The above sites are explained in more detail below in Table 10.2, where figures that illustrate the context of the sites are also included.

It is easy to make claims such as the above regarding landscape, but when computerised mapping is utilised the accuracy cannot be denied. The positions denoted in Figure 10.2, with the exception of an approximation of the centre of Llanhennock Church [that appears to have been itself very accurate] are, according to the Ordnance Survey maps, within a metre, but given the slight variation in OS map's determinations we would accept 2-3 metres which is still perfectly acceptable.

Table 10.2 General information on sites (all dates AD)

1	Llandegfedd Church	dated to c.750 (Monastic site)
2	Ton Farm	
3	Tredunnock Church	dated to 1254
4	Site of Standing Stone (no longer extant)	
5	Christchurch Church	dated to 1113
6	Fort above Caerleon (recent University of Wales investigation revealed this of Iron Age construction)	
7	Motte due east of Twmbarlwm Mountain Top [Iron Age Fort]	
8	Llanfrechfa Church	dated to 1535
9	Llanhennock Church	dated to 1491

Fig 10.3 Llanhennock Church from South East gate.

The commonalities of the use of familiar units scaled from feet to miles between sites should convince the reader that indeed, these sites were intentionally created at these specific points and that given the numbers of sites involved this could not be coincidence. However we do not as yet have an explanation for what is seen on these pages.

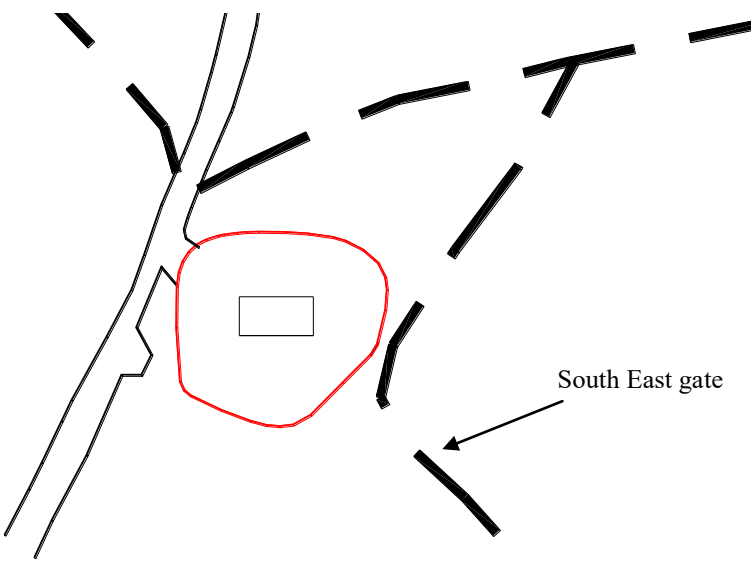


Fig 10.4 Llanhennock Church diagrammatic plan view of outline

This accuracy does not necessarily take the investigator into the church building however, except for the starting point, Llanhennock, but to a location within the churchyard. At Christchurch the intersection point is close to the base of the tower. This leads one to speculate whether these church sites were possibly built on pre-existing stone circles or cairns, which is undisputedly the case at some locations in Britain. Both Tredunnock and Christchurch, visually good contenders for such a role are seen here in photograph, [Fig.10.7] and drawing derived from the 1:25000 map.

Fig 10.5 Tredunnock Church from just inside entrance gate

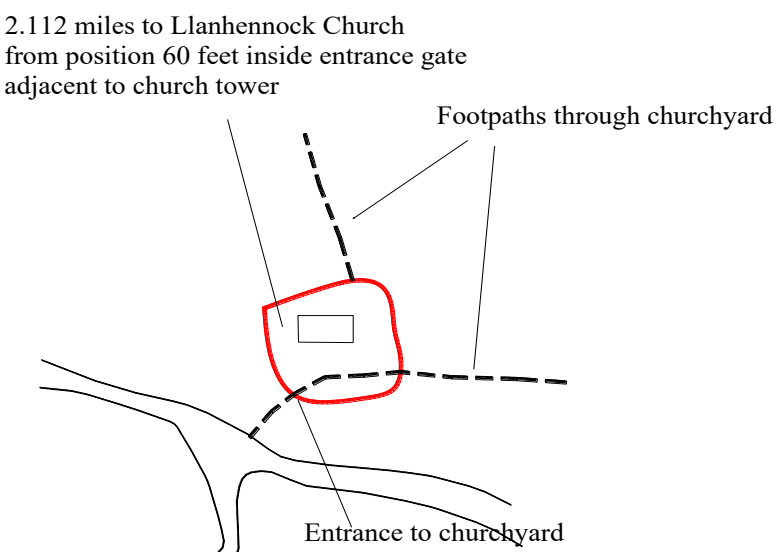


Fig 10.6 Tredunnock Church. Diagrammatic view of churchyard

The circumference of the circle passes inside the churchyard at 60 feet from the gate in a direction slightly West of North. The position is to the west of the church [just to the left of the tower in the photograph].

Fig 10.7 Christchurch from Llanhennock at winter dusk showing its prominence on the horizon line (telephoto lens).

Fig 10.8 Christchurch on map. (2.112 mile line cuts churchyard at 120 feet from North West Gate which puts it adjacent to the base of the tower. This churchyard also very neatly contains the traditional 'God's Acre').

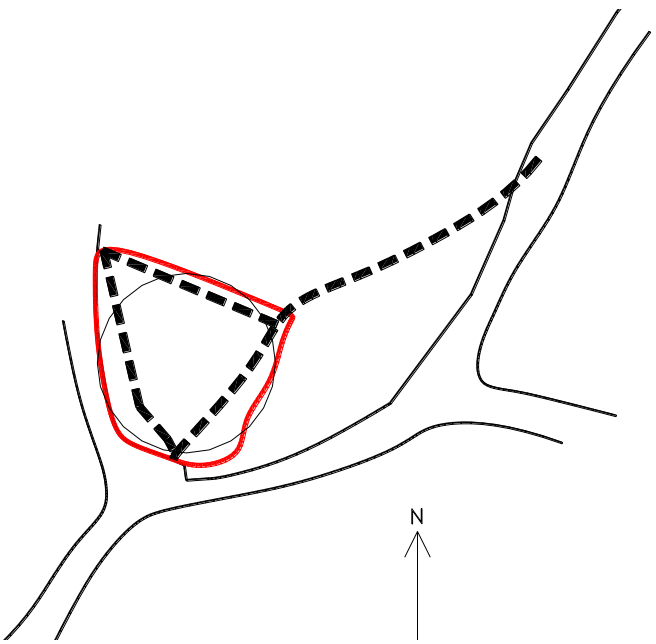


Fig 10.9 Christchurch with 'Gods Acre', a circle of 117.728 feet radius, intersection point is 120 feet into the churchyard from the Northwest extremity of the outline. This is approximately the base of the church tower.

At Llandegfedd Church the intersection point is outside the churchyard by 12 feet, but it is in line with the entrance gate. This is close enough to infer that there is an association to the circle that has so many other sites on its periphery.

The stone that is no longer extant at Langstone, however, was surprisingly accurate for position. The position of the stone marked on the first Ordnance Survey map seen below was at the bank of a very small stream still flowing along the same bed now as it was then. A comparison between the two maps below will show that the line of the driveway to *Gorelands* has altered but very slightly while a new footpath to the same location now emerges opposite the 'New Inn', now a motel. One short hedge has been planted while two have been removed but the stone would probably formerly have denoted a boundary position, [or more likely a boundary was denoted by a pre-existing stone] almost certainly prior to the planting of the hedge. The position was ascertained not only via triangulation on site and on maps but with GPS.

The accuracy of position in relation to the other elements of this circle cannot be denied, confirming the abilities of those who were involved in landscape setting out in the past. This stone position was exactly 2.112 miles from the centre of Llanhennock Church. There is a great deal more could be said about this because there is a continuum of connections to this circle and other stones and structures within the vicinity. This is an ongoing and very extensive investigation by Gill and Harry Sivertsen, an exploration that continually throws up unexpected questions.

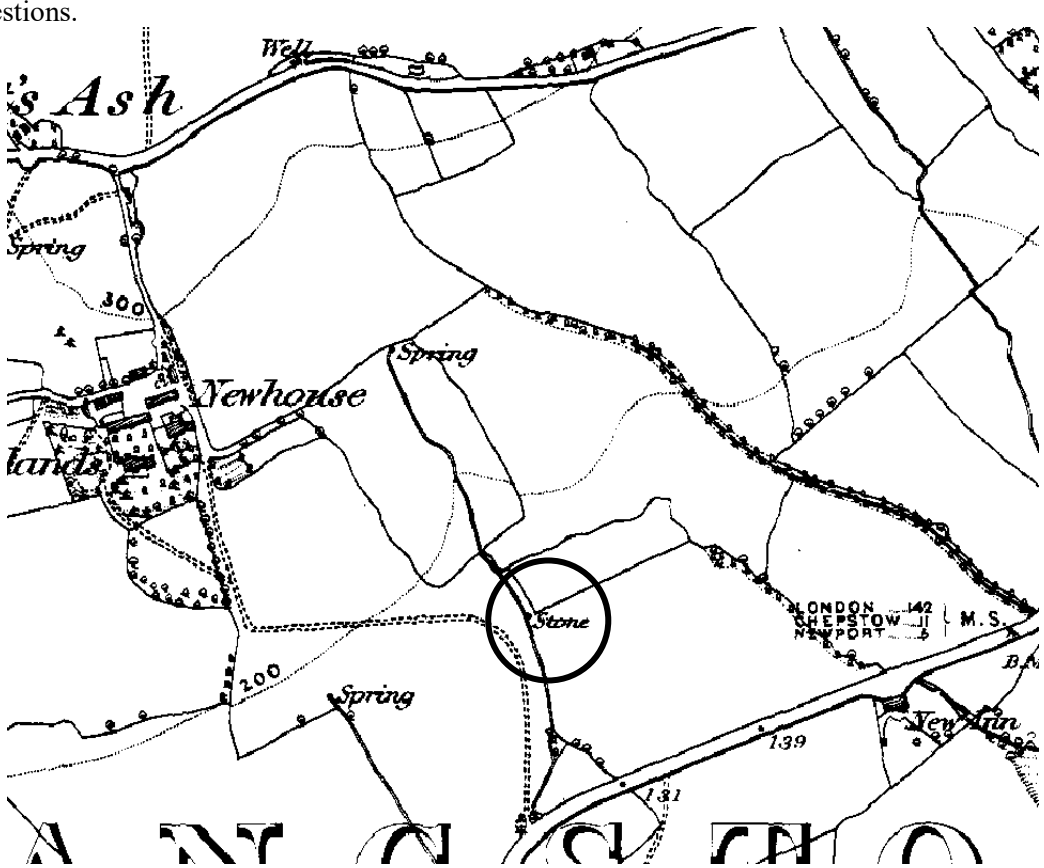


Fig 10.10 Langstone at circa 1890 on first Ordnance Survey map showing the stone on the circumference of the 2.112 mile radius circle. The path to Newhouse and Gorelands (see text) is clearly visible.

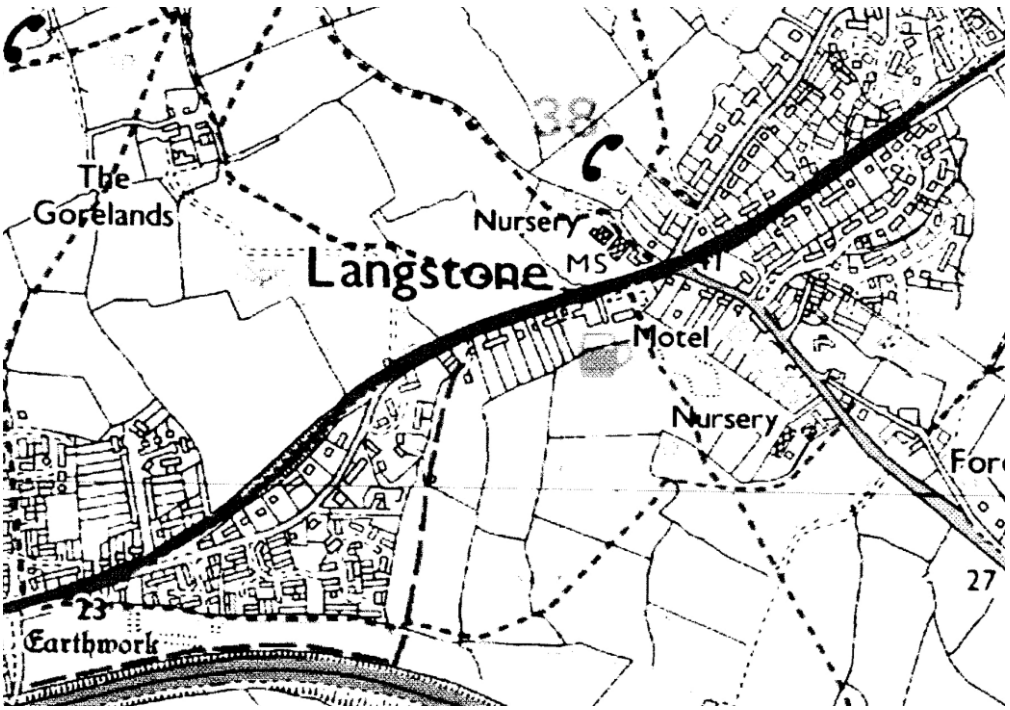


Fig 10.11 Modern map of Langstone (scanned from paper OS 1:25000 map) Note a change in hedges and no indication of the stone.

There is one more surprise to take into account here. Using 3.1418181818 as pi [a commonly utilised factor in the ancient world] the circumference of this circle at 2.112 miles radius = 36495.36 x 1.92 [cubit of foot value 1.28] where a single degree of the anciently accepted Earth circumference is 364953.6.

Note: Further connectivity is seen the following. See the section relating weight systems for extensive use of 128 in India. The reed value of the 1.92 foot cubit is 11.52 feet where the long Egyptian foot is 1.152 feet. In the circle diameter of 4.224 miles 1.92 feet can be counted 11616 times [see Chartres Cathedral and Rosslyn Chapel which are detailed in Chapter 5]

10.3Very Brief Lists of Some Site spacing in Gwent.

While reference here is to Gwent a very similar scenario is revealed when Pembrokeshire, Somerset and Fife in Scotland are examined. Some other references are included later in the chapter.

Distance:
1.056 miles [1.056 feet = 1/5000 of British mile=initial evaluation of foot]

Site	OS ref	Date	Site	OS ref	Date
stone	333792,188690	?	Julius and Aaron Church	332287, 189482	864
			Caerleon Roman Amphitheatre		c.200
Llanwern Church	337061,187872	970	Bishton Church	338645,187297	710

2.112 miles [21.12 inches = cubit of 1.76 feet]

Llansoy Church	344222,202414	725	Llangovan Church	345672,205488	775
			Cyncoed Church	342804,205471	?
			Llanishen Church	347483,203232	970
Llanishen Church	347483,203232	970	Trellech Church		755

The baseline from Llansoy to Llanishen is inclined at circa 15 degrees to the equinox line which is once more significant in this region. The sun has an apparent travel of 15 degrees of arc in one hour [360 / 24]. Here, we find, further elements of a circle of 2.112 miles radius which also is the distance along the midsummer sunrise line between Llanishen and Trellech churches.

2.112 miles [21.12 inches = cubit of 1.76 feet]

Llangfihangel Rogiet Standing Stone	344518,187760	2500BC?	C/L Wilcrick Hillfort	341097,187808	?
			S/W Corner Caerwent Roman town	346621,190426	Circa 300AD
Llanwern Church	337061,187872	970	Bulmore Church	334477,190045	?
			Llanbedwr Church	338874,190755	1045

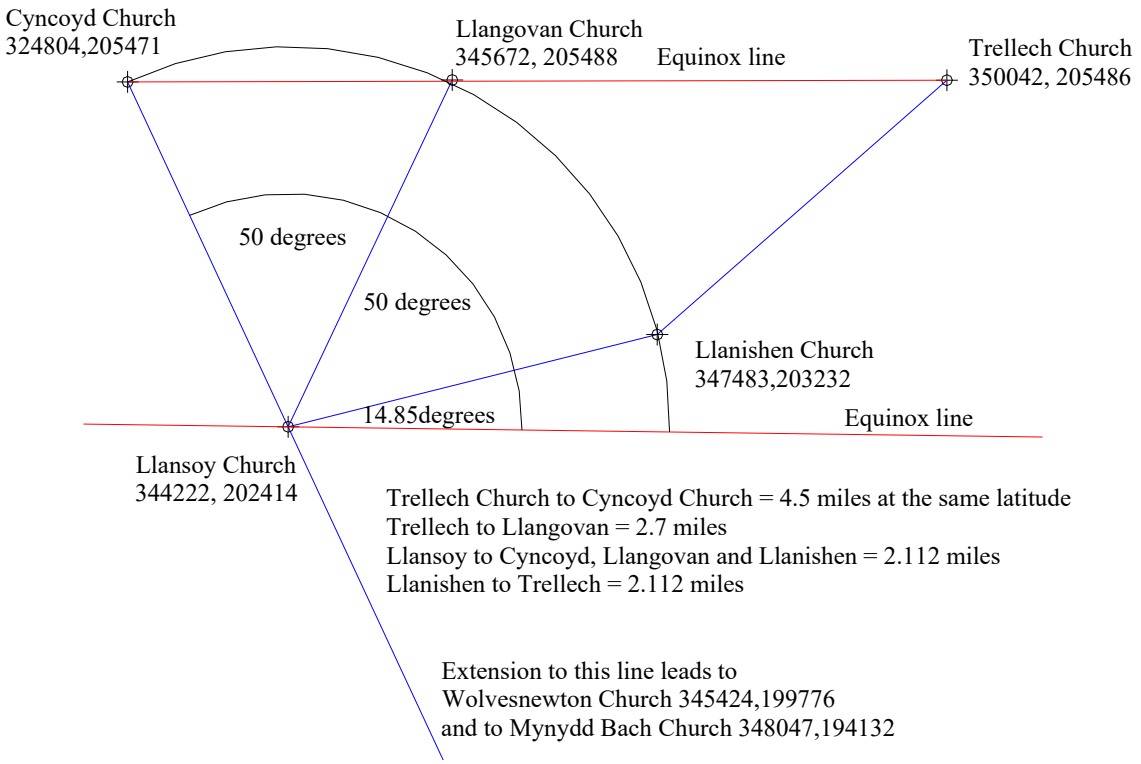


Fig 10.12 Layout of churches centred at Llansoy

Church dates
Trellech 755AD
Llangovan 775AD
Llanishen 970AD
Llansoy 725AD
Cyncoed -mid 19thcentury Baptist Chapel. Note the further use of 2.112.

Circle centred on Llanhennock Church at 2.112 miles radius [Figs 10.1 &10.2]

Tredunnock Church	337959,194851	Llanhennock Church	335323,192705
Christchurch Church	334662,189370		
Llanfrechfa Church	332053,193633		
Llandegfedd Church	333788,195737		
'Motte' East of Twmbarlwm	331930,192489		
Ton Farm [listed as antiquity']	336475,195898		
Stone at Langstone	337763,190344		
'Fort' at Caerleon	332229,191297		

Dates: Tredunnock 1245
Christchurch 1113
Llanfrechfa 1535
Llandegfedd 750
Llanhennock 1491

From this is it appears clear that at least some of these churches are on ancient sites, Christchurch with its 2500BC Pleiades alignment [see Chapter 9] and yet dated to circa 1113AD being a typical example. Certainly all churches on this circle appear to have a spatial relationship with elements that predate their [the churches] construction. Note also that while Llanhennock may be the centre of this circle it is a long way from being the earliest church of this collection to be built. Llandegfedd Church has this honour. In other words, as is also the case with Llanfihangel Pontymoel as is seen a little later, this central position was either denoted via the other earlier sites or the site was already occupied with an earlier structure. Certainly the motte within the fort at Lodge Hill Caerleon predates all these churches as does the motte due east of Twmbarlwm. Arcs calculated from these three sites would pinpoint Llanhennock. It appears that the first measures was possibly from the two Norman 'mottes' that were later erected due east of Twmbarlwm and at Lodge Hill fort and the church at Llandegfedd provided a third correlating position. The motte at Lodge Hill was demolished sometime during the 20 odd years between 1933 and the mid 1950s. It is seen on 1930s OS maps but was not there at my first visit in the mid 1950s.

4.224 miles [2.112 x 2] (Note that St Woolas dim. position is entrance to Churchyard)

Bassaleg Church	327736,187132	1072	'Motte' East of Twmbarlwm	331930,192489	?
			Machen Church	321264,189302	1102
Devauden Church	348357,199121	?	Mounton Church	351247,192962	1348
			Dingham Castle	348030,192340	?
Llanhennock Church	335323,192705	1491	Llanllowell Church	339260,198582	1254

St Woolas Cathedral	330889,187613	1100	Llanhennock Church	335323,192705	1491
			Marshfield Church	326171,182579	1100?
Llanwern Church	337061,187872	970	Llanvaches Earthwork	342434,192059	?
Nash Church	327736,187132	1072	'Motte' East of Twmbarlwm	331930,192489	?
Bassaleg Church	327736,187132	1072	'Motte' East of Twmbarlwm	331930,192489	?
			Machen Church	321264,189302	1102
Devauden Church	348357,199121	?	Mounton Church	351247,192962	1348
			Dingham Castle	348030,192340	?
Llanhennock Church	335323,192705	1491	Llanllowell Church	339260,198582	1254

2.64 miles [1.056 x 2.5= step of 2.64 feet]

stone	333792,188690	?	Motte East of Twmbarlwm	331930,192489	?
			Llanhennock Churchyard	335323,192705	1491
St.Brides Wentlooge Church	329237,182292	1230	Duffryn'fort'	327331,186215	?
St.Brides Wentlooge Church	329237,182292	1230	'The Mount' fort	325851,184865	?
St.Brides Wentlooge Church	329237,182292	1230	'motte' at Castleton	325141,183469	?
South Western corner of Caerwent Town		Circa 300AD	Penhow Church	342406,190825	?

Kemeys Church [seen in list below] was deconsecrated some years ago and demolished, its stone used on an extension to St. Woolas Cathedral. The River Usk is now undercutting the church remains [two stone courses above ground level at last viewing] which in the near future will be part of the river bed. This site, known to be Christian for over 1000 years is another of those places of peace that we have very unfortunately lost. The site, although in a completely rural setting, has been adjacent to a busy bypass for upwards of 20 years. Still, the happy memories of childhood visits to this once peaceful haven live on.

1.584 miles [1.056 x 1.5= cubit of 1.584 feet]

Llangibby Standing Stone	337407,196693	?	Llanllowell Church	339262,198586	1254
Druidstone' Standing Stone	342111,183492	2500BC?	Llanedrin Church Old St. Mellons	322059,181981	?
Stone at Langstone	337763,190344	?	Llanwern Church	337061,187872	970
Motte East of Twmbarlwm	331930,192489	?	Site of Julians Chapel	332397,190000	?
Site of Kemeys Church	338095,192730	950	Site of Saint Albans Chapel	336123,191063	1495

3.96 miles [1.584 x 2.5]

Llangibby Standing Stone	337407,196693	?	Top stone in alignment at Gray Hill [exact]	343758,193576	1400BC
Christchurch Church	334662,189370	1113	Tredunnock	337959,194851	1245
Christchurch Church	334662,189370	1113	Llandegfedd	333788,195737	750
Nash Church	334300,183657	113	Bulmore Church	334477,190045	?
Llanfihangel Rogiet Standing Stone	344518,187760	2500BC?	Llanbedwr Church	Llanbedwr Church	338874,190755

3.168 miles [1.1056 x 3]

stone	333792,188690	?	Bettws Church	328976,190307	1348
			stone	337752,191918	?
			earthwork	337950,191630	?
			Bishton Church	338645,187297	710
			Nash Church	334300,183657	113
Llanwern Church	337061,187872	970	Llanhennock Church	335323,192705	1491
			Nash Church	334300,183657	113
Druidstone' Standing Stone	342111,183492	2500BC?	Bassaleg Church	327736,187132	1072

1.008 miles [diameter of circle 3.168 miles circumference]

Caerwent Motte	347064,190314	?	Ruins of Chapel East of Caerwent	349518,191600	?
Gray Hill Cairn	343387,193551	?	Llanfair Discoed Castle	344557,192410	?
StCurigs Chapel	337109,190775	1536	Langstone Church	337129,189158	1230

5.040 miles [Rad. of circ. of 31.68 miles]

Llanwern Church	337061,187872	970	Earthwork	340961,192428	?
			Coedkernew Church	327623,183492	?
Llandevaud Church	339670,190947		Goldcliff Church	336520,183160	1113
			Llanfrechfa Church	332053,193633	1535
Llangibby Standing Stone	338046,196384	?	Wolvesnewton Church	345424,199776	1254
North Trellech Standing Stone	350232,206358	?	Wolvesnewton Church	345424,199776	1254
Gray Hill Cairn		?	Llanhennock Church	335323,192705	1491

10.08 miles [Dia. of circ. of 31.68 miles circ]

Llansoy Church	344222,202414	725	Christchurch Church	334662,189370	1113
			Llanwern Church	337061,187872	970

There is much more than this to consider however and we even have a Welsh remen…For those who have no idea what this implies, a remen is a unit of length that in ancient Egypt at least was the hypotenuse of a square one cubit per side. The difference here is that we have a remen where there are two different cubits…one at a single British mile and one at two British miles…

We also have what is seen in the illustrations below and this is just a very small portion of what can be found on the Ordnance Survey 1:25000 scale maps. In addition to the listings here a further list that takes in some on the illustrations below, we count

25 counts of 8.1 miles,
14 counts of 8.4 miles
11 counts of 5.04 miles

and more additions to the on the ground measures…and this is only a brief listing of a singular county and the spatial relationships between churches, and with the new additions, motte and bailey castles of the Normans who in fact built most of the churches involved in this investigation.

Figs 10:13 and 14 below show the setting out in a small part of Monmouthshire. Note the dates and angles and the fact that what may appear to be a centre of setting out is not the earliest of the sites. This raises questions in more than one direction

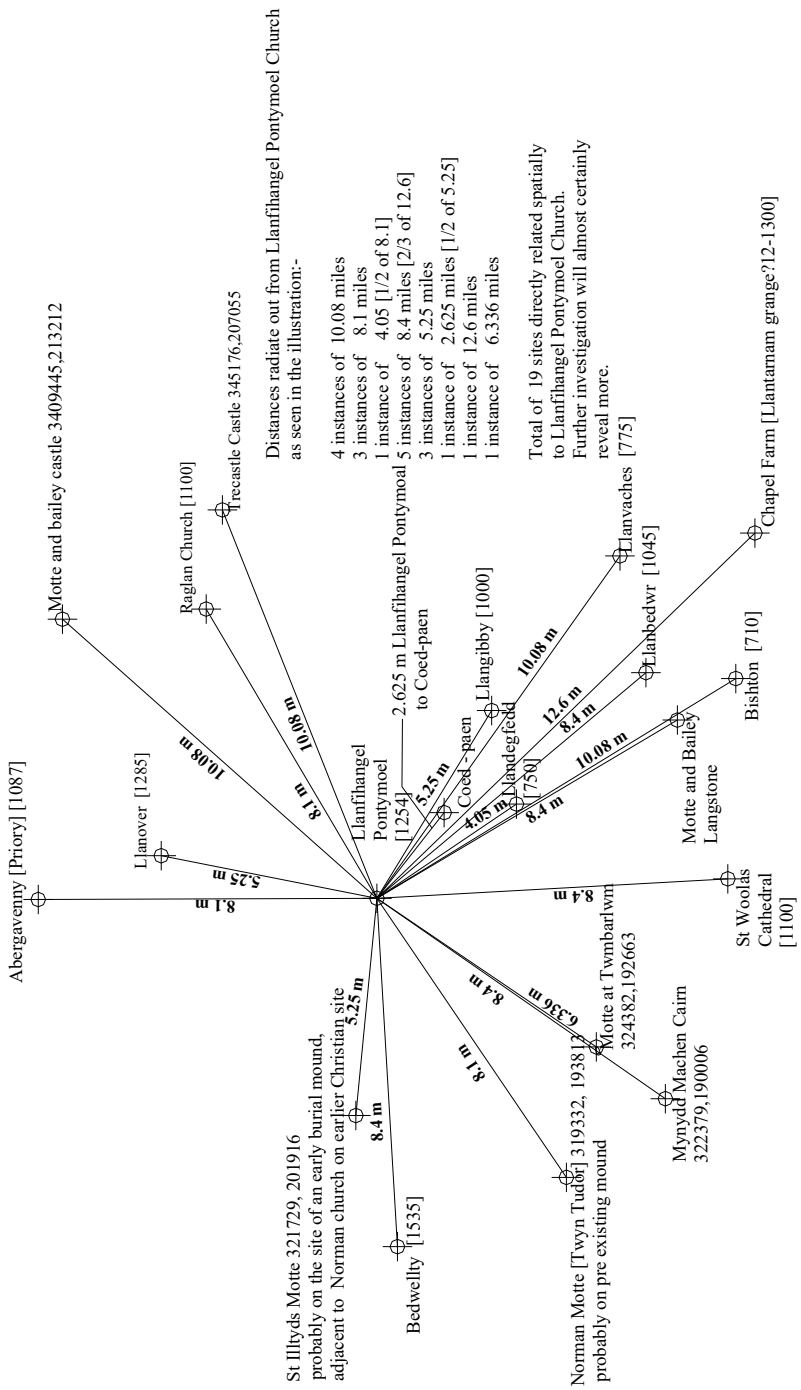

Distances radiate out from Llanfihangel Pontymoel Church
as seen in the illustration:-
4 instances of 10.08 miles
3 instances of 8.1 miles
1 instance of 4.05 [1/2 of 8.1]
5 instances of 8.4 miles [2/3 of 12.6]
3 instances of 5.25 miles
1 instance of 2.625 miles [1/2 of 5.25]
1 instance of 12.6 miles
1 instance of 6.336 miles
Total of 19 sites directly related spatially
to Llanfihangel Pontymoel Church.
Further investigation will almost certainly
reveal more.
Abergavenny [Priory] [1087]
Llanover [1285]
Motte and bailey castle 3409445,213212
Raglan Church [1100]
Tregastle Castle 345176,207055
Llanfihangel
Pontymoel
[1254]
2.625 m Llanfihangel Pontymoal
to Coed-paen
Coed - paen
Llangibby [1000]
Llandegfedd
[750]
Llanvaches [775]
Llanbedwr [1045]
Bishton [710]
Chapel Farm [Llantarnam grange?212-1300]
Motte and Bailey
Langstone
St Woolas
Cathedral
[1100]
Motte at Twmbarlwm
324382,192663
Mynydd Machen Cairn
322379,190006
Norman Motte [Twyn Tudor] 319332, 193812
probably on pre existing mound
Bedwellty [1535]
St Illtyds Motte 321729, 201916
probably on the site of an early burial mound,
adjacent to Norman church on earlier Christian site
8.1 m
5.25 m
10.08 m
8.1 m
10.08 m
5.25 m
8.1 m
2.625 m
5.25 m
4.05 m
8.4 m
10.08 m
12.6 m
8.4 m
10.08 m
8.4 m
6.336 m
8.4 m
8.1 m
5.25 m
8.4 m

Fig 10.13

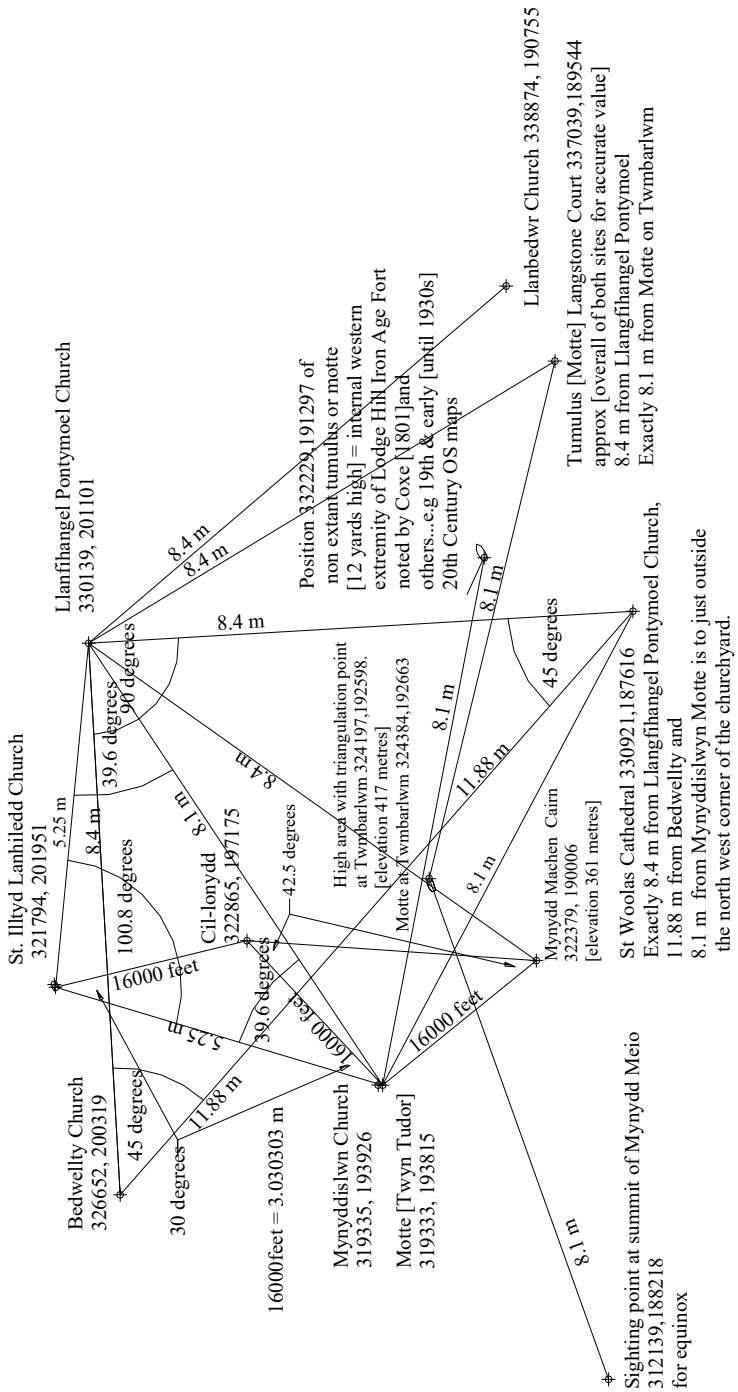
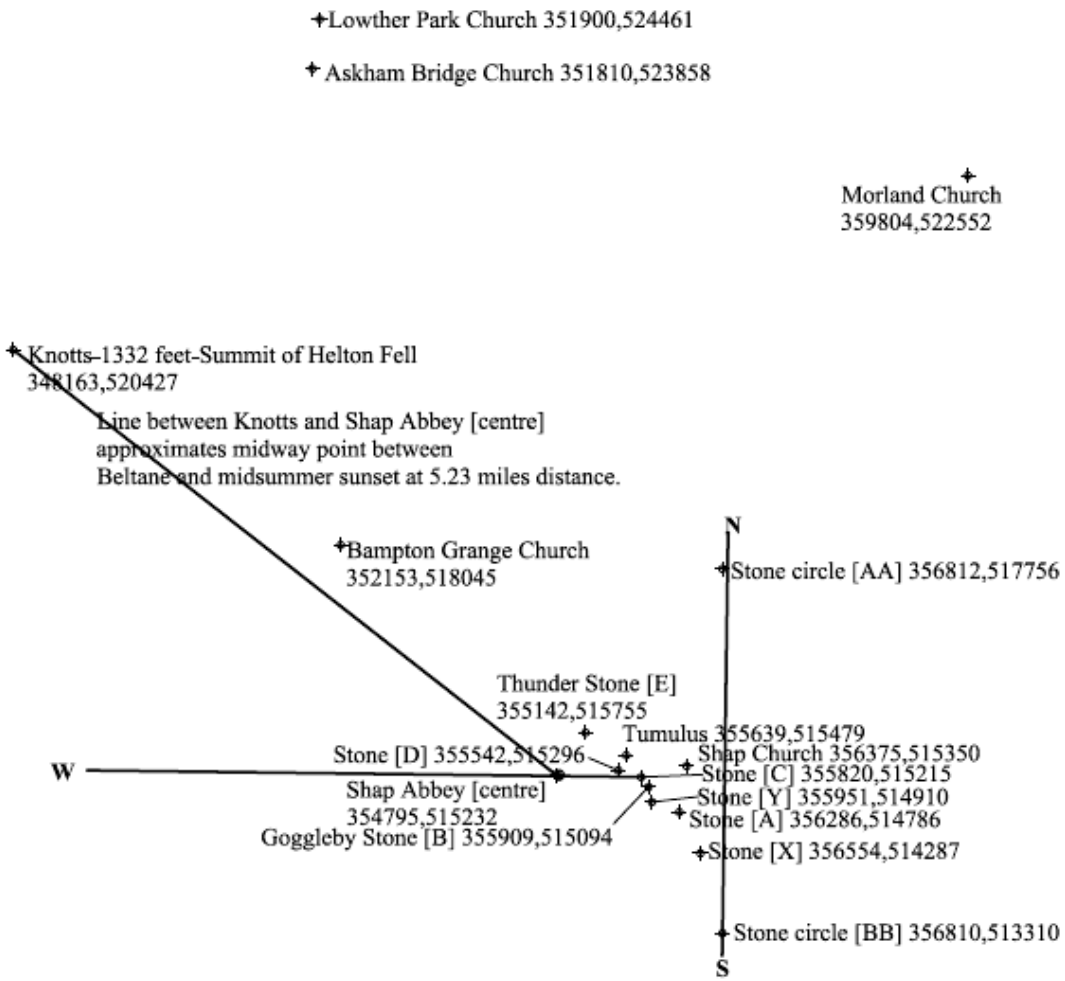

Llanfihangel Pontymoel Church
330139, 201101
St. Illtyd Lanhiledd Church
321794, 201951
Bedwellty Church
326652, 200319
Cil-lonydd
322865, 197175
Mynyddislwn Church
319335, 193926
Motte [Twyn Tudor]
319333, 193815
Mynydd Machen Cairn
322379, 190006
[elevation 361 metres]
St Woolas Cathedral 330921,187616
Exactly 8.4 m from Llangfihangel Pontymoel Church,
11.88 m from Bedwellty and
8.1 m from Mynyddislwyn Motte is to just outside
the north west corner of the churchyard.
Sighting point at summit of Mynydd Meio
312139,188218
for equinox
Llanbedwr Church 338874, 190755
Tumulus [Motte] Langstone Court 337039,189544
approx [overall of both sites for accurate value]
8.4 m from Llangfihangel Pontymoel
Exactly 8.1 m from Motte on Twmbarlwm
Position 332229,191297 of
non extant tumulus or motte
[12 yards high] = internal western
extremity of Lodge Hill Iron Age Fort
noted by Coxe [1801]and
others...e.g 19th & early [until 1930s]
20th Century OS maps
High area with triangulation point
at Twmbarlwm 324197,192598.
[elevation 417 metres]
Motte at Twmbarlwm 324384,192663
16000feet = 3.030303 m
16000 feet
16000 feet
16000 feet
8.4 m
8.4 m
8.4 m
8.4 m
8.1 m
8.1 m
8.1 m
8.1 m
8.1 m
11.88 m
11.88 m
5.25 m
5.25 m
90 degrees
39.6 degrees
39.6 degrees
100.8 degrees
42.5 degrees
45 degrees
45 degrees
30 degrees

Fig 10.14

Having revealed some of what is hidden in the Gwent or Monmouthshire landscape let us look a little further afield. We shall examine some of Cumbria and France.

10.4 Stones and churches at Shap, Cumbria

Fig 10.15 Map of Shap, Cumbria



10.16 Shap Region layout of stones and churches.

Notes to Shap stone and church layout

The church arrangement naturally extends beyond the confines of the illustration and in its entirety would contain much more than is included in this brief report. Note that stones [x] and [y] are no longer extant and their positions were obtained from early maps. Tradition claims that many more stones were in the vicinity in the past but we only evaluate that of which we are aware.

- Askham Bridge Church = 31680 feet [20000 x 1.584] = 6 miles from Shap Church, centre to centre

NB [1.584 = cubit of foot value 1.056]

- Lowther Park Church = 2000 feet from Askham Bridge Church

= 1/15.84 of Shap -Askham Bridge

- Morland Church to both Askham Bridge and Lowther Park Churches

= 16800 x 1.584 feet [from centre of Morland Church to positions within churchyards at Lowther and Askham Bridge churches] Note that this equals 5.04 miles and that this measure as a radius denotes a diameter of a circle of 10.08 miles with a circumference of 31.68 miles [105600 x 1.584 feet] representing the square containing the circle of the Earth.

Also that 6 x 1.68 = 10.08.

- Shap Church [centre] to Bampton Grange Church = 16800 x 0.977777 [where 0.97777=11.733333 inches and 1.1733333 feet = foot of 2.93333 step].

= 5600 x 2.93333r

NB [2.9333r = step value associated with reed of 10.56 feet and cubit of 1.76 feet and foot of 1.17333333 also 1.76 /1.111r [1 $^{1}/_{9}$] =1.584]

- Bampton Grange Church to Stone Circle[AA] = Bampton Grange Church to Knotts and Bampton Grange Church to stone [C] = 10000 x 1.52064 [long Greek cubit as assigned by Michell] [within 14 feet, which is acceptable for churchyard dimension]

= 8640 x 1.76.

- Morland Church [centre]to Bampton Grange Church [centre] and Shap Abbey [approx centre]also stone [X] = 27000 x 1.08 [foot of cubit of 1.62 feet] measure within 8 feet.

= 5.4 miles at 5400 feet =10800 steps at 2.7 feet = 3000 reeds at 9.72 feet.

- Centre Stone Circle [BB][approx]to centre of Tumulus = 1.62 x 5000
- Stone Circle [AA] to Stone Circle [BB] = 9000 x 1.62
- Shap Church [centre]to transepts in Shap Abbey = 3168 x 1.62
- Shap Church [centre] to stones [A] and [C] = 1680 x 1.115136 [1.056 x 1.056]
- Stone [A] to Stone [B] = 168 x 9.504 [reed of 1.584 foot cubit] =1008 x 1.584

NB 1008 = diam. of circle 3168 circumference and diam. Stonehenge Sarsen Circle = 100.8 feet thro. centre of lintels

- Stone [A] to Stone [D] = 1680 x 1.76 =1008 x 2.9333r
- Stone [B] to Stone [C] = 1680 x 2.9333r
- Stone [B] to Stone [E] = 1680 x 1.98 = 2520 x 1.32 [15.84 inches] =1008 x 3.3 =2100 x 1.584 = 3.3 x Stonehenge Sarsen Circle diam [centre of lintels]
- Stone [C] to Stone [D] = 950.4 feet = 90 x 10.56 = 600 x 1.584
- Stone [x] to Tumulus = 1680 x 2.933333 [northern edge]
- Stone [x] to stone [y] = 1680 x 1.68
- Centre of Tumulus to transepts of Shap Abbey = 1680 x 1.68

Note there are 10 repeats of 168 or 1680, these generally with either the dimension sets based upon a foot of 1.056 or 1.1733333 which are related via the factor 1.111111 [1 $^{1}/_{9}$].

The cubit of 1.68 feet is also seen here as is 1.62 feet. 3168, the number associated with the square containing the circle of the Earth and the measure of the 30 day month is seen but as the 1.584 foot cubit is strongly in evidence this is not surprising as 1584 x 2 = 3168. 168 fits into the scheme of things as when the mile associated with the cubit of 1.584, the British mile, is divided by $^{22}/_{7}$ the result is1680. While the stones involved are large, there are far, far too many numerical commonalities here to put down to coincidence. Very extensive investigation has failed to arrive at a different conclusion; it appears that these measures are the original target dimensions of the site.

Stone [E] [Thunder Stone]at elevation 860 feet, sighted from the position of Stone [A] at elevation 834 feet, although being currently invisible from the position of Stone [A] due to small rise in land, drystone walls and a copse of trees] is precisely the line of the Major lunar standstill.[5 degrees north of the midsummer sunset position]

This line can be extended over the local high ground [6 miles distant] of circa 1100 feet elevation directly to the peak of Carrock Fell [18 miles distant] at an elevation of 2116 feet. Midsummer sunset would be seen from Stone [A] with the sun sliding down the northern edge of the slight protuberance above the local hills known as Knotts.

Kemp Howe Stone circle [BB] 356810,513310

The position of this circle [almost completely destroyed by the railway running through its centre] appears to have been denoted by its location being precisely due east of the highest location in the fells locally. This location is known as High Raise and has an elevation of 802 metres or 2631 feet. In the direction of midsummer sunset from this circle there is the unusual feature of a line of peaks all exactly behind each other. Beginning with the most distant [and highest], Cairn Pike at 594 metres [1951 feet], Souther Fell at 515 metres [1689 feet] and Great Mell Fell at 532 metres [1747 feet].

Fig 10.17 Shap stone [A]

Fig 10.18 Shap stone [E] Thunder Stone
The stones at Shap are all large.

How much of the above is a natural occurrence and how much is by hand of man we cannot say but have simply reported what has been found.

10.5 Investigations by others

As an example of what may be a wider construct, the 'measurements in the landscape' concept is extended a little further with the work of Henry Lincoln. Lincoln has discovered a number of interlocking circles, each incorporating a selection of churches, castles and other items on their peripheries and along lines formed by the geometry that denotes these positions on the ground. As he relates and describes well, these are clearly seen on the relevant maps of France. From the point of view of this study however, the interesting facet is the circle dimensions. Lincoln has calculated a radius from the approximate value on the 1:25,000 scale paper maps of 188mm.[4] After much evaluation he has given it the count of 933.586 English poles.

The English pole is a length of 16.5 feet and hence the radius according to Lincoln would be 2.91745625 miles or 15404.169 feet. However, utilising the values now known to have been in use as seen in this work the correct scale value is perceived to be 187.9474837 mm [visually 0.0525163 of a millimetre different to Lincoln's measure!] which results in a difference in the actual length of the radius on the ground of 11.47 feet.

It is calculated here that the circle radius was originally set out to represent the Greek step at 2.5344 x one minute of arc of the Earth's circumference as calculated by Michell [6082.56 feet]. The diameter of the circle would therefore be 6.08256 x 5068.8 where 5068.8 feet is the *Long Greek Mile* which is 1/25920 of Earth's circumference. Interestingly the *Long Greek Mile* x 1.2 = one minute of arc or 1/21600 of Earth's circumference. Hence the diameter in feet is seen as:-
[5068.8 x 1.2] x 5.0688 = 30831.28013 = 6.08256 long Greek miles which compares to Lincolns assessment which in the same measure would be 6.078033854 miles, within 22.6 long Greek feet. On the metric 1:25000 scale map the diameter would therefore read as 375.8949673 mm or for the radius,187.9474837mm.

There are other of the values of antiquity that also fit these dimensions, confirming their validity.

In terms of British miles a count of 2.9196288 miles emerges for the radius, and for the metric aficionados the distance is an odd and cumbersome 4.698687092 kilometres. Among the ancient measurement units as seen earlier in Chapter 4, in conjunction with Posidonius, we find 1.216512 feet and this foot unit, here multiplied by 12672 or the number of inches in 1056 feet again gives the radius of this circle. The diameter in *Long Greek* feet is 30412.8 whereas the Great pyramid perimeter length measured at the socket lines is 1/10 this count in British feet. The circumference of this circle in feet has a value of 3.475748571 feet [lintel width at Stonehenge and 1/150 of Eratosthenes stade value] x 27878.4 where 27878400 is the number of feet in a British mile.

It is little wonder that modern researchers in general have no idea of the use of numerical values among earlier cultures. But some of us have taken up the cudgel and proven Michell's measures to be correct via evaluations such as this, that seen above and on site surveys of structures.

Yet another most intriguing situation arises where a colleague of Lincoln's, Erling Haagensen, has evaluated a further circle of 56 miles circumference on the island of Bornholm.[5] His work has been checked by others and found to be correct. This circumference measure is interesting as it contains 1680000 cubits at 1.76 feet, 28000 reeds at 10.56 feet and 252000 at 1.1733333 feet, the foot associated with the 1.76 foot cubit. [252000 is the number of Eratosthene's stades in Earth circumference.] A count in the associated step value of 2.9333r feet is 100800.

There is obviously much more to be discovered here in the ancient landscape but more research needs to be done to clarify the situation across Britain and Europe.

We should not also forget here another work by John Michell *At the Centre of the World* where he suggests that something he calls 'centrism' is at play also in ancient landscapes.[6] He makes a convincing case for this idea in what is recommended reading for the interested reader in this area of study. However, he does not explore *why* these centric ideas were so important to ancient pre-Common Era societies. Again, it is such questions that drive the research and this is being investigated.

10.7 Evidence for Long Distance Setting Out in France.

It would appear that there is a pattern among the Notre Dames cathedrals of France which is taken from the sky. Charpentier was of the opinion that Chartres, Reims, Amiens, Bayoux and Evreux formed a part of the constellation Virgo.

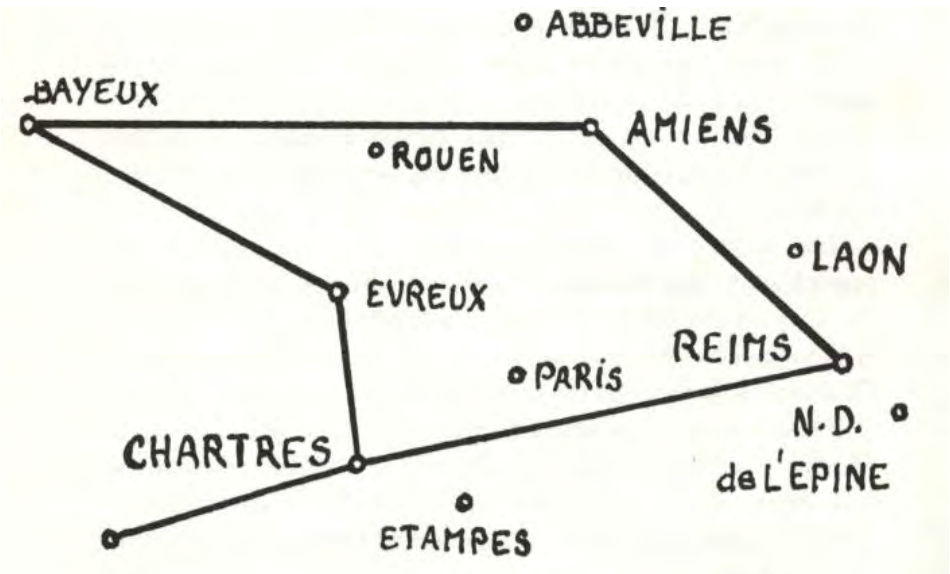


Fig 10.19 French Cathedrals Emulating The Constellation Virgo [after Charpentier L.]

In his appreciation of the concept of such a layout he was not alone because as he notes, Maurice Leblanc and others had previously noted that the Benedictine Abbeys of the Caux country trace on Earth the form of the Great Bear[7]. Charpentier also mentions in passing the discovery of the Glastonbury Zodiac, which is a reference not to the cathedral but to the formation of boundaries and features on the land surrounding the impressive tor. Our opinion is that this is a possibility but with so many streams and boundaries, it is more likely to be an accident, somewhat akin to seeing a face in a fire. We view the idea of geometrical shapes in the landscape in a similar fashion, circles excluded, why should anyone go to the trouble of setting out over many miles, a hexagon or some other related shape? Most alignments are related either to astronomy or to hill tops for direction giving while others may be caused by specific dimensional setting out. Any geometrical shape will be the result of accident and not design, it would serve no purpose. The emulation of a constellation is a different matter and indeed this has occurred, albeit not to the best of our current knowledge in Gwent.
Charpentier and Leblanc, were both correct in their assertions regarding long distance setting out of these structures although Charpentier has been seen to be in error regarding his choice of constellation. His assessment of the layout of the cathedrals, as seen above, was that they

emulated Virgo. Revealed by the painstaking work of Greg Rigsby we now know that these cathedrals do not emulate Virgo, but Ursa Major, the Great Bear.

Greg Rigsby was fortunate in having computer astronomy and mapping programs to aid his research while Charpentier was working long prior to the advent of these tools. Rigsby certainly was most meticulous in his researches and utilized these modern techniques. Regarding this concept of location spacing, emulating the stars and constellations in the sky, the evidence from other regions in France, from Greece and from the Baltic will verify that indeed it is not only in recent centuries that the ability to accurately long distances measure over land, has existed. We offer no explanation regarding method, but only demonstrate that this did occur.

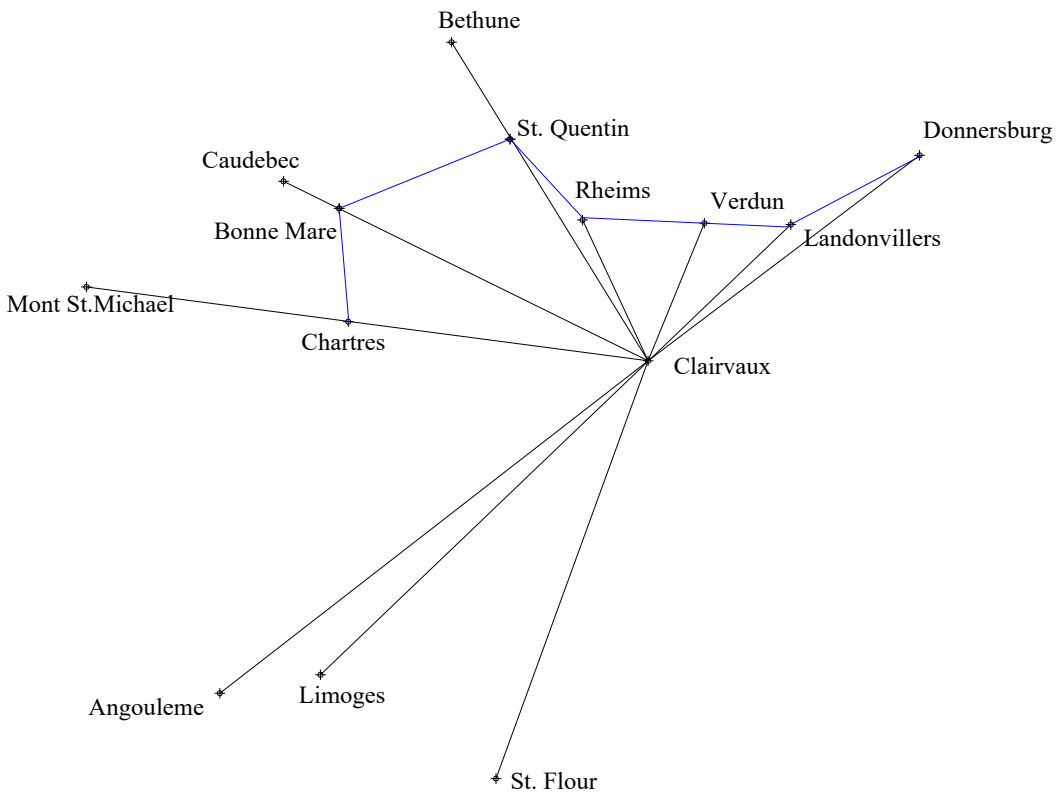


Fig 10.20 Layout of Cathedrals in France following the shape of Ursa Mayor
[after Rigsby G.]

There are naturally dimensional considerations to take into account here. A line drawn from Chartres to Donnesberg will have its centre at the centre of a circle that takes in, on its circumference, Chartres, Donnesberg and Bonne Marie. This same point is the centre of two circles that have on their perimeter, Reims and Verdun and St Quentin and Landonvillers. The distance between Chartres and Donnesberg measured by Rigsby is 1596670 feet.[8] Here we

have a slight difference of opinion. Unfortunately for Rigsby he did not have a full understanding of the ancient measures and has picked up some information from Michell's work without comprehending the implications of the involved values. The actual intended target distance between Chartres and Donnesberg would have been 1596672 feet. Not exactly a large difference, a mere two feet over 302.4 miles but nevertheless, an important one. This two foot difference means that there are no incomprehensible fractions at the ends of otherwise neat values that fit with one another.

Nevertheless, there do remain doubts regarding such very extreme accuracy over an extended distance such as this and it is felt that this is more a case of theory than actuality. However, a circle with a circumference of 31680 has a radius of 5040 which in terms of British feet is the value of what Michell has termed the 'short' Greek mile. The diameter of course is 10080 as at Stonehenge we find a diameter through the centrelines of the Sarsen lintels of 100.8 with an appropriate circumference of 316.8 feet. At 1596672 feet we find the 10080 value still applies but with the count in units of 158.4feet. Hence the circumference of this circle would be [10080 x 158.4] x 22/7 or put another way, 302.4 miles [100.8 x 3] x 22/7. The result is 950.4 miles or 31680 x 158.4 feet. 9.504 feet is 6 cubits at 1.584 feet and here we find the same count scaled up into miles and multiplied by 100, a similar concept to the enlargements seen in Gwent. The numbers here are becoming familiar and again show that the same counts of feet and inches can be replicated in miles and vice versa.

The following chapter relate more of what has been discovered in Britain and France. Here the investigation revealed that two very specific structures, Chartres Cathedral in France and Rosslyn Chapel in Scotland display distinct Biblical connections via a figurative telling of tales. There is also additional information relating to some of the sites of Britain examined by Gill and Harry.

CHAPTER 11

Repositories of Measure: Cathedrals, Churches, Monasteries and Palaces

But they will maintain the state of the world, and all their desire in the work of their craft.
Ecclesiasticus 38:34

11.1 Introduction

In this chapter it is demonstrated that the ancient figures can be found by anyone with the ability to accurately survey churches, cathedrals, monasteries and similar buildings. For those who wish to conduct a serious study of some very interesting historical buildings here are found some typical examples, with indication of the elements of which the researcher needs to be aware. This chapter was initially written in the early 1990s and has had the occasional revamp over the years since. Apart from Chartres and other locations where indicated, all the surveys here have been conducted [as have numerous others not included] by Gillian and Harry. As is usual, Harry is responsible for the analysis and of course any arising errors.

Many churches and other buildings reveal some element of the figures and combinations seen in this work but frequently it is a painstaking operation to discover precisely what the intention of the architect actually was, more so when there are a number of possibilities with little difference between them. This is compounded when a structure has been altered on a number of occasions. Additionally, when looking at churches, there is the problem that not all of these structures were built by masons who were initiates to the system, and in such cases other values were in use. The research has not, to date, encompassed the additional measures evaluated by John Neal in this direction, but possibly some of these were in use where those in this work were not. We welcome response from readers who take up this research, the sooner that a full evaluation is conducted of as many ancient and mediaeval structures from a metrological viewpoint the better. It is essential that archaeologists take metrology on board as a valuable tool, something which as is evident throughout this work; they have singularly failed to do.

Not only are our cathedrals and churches along with other medieval and later buildings seen to be measurable in the familiar units, other remains can also provide valuable information. Without travelling abroad there are numerous ancient artefacts and building remains to be seen in Britain, left by the Romans. Here one initially would assume that the Roman measures need to be applied, but as has been stressed, the measures were universal and this is not necessarily the case. The same values were in use over a very wide region and an equally broad expanse of time as we have demonstrated throughout this work. Museum pieces frequently have their dimensions [invariably in metric] noted and these can be enlightening. Historical studies also play their part and in Volume 12, Number 6 / June, 1969 of

Measurement Techniques an article by N. A. Shost'in revealed a number of studies into Russian historical measures, studies commencing in Palestine in 1106AD by Father Superior Daniil. The Russian cubit was known as a *locot* and a span [half cubit] *a pyad.* The result of this study implied that the Russian cubit had a length of 1.532152 feet, a value that was much later, in the first half of the 20th century, extended by N.V. Ustyugov to 1.5551229 feet. This value is virtually exactly 1.5552 feet, the difference is merely 0.0009252 of an inch and hence as 1.5552 feet = 18.6624 inches or 4.32^2 we accept that indeed this is the measure for which these gentlemen were searching, but as in so many other cases, without a background knowledge of the ancient values, failed to correctly ascertain. Note here that the values in the article are denoted in metric units and we have to take care regarding which value of the metre we utilize for evaluation as was demonstrated in Chapter 6.

Regarding buildings, occasionally when a specific measure has been discovered the information seen in this book can lead to knowledge of what else will be found within that particular structure. This can be seen in the first example and for this we have to leave Britain and take a trip across the channel to France.

11.2 Chartres Cathedral.

An in depth study of many of Europe's famous cathedrals would in all probability reveal a tale similar to that of Chartres. It is chosen here because of a fascination with the story as related by Louise Charpentier. There additionally are links from Chartres to Rosslyn Chapel which are seen later in the chapter.

Much mystery surrounds this particular cathedral. It was apparently the first of the great Gothic cathedrals, yet it grew out of the ground with scarcely a pause, perfection at first attempt. No-one has yet explained this sudden emergence of great architectural, geometrical and engineering skill, it is one of the enigmas of Chartres. However although there is much that remains in the realm of the 'not satisfactorily explained' category there is also a great deal that can be seen to make sense when the rules of ancient symbolic measures and numbers are applied. Before delving into the dimensions of the structure however, it would be prudent to note a little of the history of the cathedral and its human associates. The following history of Chartres, and indeed, the initial all-important initial measure, albeit in metric units, was derived from the work of Louise Charpentier.[1]

The prime key to Chartres is the inscription over the North Door, also known as *The Door of the Initiates*, which states in Latin,

...Here things take their course…you are to work through the Ark…

There is no doubt which Ark is implied as the carving clearly indicates the Ark of the Covenant but before the numerical element that is implicit in the statement is unravelled we shall take a look at some history and dating. Here we ask readers to bear in mind the first part of the inscription… *Here things take their course…*

11.2:1 History of Chartres Cathedral

It is said that prior to the construction of the existing cathedral the previous church was dedicated to the Virgin Mary. This was built [not unexpectedly] on the site of a dolmen, the remains of which are still in existence at Chartres. Apparently, in the year 876 AD, the building was endowed with what was known as the 'Holy Tunic of Mary'. This symbolic garment was originally housed in a cedar wood reliquary. In the tenth century, the container, reliquary, or to use another perhaps in this case the more appropriate word, ark, was encased in gold in a similar fashion to the Biblical description of the Ark of the Covenant.

Evidently the existence of this tunic attracted large numbers of pilgrims and to ensure that this remained an ongoing situation the rumour was spread that the garment had miraculous healing properties, a common religious ploy.

Unfortunately 144 years later in 1020 the church was destroyed by fire. The night of September 7th saw the place razed to the ground and it must have been by a miracle [so the story relates] that the Holy Tunic was saved.

The Bishop of Chartres immediately set the architect Beringer to work on a replacement building for the Church of Gislebert as it was then known. Some, however, claimed that the church was in reality already a cathedral, perhaps because of the 'magic' tunic bringing in numerous visitors who probably greatly swelled the coffers of an otherwise unknown, unimportant rural church.

The new church was again a timber construction but this time much larger than the original, which itself implied an expanding population and the growing need for a larger building. It appears that the magnetic tunic was still drawing visitors in large numbers from far afield. The Church of Gislebert itself was built on the site of a Roman temple, which again was located on an ancient sacred spot with the aforementioned remains of a dolmen beneath. Here we have Christians utilising a Roman site which were over even earlier site. The *place* was of importance which appears to link to the setting out discovered by Greg Rigsby seen in the previous chapter. Whether there is an association here or not, as in so many other cases, this has been a 'sacred' site for an untold period of human history, possibly initially simply due to an excellent view of the heavens and where the heavens meet the horizon for recording the rise and set of the lights in the sky…pure practical astronomy.

1134 saw the next stage in the development of the cathedral when again there was a large fire. This time the western porch and adjacent belfry were destroyed along with a substantial section of the town itself including the hospital. Work was again set in motion and the replacements were soon to be seen taking shape but this time a strange situation began to develop. The church was repaired but well in front of, and not in any way connected to the newly repaired wooden church, a pair of stone towers began to grow. These in fact are the towers seen today. The spires were a later addition but the basic towers were built long before the present cathedral.

Does it not seem odd that two towers, apparently at the time of no use, were built at great expense, certainly much greater than the church building itself, in front of a still relatively small rural church *and then left in readiness to be incorporated into some future building?* This at a time *when in Paris itself, such projects were frequently held up for years because of a*

lack of funds? So why build these expensive, unnecessary towers at this place, at this time? Of course they were essential to the later cathedral but here is merely a medium sized timber church whose only claim to fame, other than being on an ancient site which was by no means unique, was the Holy Tunic of Mary. There is no written explanation but it is self evident that long term planning was involved; the towers must have held the key to the future cathedrals design.

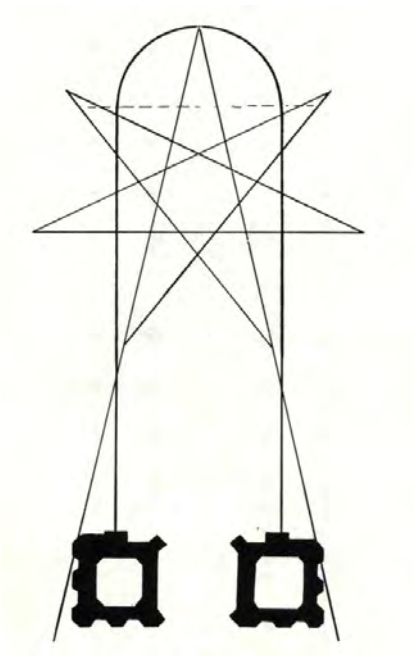


Fig.11.1: The Towers and Cathedral Geometry

It can be clearly seen in this illustration from Charpentier that the original towers formed an integral part of the overall concept of the design of the cathedral.

This in itself implies that the destruction of the now rebuilt Church of Gislebert was already pre-ordained.

Seemingly there were plans afoot for this particular site, the little country town was important in someone's eyes, and that someone clearly held a great deal of influence. As to be expected, 60 years later, in 1194 the replacement was again burnt out, and as there is no further mention of the Holy Tunic it is assumed that it was destroyed in the conflagration. This time there was no patch up job, no quick fix with a timber church, the cathedral design in stone was seen to raise itself out of the ground. However the timing should be noted for there is something afoot here.

The bulk of the new work was carried out in a most unusual manner considering the financial situation relating to equivalent buildings in the large cities where funding was always a problem. Chartres was completed in the short time of 26 years which takes us to the year

1220. Chartres was a small rural town and yet this large, exquisitely designed and executed piece of work was carried *out without a break to raise funds.*

This is seen in relation to the previous illustration showing the towers. The diagram clearly shows the integration of the design indicating that the building was designed prior to the fire of 1194 and possibly before the earlier destruction of 1134. By 1245 the transept and the two porches were finally complete and after a so far unexplained wait of 15 years the cathedral was finally dedicated in the year of 1260. Legend states that the kings Philip Augustus and Richard the Lionheart made substantial donations to the funding of the building as did numerous bishops and clerics but on the face of it, is this consistent with the importance of this little country town and its church? The tunic which had magically drawn many visitors had apparently been lost so what was so important about this particular structure, and perhaps even more to the point, who was behind its design?

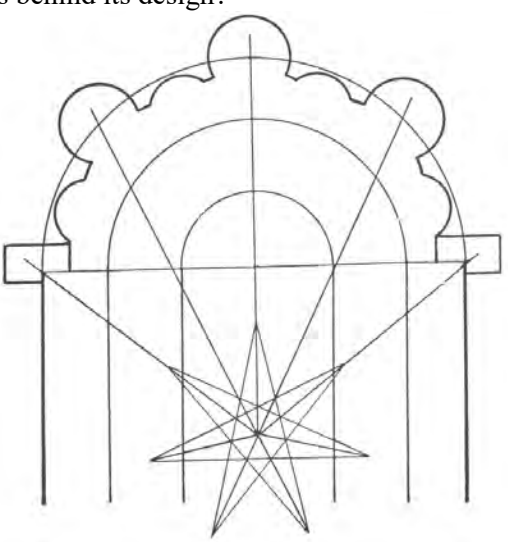


Fig.11.2 : The Apse Of The Cathedral

11.2:2 Knights Templar

The matter of the Knights Templar is introduced here because there is strong possibility that this group were associated with the building of Chartres. The Knights Templar were initially set up at the instigation, it would appear, of Bernard of Clairvoux. Bernard was a Benedictine monk who left the order to form the Cistercian movement. Histories of the Knights Templar and the relevant associations abound so there is no need to delve into the intricacies of those matters here, it is the following history which is of interest in this work, specifically the dates attached to events.

In 1118 nine Knights made their way to the palace of the King of Jerusalem. Their leader, the Count of Champange presented himself and his eight companions with no apparent preceding introduction and was most cordially received, in fact these travellers were made so

welcome that a complete wing of the palace was given over to their sole use. The mission of these Knights was said to be to protect pilgrims on their way to Jerusalem from being waylaid by bands of brigands and suchlike evildoers. Strangely there is no record whatever of such behaviour, in fact once inside the palace they apparently were not seen for a number of years. So why were they there? And why did the ruler of Jerusalem make these people so welcome, this is beyond common courtesy, or even royal friendship. There self evidently was something afoot.

The palace was built adjacent to the Muslim Mosque which itself is thought to be sited upon the original foundations of the temple of Solomon, but the outbuildings of the temple built by Herod, notably the stables, were still to be seen within the confines of the palace. It would seem and is commonly thought that these Knights were engaged in a systematic search of these remains and not in any way involved in the activities used as a cover story. There is some evidence to indicate that they even tunnelled part of the way beneath the Dome of the Rock, the Muslim Temple and site of the original building of Solomon but they apparently were either disturbed or gave up in their attempt, *or perhaps they were successful in their endeavours*.

The Dead Sea scrolls have revealed that it is possible that large amounts of valuables including silver and gold and other probably priceless sacred objects were buried beneath the temple when there was threat of an invasion so it appears that this may have been the aim of the group, to locate any such treasure. The success or failure of the mission is not recorded, although rumours abound, but it would seem that the men stayed at the king's palace for ten years, enjoying his hospitality. As the knights took an oath of poverty this does seem a little out of character, continually making the best of the finest that was available. However, there was nothing in their creed to prevent them receiving charitable donations so perhaps one cannot criticise on this count. The story nonetheless does not seem to have much credence, there must surely be more involved than this, although to date there apparently is no evidence that would contradict the tale. The Knights returned after ten years and in 1128, their leader, the Count of Champagne was made the first Grand Master of the movement.

There has been much speculation about the involvement of the Knights Templar in the building of this Chartres cathedral. Speculation is perhaps the correct word for although much information points in this direction it has not been proven that they were involved. A building division known as the *Children of Solomon* are thought by some to have been involved in the construction of this cathedral and again there are some hints that they may well have been connected with the Templars. They appear to have perfected the Gothic style of building. Another group apparently specialised in the Romanesque style. These were the *Children of Father Soubise*. The last group of this trio of religious builders all three divisions of which refused to work on castles or jails were named the *Children of Maitre Jacques*.

According to some it seems that with the trial of the Knights Templar under Philippe le Bel, these building groups all became amalgamated within a secretive organisation which named itself the *Compagnons des Devoirs* and maintained this title ever since, being still in existence as a secretive, but known organisation in modern times. The title has seemingly altered to *Les Compagnons des Devoirs du Tour de France,* which name they took up during the course of the19 th century. Given the evidence, it almost a certainty that the modern Freemasons were originally derived from this group. A while after the dissolution of the

Templars the Freemasons were known to be in existence in Britain, Britain had also been home to many Templars and their traditions would have lived on in their families. Many of these knights were associated with Royalty and were themselves of high status. Hence when the new group, modelled on the craft masons who built the churches and cathedrals was eventually set up, it was by high ranking people or directly associated men. Is it not odd that within a very short time of this organisation's birth it was populated by the elite of the European countries including royalty? Is it at all likely that a king, prince or the equivalent would have any desire to emulate the activities of a building worker? High status academics, scientists and the highest of numerous professions were to be found among the brethren. There had to be something else behind this and the common denominator is the Knights Templar and their building divisions. As is demonstrated later, the modern masons know of the ancient measures and the builders of the cathedrals, specifically Chartres and the beautifully executed Roslyn Chapel just outside Edinburgh were well aware of the Biblical configurations that are revealed in the companion book to this volume, *Deluge*.

One could view the change in title to *Compagnons des Devoirs* and sudden secretive move at the time of the persecution of the Templars as further indication that indeed these building groups probably were connected. Why else, if not connected to the Templars, should honest craftsmen suddenly amalgamate into a single secretive group of men with allied skills, all related to the trade of building when the primary employment had been in the construction of cathedrals, monasteries and palaces? One only has to measure a few castles to realise that the same criterion was definitely not applied to these structures regarding measures and hence it is almost certain that the same people were not involved. The builders of religious structures and the palaces of royalty were a class apart and utilised different measurement units and proportions to those building fortresses and / or prisons. In fact this idea, which has been formulated from the results of many personal surveys in Britain, appears to comply with what Charpentier states regarding the *Compagnons des Devoirs:-…they have always refused to work on the building of fortresses and prisons.* It is satisfying to find that one's own theory, derived from surveys and analysis of many structures is confirmed by Charpentier.

It is easy to understand however, how the Freemasons came into being when we view this group, an affiliated connection of bands of highly skilled builders who of necessity during the persecutions had to have secretive recognition signals. Such recognition signs would have been in existence prior to the persecutions but only as a safeguard against lesser skilled individuals attempting to inveigle their way into the craft guilds. When Philippe le Bel started his 'witch hunt' secrecy became a matter of life or death and not merely the safe guarding of ones craft associations. Not all the Templars were caught and many of these were from influential families. A few generations later when the hue and cry had died down, these families would have wished to rejuvenate the former associations and the secret recognitions that would have been handed down within families and guild associations, between Master Mason and Templar, again came to the fore. A new organisation was born with some high status individuals involved.

11.2: 3 Some Strange Dating

Now to examine some dates. After a period of 60 years there was a meeting between the now growing group of Knights Templar and [according to one line of research] another organisation. This group was known as the Priory of Sion or in the French, *Priure-de-Sion*. Obviously Sion or Zion is a reference to Jerusalem and specifically to the temple and its original environs. It has more recently been argued that this organisation did not exist and that any evidence is in fact a hoax. If this is the case then the perpetrator of the hoax was intimate with the dimensions related here, measures not seen in the work of anyone else as will be apparent when the time factors are seen below. Indeed, for a hoax of the magnitude such as is suggested to have been perpetrated, some fine organisation, not an inconsiderable amount of finance and many generations of patience would be entailed, and for what? There is no gain and in any case, only a minority of people would be aware if such a hoax was carried out. It seems so pointless that we doubt if there was a hoax although the organisation may well have died out centuries ago and the modern element may be a leg pull. What little evidence there is suggests that this organisation was in existence around the time of which we write.

There is no real publicly available knowledge of the originations of this shadowy organisation despite intensive research by Henry Lincoln and his colleagues which is well documented in The *Holy Blood and the Holy Grail*[2]. However, their investigation revealed records of a meeting that took place between this organisation and the Knights Templar in the year 1188. A decision was taken to make a split between the two organisations, which implies that they were previously linked. It would seem that during the same year, a meeting that again is of rather a mysterious nature took place between English and French royalty. To mark the event a specific elm tree was cut down. Interestingly one legend surrounding this relates that the stump was encased in bands of iron. In the book of Daniel we find a similar situation being the result of a dream where the tree's stump was encased in bands of iron and copper. [The considerable significance of this story in Daniel is explained in our companion book *Deluge.*] So why should a similar situation take place many years later in France? Perhaps more to the point, if this was a hoax why did the hoaxer pick that specific date for the vent?

We should now look at the dating of a sequence of events that occurred in France, predominantly at Chartres.

DATE	**EVENT**
1128	Return of Knights from Jerusalem
1134	Fire at Chartres
1188	Meeting
1194	Fire at Chartres
1220	Rebuilt
1245	Complete
1260	Dedicated

An analysis of the above is intriguing.
From 1128 to 1134 is 6 years.

From 1128 to 1188 is 60 years.
From 1134 to 1194 is 60 years.
From 1188 to 1194 is 6 years.
From 1128 to 1194 is 66 years
From 1194 to 1260 is 66 years

Here we see multiples of 6, 60 and 66 years. This cannot be coincidence. Even without the debatable meeting date of 1188 this is still correct.

The total time span again is revealing in that from 1128 to 1260 is 132 years or 1584 months. When this information is put to the measures seen later it will become clearly apparent that the chance of coincidence being at work here drops to nil. The timing of the destructions of the church was deliberate.

It would appear that the inscription over the North Door of the cathedral is to be taken seriously and literally…*here things take their course*… it certainly appears that that is the case…but that being so, who is steering the ship along this course, and where is it leading and why?

11.2:4 The Measures

Connections can frequently be found between the values utilised in religious structures and mathematically Gill and Harry indeed confirm a connection between this structure and Rosslyn Chapel at Edinburgh, Scotland and there is no doubt whatever of Templar involvement at Rosslyn. The connection will become apparent later in this chapter.

It was in 1966 that Louise Charpentier published his work about Chartres Cathedral. Charpentier was convinced, and undoubtedly convinced others that he had discovered the numerical value of the units of measure used on the building. Of course he was working in metres and so there was no symbolism attached to his hypothesis and in any case this building was designed before the metric system was announced, or even dreamed of. However, while it is apparent that in this work are seen entirely differing views and the ancient values are utilised, his figures were very close to the intentions of the builders, and his cubit, when translated from the dreaded metric, almost exactly ties in with the step value associated with 0.968 feet which is 2.42 feet. The cubit value that Charpentier eventually calculated, the result of his own surveys added to the examination of the surveys of others, was 0.738 metres. In feet this is 2.421259843, which is virtually exactly 2.42 feet being within 0.015118116 inches or 0.384 of a millimetre. With this we cannot argue, the figure fits what we expect to find here perfectly. Below is an explanation of the correct values and their interpretation.

As stated above, there is a clue to the measures in use at Chartres. But to understand this clue, one first has to understand the values in use not only in the ancient world, but most specifically in the Bible. We have calculated the dimensions of both Noah's Ark and the Ark of the Covenant. [See our companion volume *Deluge*.] The value seen here is related to both Arks, but the clue relates to the Ark of the Covenant. Biblically the prime clue is in the birth date of Noah, 1056 which taken as a reed value of 6 cubits gives 1.76 feet as the cubit. On this basis both Noah's Ark and the Ark of the Covenant, being the only two items termed 'Arks'

utilised the same measurement unit, the cubit of 1.76 British feet or 21.12 inches. The architects of both Chartres and Rosslyn agree implicitly with this analysis as we shall reveal.

Fig.11.3: Inscription and Carving at North Door, the 'Door of Initiates' at Chartres

Already mentioned is an inscription at the North door at Chartres, also known as *The Door of the Initiates*. The inscription is accompanied by some relief carvings of the Ark of the Covenant, extracted from the Biblical narrative, one on a wheeled cart, presumably when it was supposedly taken by force from the Israelites and the other showing someone attempting to cover the Ark with a thick cloth at the scene of a massacre. We need not delve into this aspect of the tale here, it is covered in *Deluge* but the inscription and identification of the Ark of the Covenant is of prime importance. The inscription is in Latin and reads, *HIC AMITITUR ARCHA CEDERIS* which when translated reads, as previously noted, *Here things take their course, you are to work through the Ark*

The first part of this sentence implies that a pre-ordained course, or path is already laid out and that at this place there is no deviation from the plan, which we have already demonstrated was the case regarding the history of the building, while the second part is clearly an instruction telling us that we are to work via the Ark of the Covenant.

The Ark of the Covenant was 2.5 x 1.5 x 1.5 cubits with the cubit value being 1.76 feet. This gave the Ark of the Covenant dimensions of 4.4 x 2.64 x 2.64 British feet and a volume of 30.66624 cubic feet with a square area of the top at 4.4 x 2.64 = 11.616 square feet. From a count of 11.616 inches we can devise a foot value of 0.968 feet and this, as will be seen, is associated with the length of the foot applicable to Chartres Cathedral. The *elevation* perimeter of Noah's vessel, which is depicted within the Cathedral in dimensions in the ground plan and in pictures at the famous 'Noah Window', [which emphasises the associations] was also 1161.16 feet and as we shall later see, the centres of buttresses at Rosslyn Chapel, another building associated with the Ark of the Covenant are set at 116.16 inches. The plan perimeter of Noah's vessel was 1232 feet.

The volume of the Ark of the Covenant was as stated above, 30.66624 cubic feet. As the instruction is to 'work through' the Ark we shall divide this in two, '*working through'*, for a result of 15.33312. There are two basic cubit values to be found in the Bible, 1.584 feet and 1.76 feet. Here Harry's first attempt to evaluate the conundrum proved to be correct, because dividing 15.33312 by 1.584 [see time value in relation to the cathedral above] we find the value 9.68. This, of course, if taken at face value is in cubic feet, but we are looking at a symbolic message, a method of conveying information and the answer is not therefore necessarily in cubic feet although the figure most certainly is that which we seek. Charpentier certainly was correct in his assertions except that he had evaluated a step value and not a cubit. Hence the correct interpretation of the units of Chartres is seen in the table below. Both British and metric values are included for comparison.

Unit	Value	British Value	Metric Value
Foot	0.968	0.968 British feet	0.2950464
Cubit	1.5 x 0.968	1.452	0.4425696
Cubit	1.584 x 0.968	1.533312	0.467353498
Step	2.5 x 0.968	2.42	0.737616 M
Reed	9 x 0.968	9.199872	2.804120986

There is a remarkable consensus between the results of Charpentier's work with his value of 0.738 metres and the results of the research conducted for this volume, a deviance of a mere 0.384 of a millimetre. However, it must be stated that this building has been evaluated not by personal survey, but by close examination of Charpentier's work and application of ancient values via the deciphering of Biblical myth. The overall length of the building [see Fig 4] appears to be 528 feet at 0.968feet, 352 conventional cubits, 333.33333 cubits at 1.584feet and 211.2 steps at 2.42 feet. This, it appears, is indicative of the two arks immediately, one ark was 528 feet long, the other measured 52.8 inches with its square area in plan being 11.616 square feet while here we have 528 feet with the foot at 11.616 linear inches. Additionally 21.12 inches is the inch value of 1.76 feet, the cubit associated with Noah's Ark and the Ark of the

Covenant. However, a grid must be set for this evaluation. Utilising the cubit of 1.584 with the Ark foot of 0.968 and multiplying by 25 it appears that here is a figure that works well. In conventional cubits this is 26.4 replicating the width of the Ark of the Covenant. In British feet this is 38.3328, in metric 11.68383744 meters but both measures are discounted, this grid is 39.6 feet at 0.968 feet.

It should be remembered that in this section about Chartres all feet are seen to be of the 0.968feet variety. Henceforth there shall be no mention of the difference in foot values unless necessary for explanation. The foot in use is 0.968 British feet. It is interesting to note however that an increase from the cubit of 1.452 which is 0.968 x 1.5 to 1.584 means a factor of 1.09090909, the same as that between 1.584 and the larger Egyptian cubit of 1.728 and that this factor as a foot measure relates to the megalithic 'yard' or step of 2.7272727feet.

The frontage width of the towers appears to be 158.4 feet, 105.6 cubits at the conventional 1.5 feet or 100 at 1.584feet with the depth at 59.4 feet or 39.6 x 1.5. This results in an area in square feet of 810 x 11.616 or in basic 1.5 foot cubits, of 4181.76 representing the British foot diameter of the earth of 41817600.

As it apparently was implied by the early construction of the towers there was a key to the measures. Evidently 11.616 leads us to the Ark of the Covenant and 810 represents 81, a figure seen in the analysis of the mathematical 'magic square' of the moon. This could be a vague hint of the involvement of astronomy from which we discern counts of time. Additionally there can be no doubt of the connection to Noah and the flood story with the value of 1056 already being seen in a dominant position.

Overall width of the nave including wall thickness is three grid squares or 118.8 feet or 79.2 conventional cubits. Wall thickness excluding buttresses works out at 2.3 cubits at 1.584 feet. This is broadly in agreement with Charpentier's figures (within 0.58 of a British inch) for he made the thickness, in a metric measure, 2.332 of our cubits. Maximum height of the nave appears to be 126 feet.

Internally, to further confirm the connection of the measure with Noah, we are now left with 111.5136 feet, which is 10.56 x 10.56, and this can also be seen as 70.4 x 1.584. From this internal wall line progress is made towards the centre using another figure representative of square area, this time of the square British mile which is seen here as 27.8784 feet which is precisely one quarter of the internal width of 111.5136 feet and for another connection to both Noah and the story of the Ark of the Covenant, 17.6 cubits at 1.584. As both arks represented the British mile in feet, there is no surprise in finding these figures here.

The first step inwards of 27.8784 feet [replicating the number of square feet in a mile], brings us to a line of columns. According to Charpentier's figures we need to find a dimension for the central width of centres of the columns, which is in the region of 16.4 metres, which measure, is '*the mean of different measurements from different authorities*'. As these authorities self evidently have various ideas regarding this measure, or there would not be a mean measure, we can accept that our interpretation is as good as any. What transpires is 30.66624 [volume of the Ark of the Covenant] cubits at 1.76feet [cubit of both Arks] which is within two inches of the stated 'mean value' at 55.7568 x 0.968 feet or 16.45084312 metres. Alternatively this distance could be seen at 50 x 1.115136, which taking the 1.115236 to be a

cubit and the nave width a representation of the beam of the Ark of Noah as described in Genesis, results in a length of the Ark of 300 x 1.115136 or 334.5408 feet.

Here we have the design intention, understood simply because of knowledge of the ancient measures and their symbolism, knowledge of the Biblical values and their use, of ancient texts and cathedral building, information that unfortunately Charpentier did not have. This is one of the regions where Charpentier admits via the use of a compendium of others interpretations that he did not have accurate measures, but it can be seen that there is a distinct correlation of measures in this new evaluation, which supplies the missing figures. In reality, this central width is precisely 16.45084312 metres and at 1.76 [the cubit of the Ark] multiplied by 30.66624 [the volume of the Ark] we have a perfect representation.

Hence the internal width of Chartres cathedral can be seen thus:- the central nave to centres of columns is 1.76 feet x 30.66624 or 55.7568 feet with the two side aisles being 27.8784 or 17.6 cubits at 1.584 feet each, giving a total of 111.5136 feet at 0.968 British feet or 70.4 cubits. For further confirmation of the validity of this assessment the value of the nave at 55.7568 feet [at 0.968] x 2 results in the overall width of 111.5136 feet [at 0.968] and divided by 2 gives the side width of 27.8784. Hence the nave is exactly twice the width of the side aisles. Note that $1056^2 = 1115136$. The buttresses appear to have a depth of 13.2 feet, which makes the overall width including these protrusions 145.2 feet or 100 cubits at 0.968 x 1.5. This is 6.6 feet (79.2 inches) each side, short of the outer line of the front towers. Between the rear of the towers and the front line of the transepts we can measure 128.7 feet or 1.716 [cubit of the raft of the ark of Noah] x 75.

Across the overall width of the transepts there are five complete and two half grid squares, which results in 237.6 feet, 158.4 cubits at 1.5feet, confirming the use of both values in the structure. The length is 99 feet. Resultant square area therefore is 11.616 [Ark of the Covenant plan area] x 45 squared. An alternative interpretation would be 8640 x 1.65feet squared. Internally Charpentier made the widest point here 90 cubits and as his cubit is the equivalent of the step associated with the appropriate foot measure there can be seen a dimension of 2.42feet x 90 or 225 feet at 0.968feet or indeed 150 cubit at 1.452 where previously for building width we saw 145.2 feet. There are a number of differing values for the wall thickness here however as thickening replaces buttresses and between these sections the walls dimensions vary. At the outer, far end of the choir is the extremity of the tenth grid square making the distance from the front of the building to this position 396 feet. Here is a semi-circle with small supporting columns and the centre, the longest point of this semi circle is the end of the representation of Noah's Ark with the width being the 55.7568 feet width of the nave.

Another point needs a mention at this juncture. Beyond the transepts there is a very slight kink in the line of the cathedral. This is not discernable on the drawing as it is only of about one degree in the alignment. Such a kink is a common sight in this type of building and as yet the research has uncovered no explanation for the deviance from a true line in such a fashion unless perhaps these Christian builders had taken a concept from the Islamic faith where nothing can be made perfect as only God can create perfection and so a small deliberate error is traditionally inbuilt into many constructions and fabrications, even in rugs and woven cloth.

Overall, however, one can begin to understand the general picture that is building up at this cathedral. Effectively there is a representation on the ground within this cathedral of Noah's Ark with the foot value being 1.115136 / 1.5 or 1.1733333 [foot value of the two Arks] x 0.6336 feet [where Noah's vessel was 6336 inches in length]. The Ark was 50 cubit wide according to Genesis and the cubit was evaluated to 1.76 feet. This value was applied to both Noah's Ark and the Ark of the Covenant. It was discovered at this cathedral that the designers were already were aware of this information with the clue seen at the North Door. A large part of this cathedral's dimensions have been evaluated from the acquired information and found it to comply with the work of Charpentier. Given all the above there can be no doubt of the validity of the assertions.

Noah's vessel is seen here as in the Genesis picture, a 6:1 rectangle with length at 528 x 0.6336 feet and the width at 88 x 0.6336 or 334.5408 feet x 55.7568 feet with the foot value at 0.968. This length is 8.448 grid squares, commencing at the line of the rear of the towers, culminates at the end of the curve the end of choir. The protrusions of the columns each side of the centre of the curve take the length to meet the next grid line. The threshold of the chapel at the far end of the cathedral marks the end of the 11th grid square giving a length of 435.6 feet, still of course at 0.968 British feet. This can be seen as the width of the Ark of the Covenant x 165, which figure is connected with the area of the transepts where we saw 8640 cubits at 1.65 squared. The diameter of the circular chapel can be calculated internally as 19.8 feet with a wall thickness of 2.64 feet, the width of the Ark of the Covenant.

Moving onward from the inside wall face by 1.232 x 7.5 or 9.24 feet is the outside wall of the annex building the end of which is stepped 6.6 feet from the outside of the wall of the chapel. At this point there is an accumulated distance of 464.64 feet, which of course is reminiscent of the 46,464 square feet plan area of Noah's ark. This rectangular building with circle at each side of one end has a dimension of 31.68 x 63.36, which is representative of the larger hall of Solomon's temple. The circles have diameters of 19.8 feet overall giving 64.8 feet maximum width. The extremities of these circles indicate the overall length of the cathedral at 528 feet, [at 0.968] which means that it is 0.968 times the length of Noah's ark. The overall width of Noah's vessel as seen among the hills of Turkey where a geological anomaly has been discovered which fits the dimensions precisely except for the beam having been expanded via the golden section, [See *Deluge*] can probably be found in the connecting wall between two buttresses, which apparently serves no fundamental structural purpose. It is the only one of its type on the site. From the outer edge of the buttresses on the opposite side of the cathedral to the outside of this wall is a figure very close to, if not exactly, 142.3869909 feet at 0.968. [Beam of Ark = [50 cubits at 1.76 = 88 feet] x 1.618033988 [golden section]=142.3869909 The grid layout overall in width in feet of 0.968 is 39.6 x 8 or 316.8, obviously representing the width in inches of the Ark of the Covenant but in British feet this width is 306.6624 which is very intriguing because the volume of the Ark of the Covenant, from whence the figures were initially obtained, in cubic British feet, was 30.66624. Length of cathedral = 528 [Ark of Covenant length was 52.8 inches] x 0.968. However, overall length of grid in 0.968 units is 554.4. Total area measures 70,000 square cubits at 1.584, counted in the 0.968-foot value.

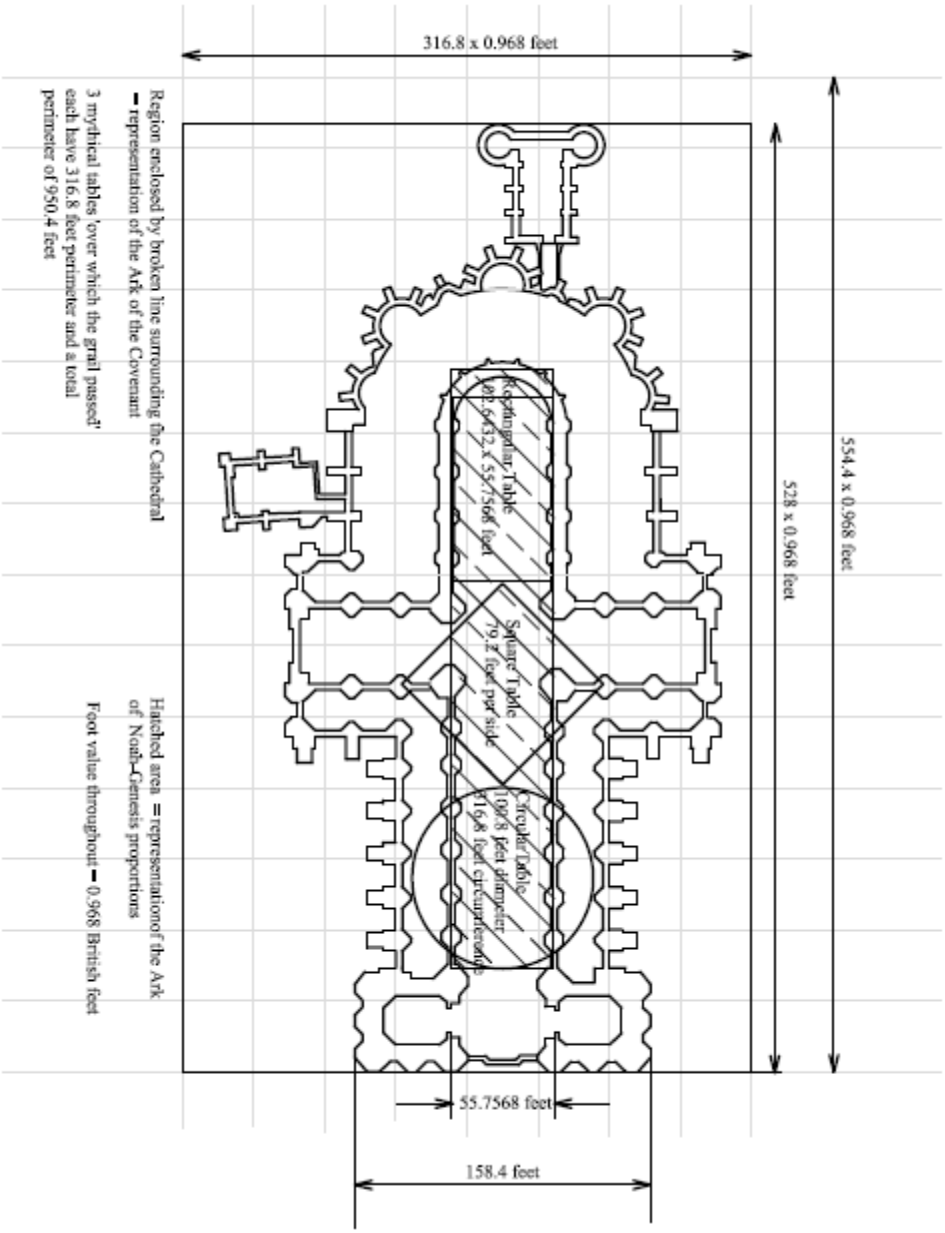


Fig. 11.4 Layout at Chartres. Shaded region = Genesis plan of Noah's Ark. Outer broken line indicates full length of the cathedral and the proportions of the Ark of the Covenant.

Perimeter of grid measures, in Noah's cubits [at 0.968 feet] = 990 which is 165 reeds at 10.56. In cubits of 1.584 we have 1,100. However in conventional cubits of 1.5 x the foot value, [in this case 1.452], we can count around this perimeter, 1161.6 cubits where the elevation perimeter of Noah's vessel was 1161.6 British feet and the plan area of the Ark of the Covenant was 11.616 square British feet.

11.2:5 The Tables

There is a legend in connection with what are known as the tables of Chartres. It appears that the tables were distinct patterns on the floor, patterns which no longer exist, due, almost certainly, to replacements of the flagstones; but it is said the present maze is the remainder of the circular table. However, this does not fit our calculations and in any case as the floor has at some point been retiled then if knowledge of the circular table was at that time available, then it would appear likely that both the square and rectangular tables would also have been well known. As this is likely to be the case, if the circular table alone was reinstated, we can legitimately ask why not the square and rectangular tables? To simply reinstate one of these tables would be inconsistent with the legend, a legend which in reality is an inherent part of the structure of building as much as if it were a stone column.

This idea will be ignored while some figures which do make numerical and symbolic sense shall be presented. It should be noted nonetheless, that the maze is thought to be the same diameter as the Rose Window of the west elevation. It also is supposed to be set in the same distance along the floor, as the window is from the floor level. Effectively, the base line beneath the window is a pivoting point for maze and window. The diameter of these items is quoted as being 'just over 14 metres'. In our figures this results in 30 cubits of 1.584, the foot value of course being 0.968 British feet as utilised by the builders. Projected onto the floor, we then see a step each side of the maze to the centreline of columns of 2.42 x 1.716 feet. In British feet 2.42 is the 0.738 metres of Charpentier's 'cubit'. Charpentier also has a theory regarding these tables, but it is a theory with which the research is in disagreement and it will not be related here.

However, according the story --- *Three tables held the grail. One was round, one square and one rectangular. Their perimeters are all the same and their number is 21.*

The mathematical magic square of the sun, when analysed correctly results in the value 36 which was seen to be representative of the 360 days in a symbolic year, a lunar / solar year and 3600 years. 36 is final number to a count commencing with 1+2+3 etc to find the total of 666. The number mentioned in the Bible of course is the infamous 666 which is NOT the Number of the Beast but when the verse is read utilising the correct punctuation seen the King James Version it is the number of a man. So while the total value is important to the evaluation [that of 666 seen in *Deluge*] the last number to add is seen as relevant as well. The count of 360 is vitally important in these matters of myth and allegory as it implies completeness, days in a year, degrees in a complete circle etc. The earth rotates every day, 360 degrees, the sun was seen to circle the earth not only every day but also once a year [something which caused

confusion] the constellations also circle the earth in a year, and in day. The moon circles the earth once a month; hence whether in days, years or degrees a revolution, a 360, 36 however it is portrayed, is of importance. It indicates a complete unit.

In this case of the tables we have a total of 21, the given value and the final number to add to reach this is 6. To obtain this we add 1+2+3+4+5 = 15 and the final number to add, which is the value for which we seek is 6. This takes us to the value 21 as stated in the verse.

One sixth of 360 is 60. Earlier in this chapter was revealed a very odd situation related to the fires at Chartres where what appeared to a repetition of the values 6 and 60 appeared. Multiplying 60 by the 21 mentioned in the related history above we find the value 1260, which is the year of dedication of the Cathedral. Is this further confirmation of the statement over the North Door, also known as the Door of the Initiates, which states 'here things take their course'?

The Ark of the Covenant, the Biblical artefact demonstrated over the north entrance to the cathedral, has given, via its 30.66624 cubic capacity and its 11.616 square foot plan area, the foot unit used to construct this building. The Ark's length in inches was 52.8 while the width was 31.68. The table's '*perimeters are all the same'* so there need be a common denominator. This is derived from the verse relating to the tables '*their number is 21'* from where we derived the values 21 and six.

528, the figurative length of both Arks x 6 = 3168, which would be most fitting because our foot value of 0.968 x 316.8 = 306.6624, and the Ark of the Covenant had a volume of 30.66624 cubic feet. Hence we now have the reasoning for the verse and the circumference of the tables, the tables over which the '*Grail Passed'*. The evaluation is therefore seen to be correct; there are too many correlations for error.

So let us examine the tables of Chartres. Commencing at the entrance to the nave, 1.5 grid squares from the frontage we have our circular table, all 100.8 feet diameter of it, Stonehenge seen in Chartres! The circumference is of course, as are all three of these tables, 316.8 feet.

Following the centre line of the building the square table is next on the list and this is set diagonally with a corner point at 8.1065154 inches from the edge of the circular version. This is seen as 8 long Greek inches which gives an increase overall of the layout of the tables of 1/7000 of an inch, a difference so small it is virtually un-measurable in masonry. The diagonal length is 112.0057141 which gives a side length of precisely 79.2 feet and a perimeter of 316.8. Again there is a step of 8.1065154 inches and we arrive at the end of the rectangular version with the same 316.8 foot perimeter. Length is calculated at 102.6432, 64.8 x 1.584 with the width at half the internal width, 55.7568 feet or 31.68 x 1.76. The overall length of the table layout of course is 316.8 feet. Steps between are obviously allowed at 8.1 inches, the 0.065154 of an inch being tolerance. The completion point of these tables therefore is the commencement of the curvature at the far end of the choir.

There are of course those who will state that a circle of 316.8 circumferences has a diameter of 100.8407519, of course they would be correct if they utilised π at its modern value, but here we are using 22/7, we are not forgetting that such symbolic values were in use for this type of work. Another version may well have been 3.1418181818 which was also in common use. In practise, to make the layout work the diameter of 100.8 feet would be the dimension to

which one would have to adhere. In this case, using modern π the circumference would be 316.6725. A difference in the length of a curved line of 1.529 inches over 316.8 feet, which works out at an error of 0.0048 inches per foot! This would be lost in the joints of the original floor tiles which unfortunately, as we have stated, according to Charpentier's report have been replaced. In any case, it is the symbolic values which are important in this work and here 22/7 was the conversion factor in use.

This is the interpretation of the positioning and dimensions of the legendary tables of Chartres which does fit with all the criterion, at least from a numerical and symbolic point of view and as we were given the number 21 and a reference to perimeters then self evidently it is, as usual, with the numbers that the answers are found. It additionally complies numerically with all else that has been discovered in this cathedral, specifically with the inscription over the North Door, the '*Door of the Initiates'*.

11.2:6 The Towers

The towers were the first sections of this magnificent cathedral to be built yet apart from their base dimensions they have not been mentioned as yet. It has been said that the taller of these represents the days in the year and the shorter is 28 feet less. This makes sense where some of the dimensions put to these towers do not. The heights given by a number of sources are 105 metres and 113 metres. According to *Sacred Destinations Travel Guide* [not a reliable source] 105 metres equates as 349 feet instead of 344.488189 feet and 113 metres with 377 feet. There is however, as tradition states, 28 feet between these measures …at least between the foot values recorded. Charpentier gives a height for the shorter South West Tower of 104.4 metres or 342.519685 feet.

As the difference between measures is close to 28 feet representing the days in the mean month it seems that this may have been the intention and as the recorded heights are not accurate [full metres would not fit the original intention] this time / measure connotation may be revealing. At a unit value of 28.5 representing the days of the mean month [28.4265 days being the accurate figure] the lower tower measures 12 and higher 13. There are 13 of these months to the lunar year commonly thought of in terms of 364 days where 28 days to the month are utilized.

12 x 28.5 = 342 feet = 104.2416 metres and 13 x 28.5 =370.5 feet =112.9284 metres.

This we feel was the original intention, although the higher South West Tower [106 metres high according to the Journal *Athena Review, Vol. 4, No. 2*] was completed by 1160 and the upper levels and spire of the North Tower not added until between 1507-1513. As there is no indication otherwise we assume this is in British feet.

Towers point to the sky. However, celestial direction is obtained not only by towers.

11.2:7 Orientation

There is one outstanding feature, which needs comment, a simple matter that apparently eluded Charpentier, the alignment of the cathedral. As it was not aligned directly east/west he was puzzled, claiming that Christian churches should always be so set out. In the course of this investigation many buildings have been examined some of which had totally different alignments. However this specific building has been found to be relatively easy to understand in this context. Apparently the orientation is 47 degrees north of east. If this is simply divided in two the solution is immediately apparent. The cathedral is set to twice the angle of the ecliptic, 23.5 degrees. One finds this angle of 23.5 degrees quite frequently when carrying out the sort of landscape study as has been demonstrated in previous pages and it is recommended that readers 'have a go' at these investigations themselves, they can be very satisfying. However, at Chartres there is another element to take into account. This is explained by the diagram below, where we compare the proportion and shape of Chartres with the constellation Gemini.

This configuration may be accidental, or on the other hand the cathedral may well have been designed in this fashion, we cannot say without further evidence. In our work Deluge the dimensions of Solomon's Temple were analysed [from many Biblical translations]. This building had a similar configuration, as indeed, as the plan drawing of Chartres above suggests does the Ark of the Covenant. Why should there be such a close affinity with Gemini?

To emulate the configuration seen at Chartres for the constellation and the sun, at the time of Solomon's Temple we would have to look at a point 20 days earlier in the year and not the summer solstice. Further, it was around 5000BC when Gemini was seen at the vernal equinox and hence a long time in the past. Currently we offer no firm and provable reasons for the use of Gemini in the fashion that appears to be evident. It may merely be a coincidence that the midsummer period offered a sunrise in a constellation that was basically of the correct proportion for a building of this nature and hence it was copied…or there may be some other far more obtuse reason as yet unexplained. However, while not answering all the mysteries, this section has revealed some of the secrets of Chartres, elements that previously were far from understood.

The clue over the *Door of Initiates* really told us the values that would be in use in this cathedral and the evaluation is further borne out by the measures of Rosslyn Chapel, our next port of call.

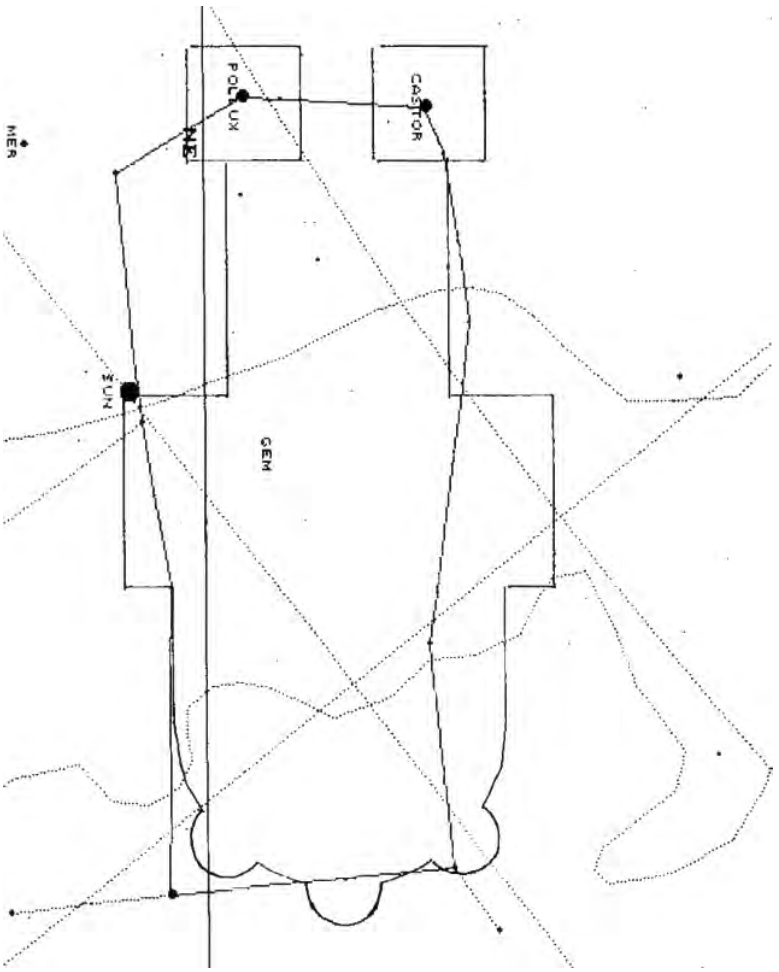


Fig 11.5 Outline of Chartres superimposed over Gemini just before dawn, St John's Day, the Summer Solstice on the day of dedication. Note that this was before the calendar reform of 1582, the introduction of the Gregorian calendar and records inform us that at this time midsummer was celebrated on 24th June in a similar manner to the birth of Jesus was originally seen as at winter solstice at 24thDecember in the Roman calendar [See Chapter 15 of *Deluge*].

11.3 Rosslyn Chapel

11.3:1 Introduction and Brief History

This delightful chapel, about seven miles south of Edinburgh, Scotland, was originally designed to be a part of a larger collegiate church. The building was commenced in 1446 however, the patron and instigator of the project, William St Clair, died in 1484 and the project was never completed as originally envisaged.[3]

William St Clair was a highly respected Knight Templar and had close association with the guilds of masons and other craftsmen working in Scotland at the time. William held not only the Lordship of Rosslyn, which village according to local history did not exist as such prior to his deciding to build the chapel at that location, *'he made them build the town of Rolsine that is now extant and gave everyone a house and lands'* [extract from the writings of Father Hay… see below] but additionally was the Earl of Orkney, a Knight of the Cockle and the Golden Fleece and other such titles. Given that William was appointed Grand Master of various orders including Craft Masons and other trade guilds in 1441, it is no surprise that many Masonic marks have been discovered at this chapel.

William was a very highly respected man, an insightful man and a man who has been described as '*one of the Illuminati'*. What we shall reveal here will undoubtedly only enhance this idea, and further reveal some of what this extraordinary man was aware. This was one of the few structures of its type where we know that the masons were working to patterns made by carpenters and approved by the owner, in this case of course, William. When William died the chapel was still not complete and it was left to the Baron of Rosslyn, Sir Oliver St Clair, William's successor and son to roof the vault over the structure.

Father Richard Augustine Hay, Canon of St Genevieve in Paris and Prior of St Piermont was the best-informed researcher into the chapel, its history and indeed, the St Clair family. There is little that has been revealed since he completed his three volume study of 1700, for which he researched historical records and the charters of the St Clairs. Parts of this were published in 1835 as *A Geneologie Of The Sainte Claires Of Rosslyn*. It is lucky for modern researchers that this intrepid investigator accomplished as much as he did because the original materials from which he worked have since disappeared.

Without the work of Father Hay we probably would not know about the Chapel being endowed with provision for a provost, six prependaries and two choristers, and additionally in 1523 under the direction of his grandson, another Sir William, land for further dwelling houses and gardens. It is likely that without the work of Father Hay we would not know that just 48 years after the last endowments in 1571 there is a record of the provost and prependaries resigning due to the endowments being taken by force into secular hands…the Reformation was starting.

The Civil War saw the attacks of General Monk's troops on the side of Cromwell. The castle at Roslyn was attacked and damaged 1650 while the exquisite chapel was designated to act as a stable for the army's horses. James II was ousted from Edinburgh in 1688 and with the now protestant dictate, the beautiful carvings of Rosslyn were deemed 'Popish', hence a mob descended on the chapel with destructive intentions. Furniture and vestments were damaged

or destroyed, yet for some reason the carvings were not ravaged. However the chapel remained abandoned to the elements until 1736 when St James St Clair glazed the windows. Note that the word used here was glazed, not reglazed because prior to this the windows had no glass. The floor was re-laid and the boundary wall also built by St James St Clair. Since then a number of people have contributed to the upkeep of the chapel and today it is being slowly dried out after the carvings were cleaned and inadvisably sealed, holding in far too much water and damaging the stone. The village is spelt with a single's' …Roslyn… while the chapel has the double 'ss' hence Rosslyn. Why this is we do not know as the village was supposedly built at the same time to accommodate the principle crafts of the builders. We may also ask of the origination of the name.

Fig.11.6 Rosslyn Chapel Showing 1882 addition which houses the Organ Loft

If there was no housing on the site previously, then this was open country hence why call this locale Roslyn or Rosslyn? Perhaps there is a connection with Lyon, which according to Chambers dictionary means the chief herald of Scotland. However we look at this name, however, it is speculation and hence we shall move on to the numerical analysis of the chapel. The drawing of the structure indicates a wall across the west end of the chapel and the thickness of this is taken into account but not the *overall* length, as this would include the 19th century addition which is not part of the original design.

Many have speculated that the Templars brought a great treasure from Jerusalem and hid it here at Rosslyn; some have even claimed that the Ark of the Covenant is here, buried in

the vaults. No direct comment upon such claims will be found in this book but what is stated is that the *Ark of the Covenant is to be found here*. It is not buried in the vaults or anywhere else, it is out in the open for all to see, and has been since the completion of the chapel. The chapel itself is a representation of the Ark of the Covenant. Once more it is seen how numerical values hide from those who do not understand, what is plain for those with such knowledge to see. It actually took three visits for Gillian and Harry Sivertsen to discover what was hidden here, each time getting a little closer than the previous as learning about the ways in which the values worked and how dimensions hid Biblical stories was increasing. It has been an uphill struggle to gain what perhaps may be termed *'part enlightenment'*.

11.3:2 The Measures

The centres of the buttresses are set out to a dimension of 116.16 inches, which immediately indicates the connection. If a measure is taken from the west end of the chapel, excluding the 1882 projection to the end of the buttress, above the lower protruding level at the east end, a distance of 77.44 feet emerges. A modern surveyor or archaeologist would record this as 23.6 metres or perhaps even round the value up to 27 metres. This is why this type of study is frustrating; one obviously cannot depend upon such figures.

In reality the metric measure should be 23.603712 metres. Record measure in metric if it is so required, but make it accurate and not loosely approximate, for the type of analysis seen in this work, it has to be accurate and converted to imperial.

The width of the structure measured to the outer edges of these buttresses is 40.888888 feet or again in metric for comparison, 12.4629316. In reality what is being observed 23.232 x 1.76 where 23232 is 50% of the square area of Noah's Ark as described in Genesis.

The length, which was measured at 77.44 feet, is actually exactly 80 feet at 0.968, the foot unit of Chartes Cathedral, but it also indicates something else, 44 cubits at 1.76 feet and the internal height also contains a count of 44, here that of feet at 0.968 British feet or 11.616 inches. This is a clue to what the researcher for this work thought may well be hidden in the building. 4.4 British feet was the length of the Ark of the Covenant. If the idea that the Ark was represented here had any validity, then it would appear that in this value of 44 cubits at 1.76 feet was to be seen its length. The problem now was how to find where its width was hidden. This was the tricky part. Numerous spots were measured across this building in the attempt to find a correlation; the overall width including north and south buttresses was 50 feet at 0.968 or 27.5 at 1.76 feet, so it definitely was not there. This important measure surely was not going to be between two edges at the top or bottom of splays of buttress? There was no way that the higher reaches of the structure could be reached but it was possible to assess some dimensions by various positions' relationships to the outer or inner vertical edges of the buttresses.

It was here among the buttress that finally the sought for measure was found. There is an outer row of pinnacles to this ornate structure [see photograph above] and the very centre line of these gave us precisely the value for which we sought, 46.464 feet or 48 feet at 0.968 or in the units that give the game away, 26.4 x 1.76 feet.

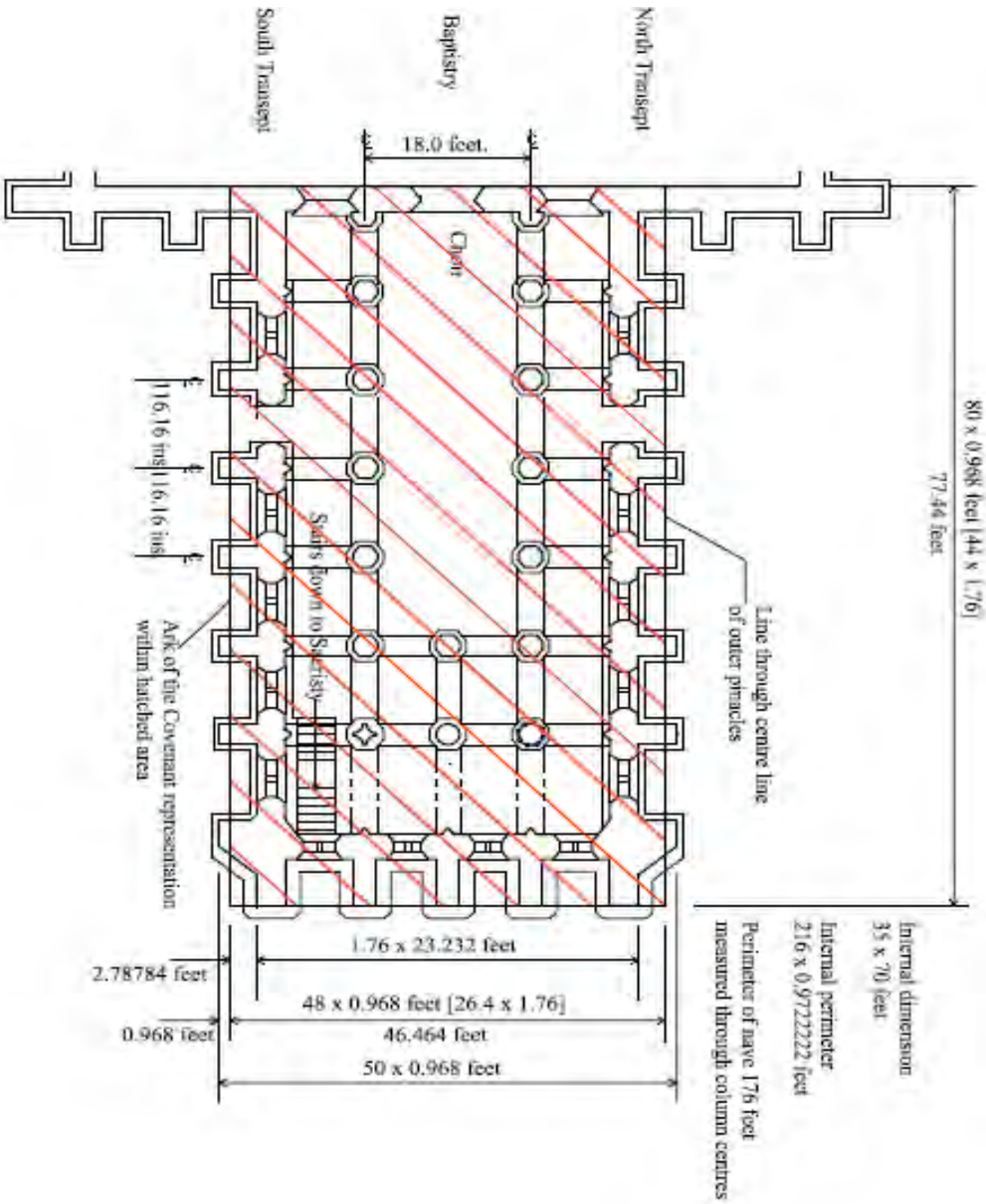


Fig.11.7 Layout of Rosslyn Chapel.

We now had the perfect proportional representation of the Ark of the Covenant. 44 cubits at 1.76 feet in length where the Ark of the Covenant was 4.4 feet and 26.4 cubits at 1.76 feet in width where the Ark was 2.64 feet in width. The cubit used to construct the Ark was 1.76.

We have a scaled up version which actually tells of the correct cubit value used on the original. Added to this is the internal height noted earlier of 44 x 0.968 feet or 11.616 inches where the plan square area of the Ark was 11.616 square feet.

Some researchers have commented that from specific angles this chapel looks as if it may have been modelled upon Herod's rebuilt Temple at Jerusalem. This is quite feasible, as the outlines would have been well understood by William. But most importantly, what others have failed to understand are the measures utilised in the structure and how they tell of the artefact that was kept in the original temple. William, as did the designer of Chartres, wished to make a statement, *'Here is the Ark, here is knowledge, here is enlightenment'*.

We think he succeeded, although again, he did not reveal just what the Ark represented, our companion work *Deluge* fills in this large gap.

11.4 The George Washington Monument

Here we wander away from British shores again. The purpose is to demonstrate that knowledge of the ancient values is widespread among the Freemasonic fraternity. We have already demonstrated this at Chartres and Rosslyn where history implies that the Knights Templar were involved and that implies masons, whether operative or otherwise. In this section, following a suggestion from Steve, the George Washington Monument is examined. This oversized obelisk has a tale to tell, a story that as with the others revealed in this chapter is quite simple; a definitive notification is secreted within its dimensions.

The huge monolith was built in the capital of the USA and was dedicated to George Washington, and hence, naturally enough the structure was known as the *George Washington Monument*. It is a great stone *obelisk* with internal ascending stairways, dedicated to the Freemason who was America's first president, the instigator of the declaration of independence in 1776.

During the year 1800 an initial proposal was made that a "mausoleum of American granite and marble, in pyramidal form, 100 feet square at the base and of *proportionate height*," be erected to Washington's memory. As Kenneth Mackenzie's celebrated *Royal Masonic Cyclopaedia* of 1877 refers to the Masonic Brethren as the '*Descendants of Noah*'[4] and the Freemasonic organization was involved from the projects inception [Washington, as noted above, was a Freemason], it is no surprise that the original proposal was for a 600 foot high monument giving the same 6:1 proportion as the Genesis description of Noah's Ark.

As an aside here however, what is interesting in this Masonic context is that the *Descendants of Noah* connotation is basically a Jewish notion. The Tanach informs us that the B'nei Noah are descendants of Noah and hence according to the Biblical story all living humans are descendants of Noah, and are thus subject to the Noahide laws. However, according to the B'nei Noah, Jews, as the chosen people, have additional responsibilities placed on them. The Seven Laws of Noah, *Sheva mitzvot B'nei Noach*, or the Noahide Laws, are seven moral rulings that according to the Jewish Talmud were given by God to Noah and were a set of laws of moral principle for all. Judaism states that any non-Jew who lives according to these laws is regarded as a 'Rightous Gentile' and as such is assured of a place in heaven. Followers of these laws are known as 'B'Nei Noah' [Children of Noah] or 'Noahides' and even

non-Jews adhering to these rules are allowed to meet in synagogues. The seven Noahide laws cover idolatry, murder, theft, sexual promiscuity, blasphemy, cruelty to animals and the necessity for a government to administer these regulations. As with a number of other Jewish rulings, these were clarified by Rabbi ben Maimon, who is better known as Maimonides, in his work of 14 volumes composed between 1170 and 1180, the *Mishneh Torah.* It is strange how few Freemasons are aware of this.

To return to the history of the Washington Monument, the day selected for laying the cornerstone was Sunday, July 4, 1848. This stone was pure white Symington marble and weighed 24,500 pounds. Strangely however, today the location of the cornerstone is unknown; it is presumed buried beneath the masonry, a rather odd situation when surely the relevant corner would have been recorded. However, there was a very large assembly of important representatives of both Knights Templar [historically non-existent at this time] and Freemasons at the ceremony, most of whom also played important roles in politics and / or commerce.

'The cornerstone was formally laid by Grandmaster Benjamin B. French of the Grand Lodge of Free and Accepted Masons of the District of Columbia. He wore the same Masonic apron and sash that had belonged to President Washington, and wielded the same Mason's gavel that had been used by him when he laid the cornerstone of the U. S. Capitol on September 18, 1793. French applied the Masonic square, level, and plumb to the northeast corner and pronounced it sound. He then poured vials of the traditional Masonic symbols over the cornerstone. They consisted of corn, invoking the blessing of plenty upon the Nation; wine, for the joy ever to be found in our broad land; and oil, the healing oil of consolation.' [5]
In the words of the Grandmaster:

'This cornerstone is now ready to receive the superstructure which is to rise above it. May no accident attend its erection, and may the capstone, that announces its completion, be laid under circumstances as happy and as favourable as this foundation stone has now been placed.' [6]

The dedication of the completed Washington Monument took place on February 22, 1885 after work being stopped during the Civil War and some added structural problems resulted in an agreed take over of the building process by Army Engineers. This dedication marked the end of construction on the memorial, aside from final details, and it eventually opened to the public on 9th October, 1888.

However, it is the height of the structure that is found to be so intriguing that it is felt necessary to analyse it here. The height of the monument is reported by the U.S. National Parks Service not at the proposed 600 feet but as being 555 feet and $5^{1}/_{8}$ inches high [555.4270833feet].
Here the concept of time is to the fore yet again. The [tropical] Solar Year, also known as equinoctial, natural or astronomical year is defined today as 365.242199 days *Universal Time* [UT]. When the *Long Greek* cubit of 1.52064 feet is multiplied by this figure, making a cubit equate with a day, the emerging value is 555.4018975 feet. In other words, according to this, the monument is 365.2587616 *Long Greek cubits* high, with each cubit representing a day in the year. This is within 0.3 of an inch of the target measure of 555.4018975 feet, an accuracy of

1 in 21,790, which is nothing less than astounding for such a tall structure in masonry. This tolerance is comparable to the best of the inner chambers of the Great Pyramid. Early commentary, as seen above, relayed that the monument was to be of a 6:1 proportion meaning that the base perimeter would have had the same numerical representation as the height but seen in *long Greek feet* instead of cubits. However, the finished object is reportedly 55.125 feet wide at the base. Here we can calculate that within 0.30726 of an inch we have the height divided by 10.08 where 1.008 feet is the *short Greek foot*. The base side target measure was 55.09939459 and the perimeter therefore divides into the height 2.52 times where 2.52 feet is the step [2.5 feet] of the 1.008 British foot.

Why, we ask, is an American monument constructed in this highly symbolic fashion using a unit of measure from antiquity? Why should the year be represented here in long 'Greek' cubits? Further, who has carried such knowledge through the long ages since ancient times when academia in general scorns the idea that such measurement units ever existed? Given the Masonic and Templar involvments the answer is clearly apparent.

The important element here is in the use of linear measurement units to denote a time element. How many others are aware of this intention we wonder?

11.5 Litchfield and Ludlow

It seems a little strange to associate a cathedral with a planet. Yet this is what legend does with Litchfield. Looking again through Michells New View Over Atlantis he relates a tale, which has been seen in other works, and is interesting from an associative viewpoint.[7]

The planet Mars is red in colour. So is Litchfield. It is dedicated to St.Chad whose feast day is also that of Mars which is March the second. The Roman god of war was Mars and the old word for war was *Liches* hence Litchfield.

Back in 1643, so the story relates, the parliamentary army was attacking Litchfield. The cathedral and the close surrounding it were themselves surrounded by a fortified wall and ditch. The commander of the parliamentary forces was one Lord Brook, who in a vain attempt to force the surrender of the cathedral and in effect remove the cities defenders out of their refuge in the cathedral, he trained a cannon on the building. While he apparently had every intention of blowing holes in the beautiful building he did have some misgivings about the idea but could see no alternative. Just before he gave the order to fire the cannon however, he stood up and actually prayed aloud for some kind of omen to prevent the necessity of what he was about to attempt.

He had his omen. He fell down dead, shot by a defender of the cathedral, a deaf and dumb man. But this is either an altered tale or has the strangest of coincidences in its narrative. The point is that Lord Brook was at war with the defenders of St Chads cathedral. He was shot by a bullet made from the lead of the roof of the building, St Chads, and the occurrence of this event? St Chads day. The Roman god of war certainly had his own back on that occasion.

Michell, from the figures contained in the mathematical 'magic' square of Mars has created a geometrical figure very similar to the three-spired cathedral of Litchfield as seen from directly in front. Whether this actually did form part of the design criterion we cannot say but there does appear to be a striking similarity.

When examining this cathedral for the units of measure in use, there was very little time to spare, but although time was 'of the essence' we did manage to assess the values in use. The unit of measure we discovered in some places to be 12.32 inches, which relates to the 1,232-foot perimeter of Noah's Ark. Across the transepts the figure appears to be 1.232 feet x 144 while the length would be 288 of these units. The perimeter therefore would be for a rectangle of 144 x 288 at 1.232 feet which is a 2:1 rectangle with a perimeter of 864 at 1.232 feet. This could also be seen as: 100.8 x 10.56 or 950.4 x 1.12. This latter value we shall see again in this chapter.

Fig 11.8 Litchfield Cathedral frontage [Gill Sivertsen]

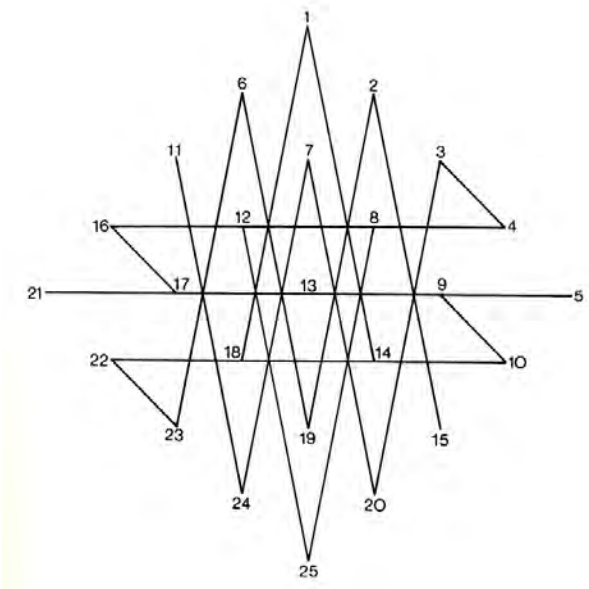


Fig. 11.9 Geometrical design of Litchfield from 'Magic Square' of Mars [after Michell]

11.5:1 Ludlow

The same day that we, Gillian and Harry, visited Litchfield we also journeyed to Ludlow in Shropshire to visit the parish church there, because like Litchfield, this one also, Harry remembered from time spent there years before, was of red sandstone. Unfortunately, when we arrived the church was locked and the surroundings in general were rather overgrown. Whether this was for reason of neglect or much needed building work we have no idea but although not 'being of the faith' Harry always feels a very strong sense of loss when a building that has meant so much to so many is seen in such a state of apparent neglect. Having spent many years working in the construction industry as a carpenter, perhaps this emotion is strengthened when others work, which has taken a great deal of thought and physical effort, not to mention dedication, is seen to be neglected or abused.

At Ludlow the building could not be approached as desired but even though there was scaffold surrounding much of it one set of buttresses could be reached. It was apparent from the design that the spacing between the buttresses was consistent and we could make a reasonable estimation of at least one side of the structure. The centre of the buttress measure was 184.8 inches which is the cubit of 18.48 inches 10 times. This is associated with the foot of 12.32 inches seen at Litchfield in association with the 1.232 foot. Hence at Ludlow we have the reduced value, that of 12.32 inches and it is counted 15 times…12.32 x 15 = 184.8 = 15.4 feet = 12.5 x 1.232 feet.

11.6 Glastonbury

If one believes in the supernatural or at the very least the idea of the transference of thoughts and ideas from some mystical realm other than the physical life which we all experience then perhaps the source of the information here is not so very surprising. The comment relates to a certain man by the name of Bligh Bond who was in charge of archaeological matters at Glastonbury Cathedral earlier this century. Bond had acquired a reputation for success in his investigative work and apparently located many sections of long lost buildings within the precincts of the cathedral's grounds hitherto unknown. In 1918 however, Frederick Bligh Bond was to publish a book entitled *The Gate of Remembrance* in which he claimed that all his information had come to him via spiritualistic means, through 'automatic writing'. The current work has no comment to make upon this; the subject of spiritual matters is outside the remit of the book.

Nonetheless, Glastonbury is a very interesting place. It would appear that this is probably one of the oldest Christian settlements in this part of Europe and some believe that the family of Jesus lived here at one time. One could further conjecture that the hill at Glastonbury may have been seen as a replication of the landing place of the Ark and that at one time a place of worship was erected at its summit, before, of course, the church of which only the tower now remains. This may well have been seen as a special mini-mountain. Certainly it would have used as a lookout place and would have been involved with the observation of astronomical phenomena. It is a very prominent lump to have protruding from the surrounding landscape.

It has been shown that a zodiac may have been constructed in the landscape surrounding Glastonbury. This is a possibility, the zodiac has always been important to people. The legends of the area are legion. Many are distinct possibilities. It is certain that the place has a great deal of importance in history, the difficulty lies in discovering precisely what has happened there and when it occurred, separating historical wheat from mystical chaff. However, given a hill of the stature of Glastonbury Tor surrounded by what in times past was basically bog land, prone to excessive flooding it is not a surprise that it became a place of mysterious tales.

The tower on the Tor, St Michaels, a name that according to mystical tradition immediately gives the site a solar connection, would appear to have been built to a different unit of measure than the cathedral. Excluding the protruding buttresses the base apparently measures 17.6 feet by 17.28 feet, which gives an area of 304.128 square feet whereas the perimeter of the Great Pyramid at the socket lines was 3041.28 feet. This can be bleak spot although it is adjacent to the town, the day that this was measured it was so windy one had to lean into the wind to stay on ones feet. Those who have been to the top of the Tor in windy conditions will understand.

The cathedral we have not surveyed. Much has been written about the building and so we will merely add a cubit breakdown that seems relevant. Bligh Bond, in his supernatural way discovered that the building was based upon an overall length of 666 feet. A grid was established of 74 feet [37 x 2 where 37 is the common denominator of all the triple numbers]

and working to this the excavators proved his assertions to be correct. The width overall was 296 feet or four grid squares.[5]

At 666 feet in length there are nine grid squares against four in the width. A total of 36 squares. If we utilise for a cubit value 1.48 feet then there are 90,000 square cubits in the area. The length has 450 of these units while the width has 200. Each grid square is 50 cubits long. The inch value of this cubit is intriguing it is 17.76 and that indicates the Biblical flood tale, the date of the Ark's coming to rest; the seventeenth day of the seventh month of the six hundredth year of Noah's life.

Here we possibly see a figurative association, which may well be coincidental but nonetheless does connect with Biblical matters, via 666. The *real meaning* of this enigmatic number in Biblical myth is seen our book *Deluge* and indeed, it certainly does have connections to the story of Noah and the Flood...and astronomy and calendars…

There is another measure involved here which we shall see later in this chapter and that unit is 9.25 inches. Some time ago information regarding a Chinese measure called the Han indicated that it was between 9 and 9.5 inches in length. Not exactly very specific! However, it has been revealed how the values in the ancient system appear to link to each other and culture to culture and here we have a count that fits exactly to all the triple values, e.g. 666,222, etc. In the length of 666 feet we can count 864 of these units and in the width of 296 we count 384 'Han'. Given that we have an exact 864 of these units in the length it would be safe to accept that indeed 9.25 inches was a measure that was in use.

Bligh Bond however also revealed that originally there was a settlement of a circular format. Of course this was a copy of the circular version of 316.8 feet. As he related in *The Company of Avalon* it was a circle with a perimeter of 120 steps. The basic Biblical cubit, which used on Solomon's temple among other places, the 'first' cubit, was seen to be 1.584 British feet which produced a step of 2.64 feet [see explanation in *Deluge*]. This is exactly 1/120 of 316.8 feet. This is no coincidence. The implication is plain; this is another representation of earth.[8]

In this context we should also note that Plato's ideal city of Magnesia was divided into 12 radial segments. The inference is for a radius of 5,040, which means a circumference of 31680. We here see a similarity, 31,680 / 12 for Plato's version against 316.8 / 120 for the Glastonbury version which itself is a replication of Stonehenge.

11.7 Pembrokeshire: Saint Caradog and Saint Ishmaels

As stated above, the measure we have termed the Han has been found outside the precinct of Glastonbury and we choose to include what we have discovered at this juncture. Not all the buildings included here are of a religious nature and some are far from ancient or even mediaeval. This indicates that the knowledge and the use of such values is far more widespread than most would imagine, as seen with the George Washington Monument. It is that element that we wish to demonstrate here.

On the windy but generally mild west coast of Pembrokeshire, that most English of Welsh counties, at least the Southern half, Welsh is the mother tongue for many in the North of the county, there lies an area called Barry Island which is not to be confused with the overrated,

overcrowded Barry Island of South Glamorgan, with its funfairs and hordes of noisy litterbugs. This is a place to enjoy the solitude and quiet of rural Pembroke and the coast at this particular part of the county is an exceptionally beautiful section of Britain. It does attract holidaymakers, but many of them are artists or bird watchers or walkers; most have an interest in the wildlife and general ecology of the region. The coastal path is a delight to stroll along, especially in late spring and early summer. The wild flowers are a delight to the eye, not to mention nostrils. It is a place that in the course of breaks from research Gillian and Harry have visited often, for a number of years having a holiday home in the county and being thought of by many as locals!

It was in this place, Barry Island, which is not an island at all that we find Saint Caradoc. That is not strictly true, he has been dead for approaching 900 years but his memory lives on, if only in the minds of historians. Saint Caradoc was a quiet man, something of a hermit. The tale tells us that in 1105 he was hounded out of his home by one of the gangs of pirates who were rife in those days. To the best of our knowledge there is nothing left of his residence at Barry Island, we suspect that it was where the farm stands at present.

Being chased from his humble abode, the authorities granted him the 'monasterium' of Saint Ishmaels. This was sited, so legend would have it, in a very pleasant, peaceful wooded valley leading up from the estuary between Milford Haven and Dale. This valley is one those places where one speaks quietly, it has that sort of hallowed feel that makes it special, with or without connections to Christian Saints or any other revered people. It additionally seems that it was seen as attractive to someone else who was highly versed in numerical associations during the Victorian era.

To explain. We are looking at an area that enclosed this lovely little valley with its stream, pond, solitary dwelling house and church, OS ref. 183023,206742, which is 1.5552 miles [0.432 x 3.6] from a standing stone at OS ref 184870, 208428 and 1.6 miles or 8448 feet [800 x 10.56] from Dale Church at OS ref 180624,205801. Dale Church stands 900 long Egyptian reeds of 10.368 British feet [or 9331.2 British feet] from another standing stone at OS ref.182819, 207610. We suspect that the original 'monesterium' was at the site of an adjacent farmhouse, as we have no knowledge of it being within the confines of the valley although the house would make the ideal location. Enquiries have led us no-where in this regard and we have not pursued the questioning to include the owners of the farm.

A sturdy stone wall runs the length of the valley from just above the church and this wall forms a part of what appears to have been an ornate farm workers cottage. This formed part of the estate that seemingly was created in the Victorian era. The wall runs for perhaps a half mile or a little less to the sea. Here it terminates as the side of a folly at the top of a cliff overlooking the wide expanse of the entrance to Milford Haven.

Returning to the cottage or as we eventually termed it 'The Gate House' as the wall has a buttress in built to take a five bar gate and the buttress also reinforces the building at that point, we find basically a four-roomed structure. There was a first floor on one half but all that remained when we were last there at around 1990 were the walls and the remains of the interior plaster. Trees were falling into the building so it will not be there for much longer.

For a small, humble abode, this was rather ornate. While we have assumed that it may have been originally constructed as a workers home, there is another possibility, that it was a

sort of summerhouse or retreat for the estate owner. One half has castellated walls and secret gutters, while the quoins are very carefully built of cut and prepared ashlars. These quoins are what made the measuring so accurate, there was no variance at all when measured at 6feet above ground to about a foot above ground; all was perfectly parallel. We can add that the site is on high ground above the pond and that the trees are not very old, in general being very much younger than the building. A path below the building seems to have at one time been a garden path with still some remnants alongside of garden flowers.

So what were the dimensions of this rather odd building? The building in plan measures 60 Han by 20.25 Han, the unit that we found fitted at Glastonbury. This odd width is not really as odd as it sounds because in terms of a step based upon the Han as a foot unit we see 8.1 and the structure to the base of the castellation evident at roof level is 10 steps. The area of the end elevation is obviously to be seen as 81 square steps, a number which we recognise as being associated with the mathematical 'magic' square of the moon. One may assume that this is coincidental but an examination of the wall thickness and detail of the adjacent gate opening reveals that the figures here must have been deliberate, they are all very accurate. In British measure of inches we count 555 in the length of 60 Han. Area is seen as 1215 square Han [as foot value] or 540 square cubits, 15 square reeds or 194.4 square steps.

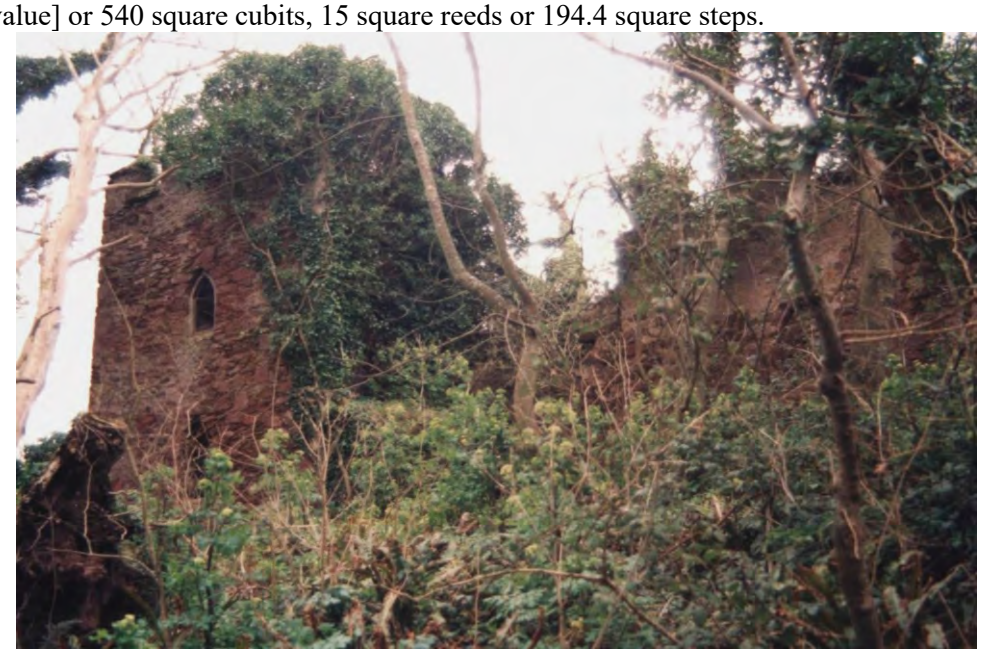


Fig 11.10 Gate House' at Monkhaven

Beneath the little house, in the wooded valley is a large pool which one is led to believe was a fish pond and although for a numbers of years it seems that there was no fish life at all, on our last visit it was apparent that at least five large goldfish had been introduced, long may they thrive. The stream, which is quite a substantial affair, and which even in drought conditions appears to flow quite well, feeds the pool. This stream also runs through a pond in

the grounds of a gardener in the village above the valley. It was from here that the goldfish came during an exceptional storm. As one would suspect, the local farmer uses the pool; water is pumped out for crops during dry conditions.

Fig.11.11 Gate House' at Monkhaven showing buttressing to gate opening and entrance door opening.

Following one wall, which is part of the structure of the 'gate house' for perhaps a half-mile to the coast we find a folly, which is dated, according to the local library's documentation, to 1860. It certainly is of the Victorian period and makes a good lookout post. It is highly likely that the monks of the district also had such a structure at this location; it is ideal for the purpose, looking out across the bay below Milford Haven. According to the legends, pilgrims to Saint David's landed here and travelled across the land to save themselves the perilous journey around the Pembrokeshire coast. Having experienced some of the over falls and choppy waters of the headland areas in our 17 foot boat we can well understand this thinking.

Fig.11.12 Folly at St Ishmaels (Monkhaven)

From a numerical point of view this little tower is interesting because once more it utilises the unit of the Han and it has castellated walls. Its plan dimension is 16 Han x 15.75 Han, which gives a square area of 252 Han or 112 square cubits. The castellation at the top of the structure is the same as that of the 'gate house' and this building again is in line with the wall although the height is five Han less in this instance, giving a volume of 5040 cubic Han. In fact this is the end of the wall which is part of the 'gate house', for the folly is perched at the top of a cliff which drops straight down to the sea, or at least the estuary which at this point is around two miles across and which with a very slight change of direction points one directly at South America.

The church mentioned above was constructed not far above the site of the building we call the "gate house". This is the Parish Church of Saint Ishmaels, which is said to date initially from the 16th century and is apparently associated with the monastery. That being the case, the monastery site was extant at that time and so should be traceable. Having not seen the church records, it cannot be ruled out that this church may be on the site of the monastery. We additionally have not ascertained the units of measure used on this quaint little church in a very peaceful location, although we have visited on a number of occasions.

11.8 Pembokeshire: Haverfordwest Priory

Saint Caradog, whom we met above at Barry Island, was not left at peace in his quiet home; a man called Tancard is recorded as having taken great delight in persecuting him. This

Tancard was the father of Richard Tancard who in turn was the father of Robert, the Lord of Haverford. For a peaceful man of God, poor Caradog led a disturbed existence. We do not know when or where he met his end but legend has it that Robert Tancard erected the priory in Haverfordwest in his memory. In 1331 a Royal Charter confirms that grants were made to Robert and it is assumed that these were for the building of the priory. St. Caradog is reputedly buried in St. David's Cathedral.

Haverfordwest Priory we have not extensively surveyed but we did ascertain one critical dimension and made a number of other checks to confirm that the same idea was followed throughout. The knave of the church, upon one of our visits, had had some of the stone of each sidewall, of the little that remains, taken out for archaeological purposes. There are frequently archaeological students working on this building, and as it happens this was lucky for us because their work revealed a situation that we have found to be somewhat unusual. The relevant dimensions appear to be worked from the centre of the walls in this particular case, whereas it is far more common to discover meaningful figures relating to overall dimensions or in the case of larger buildings, frequently both internal and external. Having made extensive checks to ascertain that we were not mistaken, we measured to the points indicated. These were in the centre of the walls that form the knave, adjacent to the transepts, and the actual points were the diagonal corners of exposed ceramic tiles. One of these tiles was laid diagonally at each side, centre of the wall, when the wall was initially built, giving the masons an initial line from which to work. The positions of these tiles leave no doubt regarding their purpose. No doubt the masons would have had measuring rods that gave them dimensions from this position, but it is unusual to find such an initial setting out point. The centres of these tiles, which were at the centres of the two walls, when measured, gave a figure of *exactly* 40 Han or 370 British inches. It would appear that the church of the priory, which is in the usual cruciform shape, has overall dimensions worked from centres of walls of 120 Han by 200 Han. Area in the relevant square step is therefore 3,840. Measured to internal or external walls, we could not discern any other value that linked to the units with which we have become familiar.

There is another little building that we wish to mention here. It is a tiny little place that again is set out, at least in part, utilising the unit that we have evaluated as the Han.

11.9 Pembrokeshire: Saint Govans Chapel

Perched halfway down a steep cliff in the south of Pembrokeshire is a tiny little chapel. It is partially cut into the cliff and partially perched on a ledge.

It is thought to date to the same era as the priory and so has survived some atrocious conditions. It is clearly apparent, however, that this place is regularly maintained. A steep stepped path, which legend states that always has a different count of steps going down than coming up, takes one down to the chapel. Past the chapel one struggles on to a rock strewn cliff base which during a strong wind from anywhere south of east or west receives a heavy pounding. This certainly is not the ideal place to bring in a boat of any description. There was a freshwater spring just below the chapel building that of course has become the traditional 'Holy Well'.

St Govan's measures externally, and here only two and a half walls can be examined, the rest is cut into rock, 30 x 22 Han. In square area therefore we find 660 square Han. Inside the chapel we find that British measure prevails and internally it measures 18 x 12 feet, which results in 216 square feet.

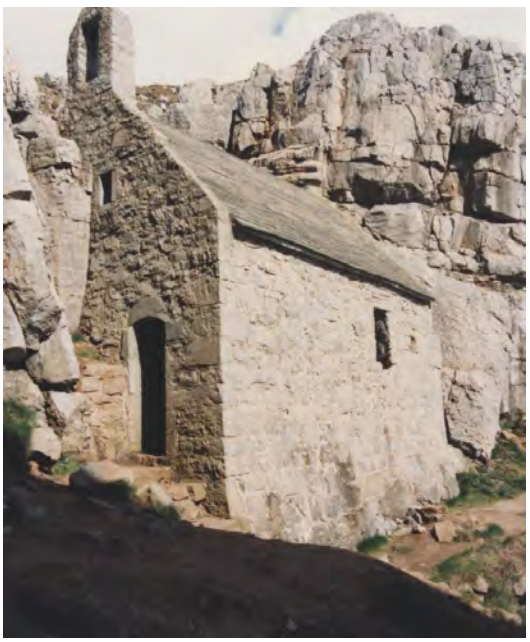


Fig 11.13 Saint Govans Chapel

11.10 Pembrokeshire :Saint Nons

Around the St David's district, which is a very pleasant part of rural Britain, there are a further two churches, or being more accurate, remains of chapels that are worth a mention in this numerical context in addition to the cathedral itself. Of course there are many more of interest to our study but given the numbers involved we have not surveyed and evaluated them all. We shall merely deal here with the few around St. David's region.

With only the walls remaining there is little to see at the traditional birthplace of Saint David, Saint Non's Chapel. The stone has seen better days but it is possible to discern its dimensions. These are not the original walls because it is known that the chapel has been rebuilt on a number of occasions. However, the foundations were not altered, and it appears to have been resurrected to its same dimensions. The length is 37.8 feet and the width 21.6. The division is in 1.5 foot cubits of which the width has 14.4 and the length 25.2. The perimeter therefore is seen to be 79.2 cubits at 1.5 feet.

11.11 Pembrokeshire: Saint Justinians

A few years ago a television series titled Lifeboat was centred on this location. Although many places in South Wales were used for the filming, the lifeboat station was this one, St Justinian's.

In the grounds of a private house immediately above the station and boathouse are the remains of the chapel. There is no roof to it, merely the walls. However, this one is interesting and considering both the location and association with the lifeboat, rather fitting. In this case, inside and outside measures have relevance, specifically to the concept of saving life in a boat. We have reference to the Ark of Noah at this location.

Externally we measure in Greek feet of 1.01376. There are 52.8 of them in the length. The width reveals a further 24 of the same units. The total square area of the building is therefore 12,672 square Greek feet. There are 126.72 inches in 10.56 feet with Noah born in the year 1056 and the Ark was 528 feet in length.

Internally we are looking at the perimeter and ignoring the partition two thirds of the way down its length. Here the measure is in short Greek feet of 1.008 British feet. Length has 44 of them and the width 17.6. This reveals a total perimeter of 123.2 where the plan perimeter of the Genesis description of the Ark was 1232 feet.

In effect we have a lifesaving vessel housed next door to the ark.

Fig 11.14 St Justinians Chapel

11.12 Pembrokeshire: St. David`s Cathedral and Bishop's Palace

The Cathedral of St David's appears to be set out externally using the cubit of the water tunnel at Siloam, 1.45833333feet and in overall length this can be counted 216 times. Width, again overall has 100 of these cubits. Therefore the rectangle containing Saint David's cathedral has 21600 square cubits at 1.14583333. This is 600 square reeds or 7776 square step. Returning to the length and counting in British feet the result is 315. It appears from a cursory examination that the interior is based upon the basic 1.5 foot cubit. The Dean of St. David's has informed us of the existence of a connection between the old rod, pole or perch of 15 feet and the internal width of his cathedral. This would comply with an internal grid of 1.5 feet x 11, which is 16.5 feet.

The most interesting find here, however, was not at St. David's Cathedral itself, but at the Bishop's Palace. Unfortunately, the chapel was unavailable due to ongoing maintenance work on the day when we specifically went to see what we could discover regarding measures. Additionally the oldest section of the building, North West of the courtyard, was having new floors laid, so was also out of bounds. However, we commenced our numerical investigation at the Bishop's Chapel (not to be confused with the chapel at western corner of the courtyard).

The Bishop's Chapel we measured at 16.16666 x 34.16666 feet. Adjacent to this room is the Bishop's Solar, which, due to a very large fenced off hole in the floor we could only measure in one direction, its width, which should have been the same as the Bishop's Hall next door. The width of the Solar as measured was 23.3333 feet where the width of the adjacent Bishop's Hall was 23.5. It was obvious that the two should have been the same so we examined the relevant wall and found bumps and hollows. An average was therefore required when it came to evaluate the findings. The Bishop's Hall had a length of 60.75 feet. Beyond the Bishop's Hall, adjacent to the kitchen, is a serving corridor with an arch revealing an opening of 123.2 inches. This was our first indication of measure associated with the flood story.

Southwest of the courtyard lies the Great Hall; this has a length of 88 feet and a width of 30 feet. Beyond this is a short room by the same width, which is another private solar, a room for solitary contemplation. We measured this room at 28.3333 feet by 30 feet.

11.12:1 Evaluation

There were two indicators of the symbolism involved with these measures, the arch in the corridor and the length of the Great Hall. However, we did not discover any related values until a room's length was divided by its breadth, thereby revealing its proportions, which were quite telling.

88/30 = 2.9333333 = step value associated with Noah.

This is fitting as 50 of the 1.76 foot cubits gave the Genesis Ark beam of 88 feet. The plan perimeter of the vessel was 1,232 feet and the corridor arch opening gave us 123.2 inches. The Bishop's Hall, treated in the same manner as the Grand Hall gave a figure almost exactly 2.592 and so it was assumed that this was the intention. In this case the room width for which

we were seeking when we found bumpy walls in the Solar and Bishops Hall would have been 23.4375 (23 foot 5 1/4 inches).

Looking at the first room to be measured, the Bishop's Chapel, we evaluated a number of 2.113402062. It was apparent, given the previous findings, that this was intended to be 2.112 [21.12 inches in 1.76 feet], which gave a measure to rough stonework, only 0.128 of an inch or 3.25 millimetres different to our site dimension. This accuracy, nonetheless, was not apparent in the room widths of the Bishop's Hall and Solar. Nor was it even in the 30 foot width of the Great Hall for this was an average. Nonetheless, given the connections, it appears that the intentions were as we perceive them. The solar beyond the Great Hall measured 28.33333. Here a similar situation arises. Given the formulae of proportion we find 1.0588. It is too coincidental; this had to have been intended as 1.056 which would mean a length of 28.40909 feet, a difference of 0.9 of an inch.

11.12:2 Conclusion

It appears that in some cases proportion may indeed hold symbolic numeration. The rooms examined at the Bishop's Palace gave us the figures 1.056, 2.93333, 2.112 and 2.592 to which can be added the 123.2 inch arch opening and additional window openings measured at 50.4 x 1.1616 inches. This was the first time we had discovered the method of proportional representation of symbolic numeration. Indeed it is possible that information may have been missed elsewhere due to not employing this method, having found the symbolic numeration in other sources such as lengths and areas. This is something that we shall not miss in the future.

12.13 St.Pauls Newport Gwent

As this superb local building also utilises similar units we shall include a brief reference to it here. The main body of building, excluding the entrance region beneath the tower has a length of 1056 inches [88 feet] and a width of 720 inches [60 feet]. The area therefore is 760,320 square inches or, in square feet, 5280.

11.14 Abbeys in Britain

It would appear that there may be a connection between some Cistercian abbeys, the number 224 and the work of Indian scholar B.G. Tillak. In the early years of this century, Tillak made claim that the home of the sacred texts, the Vedas, was the Arctic. [Note: we deal in some depth with this subject in our work *Deluge*.] It is a curiosity that there are 224 days at the northernmost region of Earth when the Sun, as twilight or full Sun, is visible and in addition the solar orbit of Venus has the same duration. This express number also appears in the Temple to *Zeus* at Cyrone in terms of short Greek feet, and appears to have connections with Cistercian Abbeys, specifically in South Wales, at least in the three mentioned here. These are Strata Florida, with an overall church length of 224 British feet; Neath with 224 at 1.05feet overall but excluding buttresses [included at Strata Florida] and Tintern which measures 224 long Greek feet of 1.01376 internally.

David Williams[*Welsh Cistercians Vol.1* p.134][9] reveals that Cwmhir had a nave of 242 feet [British] with 14 bays. Was this another replication of 224, seen here in 1.08 foot units giving 241.92 [within 0.96 of an inch of 242] or have we found use of the 2.42 foot step, that which Charpentier had unwittingly discovered at Chartres, counted here 100 times? The bays would have a spacing of 17.28 feet within less than 1/10 of an inch. There additionally, at Neath and at Tintern, appears to be a repetition of 16 as the number of feet centres of columns.

However, one should take care when examining buildings from the viewpoint of others comments. A comparison between the above [derived from on site personal survey] and the dimensions and sources cited in the work of David Williams [p.136] will reveal discrepancies. Williams, citing J.H. Harvey, states that William Worcester of 1478 left such good recordings of the dimensions of Tintern that its plan could be reconstructed. Then arises a complication. Williams further cites L.A.S. Butler, who states that Neath and Tintern are internally the same length. Could this be allegory? Could it intimate that they have the same implication? Neath is quoted as being 215 feet which has to mean its internal length. The internal length of Tintern, to be theoretically correct is 227.08224. But fine measurement apart, from where did Butler obtain the notion that these structures are of the same internal length when there is a difference of 12 feet between them? Seemingly neither Williams nor Butler personally surveyed the buildings. Williams, who in his own field of Christian religious history is an outstanding scholar and also one of a dying breed, a gentleman, certainly could not have done or the difference would have been apparent and he would have queried his source.

Perhaps Butler, or a source which he utilised, was giving an allegorical interpretation. If one divides the internal length of Tintern by the number which has been seen to be of prime importance in this investigation, 1.056, the result is 215.04. [0.04 feet = 0.48 of an inch] The suggestion here, seemingly made by Butler, is that both buildings make individual reference to Noah. On this basis, Strata Florida, internally, is 0.99 of 215 feet, and 0.99 feet or 11.88 inches is relevant as a measure. Strata Marcella, according to Williams, citing *Archaeologia Cambrensis* [1892. p.15] had a length of 273feet, stated as being "60 feet longer than Strata Florida". It therefore again implies an internal dimension. However, one is inclined to doubt the accuracy of some of these measures; it seems to be more a matter of implication than precise surveying.

11.14:1 Scotland: Arbroath Abbey

This famous abbey, one of the bases of the Tironensian Monks, which also has associations with the 'scone stone' is interesting in its numerical values. It appears to be set to a grid of 31.68 x 1.008, the square containing the circle of the earth and the short Greek foot. This complies perfectly on site to the centres of the columns along the length of the building. We measured these at 31 foot 11 inches, which is within 0.2 of an inch. Over the building length this averaged out to no discernable tolerance at all. The overall length of the area is 16 grid squares and the breadth 12. This results in a length of 506.88 short Greek feet of 1.008 which itself reflects the 5068.8 feet of the long Greek mile. This being the case the short Greek mile can be seen in the number of long Greek feet in the same distance, 504.0. In effect we here have an example of the 175/176 numerical connection. The overall breadth at 12 grids at

31.68 gives 380.16 short Greek feet which in the long variety reduces to a number seen as half the length in British feet of Khufus pyramid, 378.

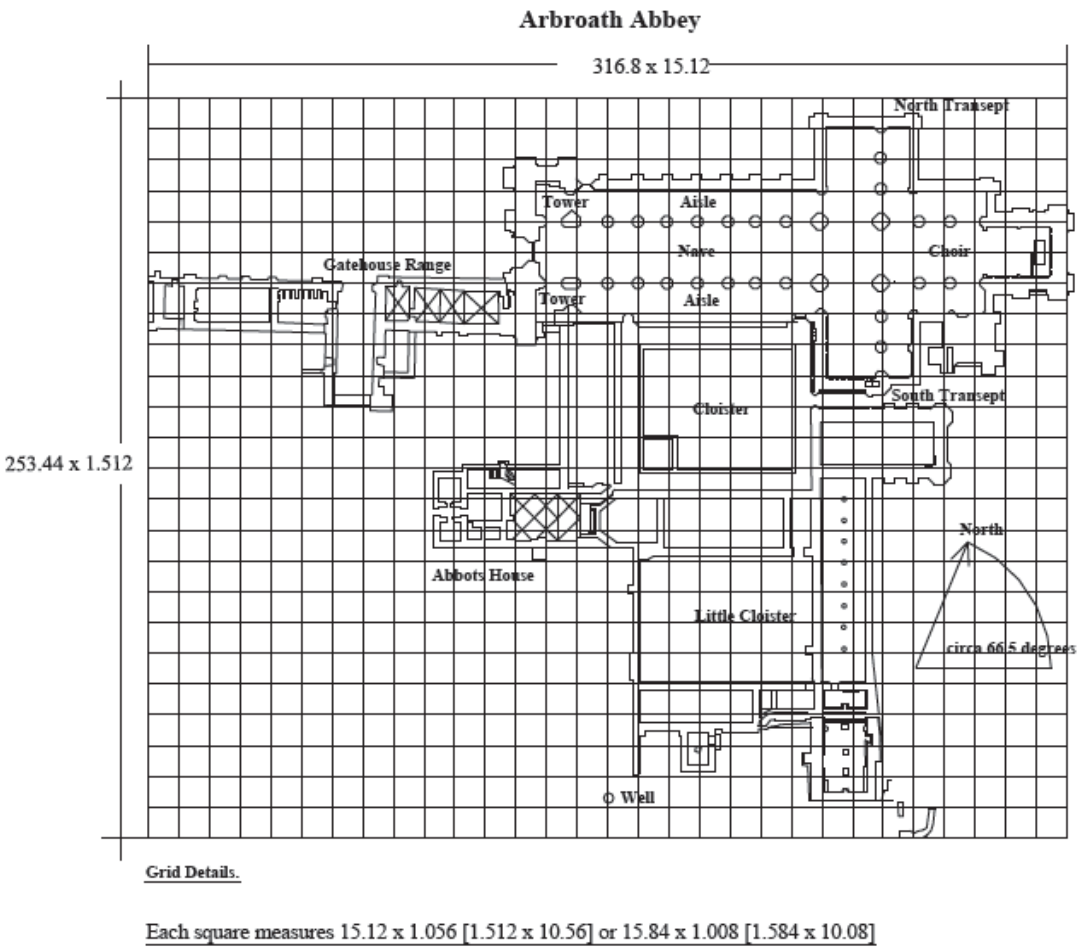


Fig. 11.15 Arbroath Abbey Layout

The figures of the church section of the monastic layout, at least the grid within which it is contained, are 10 x 5 grid squares or 316.8 x 158.4 short Greek feet. A number of combinations can be worked from this for the perimeter of the rectangle but in short Greek feet we find 950.4, which is the British foot count in the reed associated with the 1,584 feet cubit. The actual width of the church overall of walls as close as we could measure was 86.4 short Greek feet with the overall structural length nominally four times this at 345.6. Alignment is an azimuth of 23.5 degrees [the degree counts in the angle of the obliquity of the ecliptic but counted from North to Southwards and instead of East in a Northwards direction].

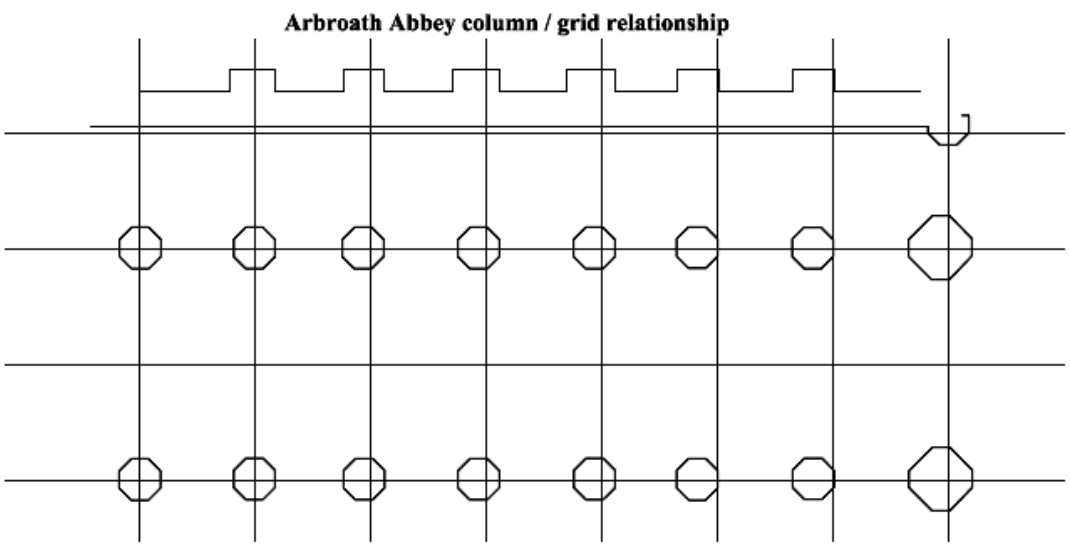


Fig 11.16Columns and grid at Arbroath Abbey

11.14:2 Some additional abbeys

Holy Island [Lindisfarne Priory] was set out using 1.458333333r as a cubit which gives a foot of 0.97222222r [1.75 / 1.2 = 1.45833r]. Rievaulx Abbey uses the same foot value of 0.972222r combined with numbers associated with 264, 1056 etc.
Jervaulx Abbey was set out using the value of 1.188 feet, as was the Priory on the Isle of May [5 miles offshore]
Fountains Abbey has a neat combination of long and short Greek measures

11.15 Scotland: Linlithgow Palace

Between Edinburgh and Stirling lies the little town of Linlithgow. In historical terms this is an important location being the site of a famous palace which was the birthplace of Mary Queen of Scots, from whom our own Queen is descended. The site during the mid 12th century boasted a Royal Manor house and it was at this time that King David I founded the burgh and granted the St. Andrews Cathedral Priory, the parish church which is St. Michaels.

The location made this a site disposed to military defence and consequently an appropriate building was constructed during the 13th century. The earliest reference to this building known to be accurate is from November 1301 when the 'Kings Chamber' was made ready for a visit of Edward I of England. However this is not a treatise on the historical nature of the building and although in 1301 the building was not as large as that with which visitors are familiar and we shall use this last item as an introduction to this very small, but we believe informative offering.

Fig 11.17 Great Hall of Linlithgow Palace

The Great Hall measures virtually exactly 30 feet x 100 feet. In inches we find 360 x 1200. The square inches here therefore count as 1200 x 360 or 432000. But we did say virtually exactly and not exactly. There is a little tolerance here.
360 / 21.12, the inches in 1.76 feet = 17.045454545 and 1200 / 21.12 = 56.8181818

17.045454545 x 56.8181818 = 968.4917355.

Hence within 0.00609 of an inch in all directions we have a correlation at 968 of Noah's cubits of 1.76 squared in this floor area. The Kings Chamber of later years, from the time of James I onward is probably a reference to the living area of the royal chambers. The bedchamber was a separate room. It appears that there were three stories, and the King and Queen had private apartments above each other so each room was identical in size.

The chamber for day use we measured at 50 feet (600 ins) by 21.12 feet (253.44 ins) giving an area of 1056 square feet, all in British measure. To complement this, the bed chamber area was 440 square feet comprising of 27.5 feet (330 ins) by 16 feet (192 ins)

The Ark's square area in plan as described in Genesis was 46464 square feet and when divided by 105.6 this results in 440. Consequently in the most personal of chambers relating to the royalty of Scotland at the time of James I we see a connection with the dimensions of Noah's Ark. Why should we find these very specific figures? This of course is not a coincidence.

Fig 11.18 Inner Courtyard of Linlithgow Palace

James I, however, not only had this palace greatly extended utilising the figures now familiar to us but also set up an organisation which apparently only included the heads of important clans. This eventually included the monarch of Britain. The group was, and still is, known as the *Order Of The Knights Of The Thistle.* Like other organisations of importance, this one still exists and meets in modern times.

11.16 St Giles Cathedral Edinburgh and Holyrood Abbey

St Giles Cathedral was originally was built as a smallish church probably during the 11th century and has been added to and altered on a number of occasions since. It is a most attractive building but there is an anomaly in the tourist publication available in the cathedral itself.

While there is a great deal of information relating to its alterations, to the recent stained glass windows which are of a very high quality, there generally are no dimensions at all given for the building. This lack of figures is not an unusual situation but note that we used the word generally, for there is one room that does have figures attached, a special room with equally specific figures.

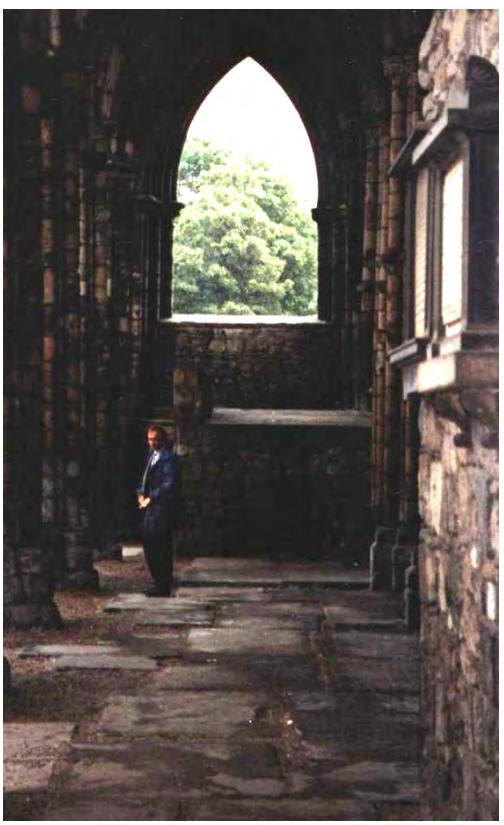


Fig 11.19Holyrood Abbey

As noted in relation to Linlithgow, James I set up the *Order Of The Knights Of The Thistle.* During the period of the wars with England this ceased to have any apparent function and they did not, as far as we can ascertain, meet as a group. James VII revived the order in 1687 and they adopted the nave of Holy Rood Abbey as their chapel. Holy Rood Abbey has a

knave of 8 bays at 15.84 feet, which results in 126.72 feet with a width of 1.76 feet x 16.8. The foot value of a cubit of 1.68 feet is 1.12 feet and this was used to set out Holy Rood Palace. The perimeter of this Knave measured in Noah's cubits of 1.76 British feet is 177.6, the Biblical date of the ark coming to rest, 17th day, 7th month, 600th year. Need we say more?
Only a year later, however, a mob ransacked the Abbey; they were incensed by the association of James with Roman Catholicism. From then until 1906 the Knights had no chapel of their own. But the 11th Earl of Leven and Melville nevertheless had left funds to be allocated to this specific purpose, the building of a chapel for the Knights and this was duly designed by Sir Robert Lorimer and completed in 1906 as an addition to St Giles Cathedral. Why the group should have waited this long is open to speculation, most of the people involved were very wealthy.

However, it is this tiny chapel, which for no reason given in the guidebook, is the only room to have any numerical value attributed. Down each side of the chapel are individual stalls for each Knight, each with a coat of arms or emblem above. Here we should point out that one of these is a bee, more on the subject of bees shortly. The overall height of the Monarchs stall is 33 feet. Width of this immaculately executed chapel is 18 feet and the length of 37. The square area of this very specific chapel designed for the use of a very particular and exclusive group of elite people is exactly 666 square feet. Once more, we state that this is not a coincidence.

11.16:1 Golden bees and a mystery

The Golden Bee element, in Egypt seen as a '*Tear of Ra'*, returns us to France and another part of the investigation by the authors of *The Holy Blood and The Holy Grail.* We look to the Merovingians, in particular to one man and an association that seems to have puzzled a great deal of people. The year 1653 saw the discovery of a Merovingian tomb in the Ardennes. This contained the remains of King Childeric I who was the father of Clovis. Clovis was the most influential of the Merovingian rulers. Childeric himself was the son of Merovee.

The interesting connection here is the discovery not only of the tomb and the remains of the king but the items that were buried with him. 300 gold bees! Whether there is a connection to the emblem in the chapel of the *Order Of The Knights Of The Thistle* and the Egyptian '*Tear of Ra*'or not we do not know but one must admit it is a very strange coincidence.

11.16:2 Holyrood Palace, Edinburgh

We were not surprised to discover yet again, within the confines of a royal residence, specific elements of the ancient measures. We can reveal that the building surrounds a central quadrangle, which is 79.2 x 1.12 feet per side. This foot value of 1.12 is not very common but relates to the cubit of 1.68 which number is seen in the abbey. As an additional piece of information in Deluge we relate that 22/7 divided into the Genesis length of Noah's Ark 168

times. Many of the familiar figures are revealed in this building. We found 1.232, Noah's cubit of 1.76, references to the foot value in inches of 14.08 and a number of interesting combinations.

To discover all this we merely had to measure between two columns and evaluate the remainder from the excellent detailed drawing in the guidebook which was surprisingly accurate. Elementary my dear Watson! As the royal family frequently stay at this palace we felt it would not be taken lightly to have someone measuring the place. The purpose was served however, we now have definitive numerical links between palaces, cathedrals and churches and abbeys. These all link to ancient Egypt and to the Biblical descriptions of the Arks of Noah and of the Covenant along with the Great Pyramid and numerous other places including the description of Solomon's Temple. There are links with the Knights Templar, the Freemasons and the Order of the Thistle. Why should these links exist?

11.17 York Minster

This must rank as one of the great cathedrals of Europe. The work is immaculate but without waxing lyrical about its magical, attractive powers and attempting to stay with the subject matter of the study we note that its length is recorded in the publicity booklet as 518 feet or 158 metres. Neither of these are correct. 158 metres is 518.3727034 feet. Having ascertained that both figures are approximations we need look for something which is very close, not forgetting that this is not far off a tenth of a mile long. It would appear that the number which we are searching for is 518.4 which would indicate 300 long Egyptian cubits, the variety utilised at the socket line of Khufus pyramid.

The width of the transepts is given as 76 metres or 249 feet. When we evaluate 76 metres we discover not 249 feet but 249.343832, a difference of over four inches. Again it would appear that the published dimensions are not reliable and so we have to look at the ancient cubit values which we know were used to discover a more plausible figure. Within fractionally over two inches of 249 feet at 248.832 there are 144 x 1.728, the cubit apparently relevant to the length of the structure. Utilising these figures as a square area we find 43200 square cubits. This almost certainly is correct. The perimeter of the so formed rectangle is 888 linear cubits.

The towers of the structure are notes as being all of the same height which is given variously as 60 metres or 197 feet. 60 metres is in fact 196.8503937 feet where the royal Egyptian foot [1.145454545] multiplied by 100 royal Egyptian cubits [171.81818181818] = 196.8107192 feet, within 0.476094 of an inch of the 60 metre interpretation. Given the use of the longer Egyptian measures elsewhere on the structure this seems a reasonable conclusion.

11.18 Roman Britain

It is widely assumed that Roman remains should demonstrate the usage of the Roman foot. Here are two examples which indicate otherwise, demonstrating that as seen continually in this book, a wide range of units have been in use.

The *Mithraeum* at Colchester has published dimensions which evaluate almost exactly with 40 x 23 at 1.848 British feet. This creates a perimeter of 126 cubits or 50.4 steps.

Moving to the Roman theatre at Gosbecks an inner and an outer diameter are clearly seen to be relevant. The outer is measured at 270 feet making a single degree a basic cubit of 1.5 British feet. At the inner measure the diameter is 264 feet or 100 steps of 2.64 feet.[10]

11.19 A Different Direction

In West Wales there is a churchyard where a Masonic family are buried. The name of the family and the title of the man who was its head we shall not reveal, we shall simply state that an important part of London has the same name as the former family residence in the vicinity of the church and he was a Baron. The grave is interesting; at least the monument above the human remains is intriguing.

Fig11.20 Masonic Gravestones (Family Internment)

Fig 11.21 Masonic Gravestone detail: Emblems in the ancient figures scaled down to inches from feet.

The headstone is set onto a substantial base and so can be accurately measured; it has not sunk into the ground. The height is a very precise 11.616 feet. This is not the only indicator because there is more than this tombstone to examine. All comply very accurately to our figures. There are a number of Masonic emblems to be seen including sun and moon, the 'all seeing eye', triangles within circles, square and compass and the level, which to the uninitiated appears as a bell. All these can be seen to comply with our measures albeit scaled down from feet to inches. The symbolism is there for all to see…but how many understand the figurative values? There is no doubt whatever of the numerical connections and the symbolic affiliations between ancient world and the Freemasons.

11.20 Famous Domes

There seems to be a particular fascination in making the *dome*, a representation of half a *spherical* Earth perhaps, representative of the planet in some way in its dimensions and/or linking them to the numerical values Biblically associated with the two Arks.

Some examples of such domes are given below, where we also briefly examine the interesting history of the construction of one of them. The following dimensions are translated into the units in use in this book from the measurement values seen in the work of E.O James.[11]

- St. Peter's in Rome is 140.8 *Long Roman* feet in diameter. [14.08 inches in 1.17333r feet]
- The Church of St. Louis des Invalides, Paris diameter measures 1.75 x 52.8feet.

- The Mausoleum Gol Gumbaz in Bijapur has a diameter of 79.2 x 1.782feet or 118.8 x 1.188 feet giving a neat circumference of 253.44 x 1.75 [25344 is a numerical value seen on Noah's vessel and at Plato's Atlantis.]
- The Dome of the Rock, Jerusalem measures 792 *Long Greek* inches in diameter
- Florence Cathedral dome has a diameter of 1.62feet x 79.2.
- The dome of the famous seat of American, in effect world power, the White House, has a diameter of 1.1616 x 79.2feet, simultaneously symbolically indicating the Ark of Noah, the Ark of the Covenant and the Earth.

A final example here of a famous dome is to be found in the Near East at the boundary of Europe and Asia in what was once known as the capital of the *Holy Roman Empire, Byzantium.* Later, this city became known as *Constantinople* and later still by its modern name, Istanbul. This is of course *Hagia Sophia*. This magnificent structure stands on the site of an earlier Basilican church erected by *Constantius II* in 360AD, some 30 years after Byzantium had become the capital of the Roman Empire.

The church was burned in 404AD and rebuilt by *Theodosius II* in 415AD, only to be again destroyed by fire in 532AD. The present structure, which is entirely fireproof, was built in 532–37AD by Emperor *Justinian* from designs of his imperial architects *Anthemius of Tralles* and *Isidorus of Miletus.* As a result of severe earthquakes, the dome collapsed in 558, but it was rebuilt by 563 on a somewhat higher curve.

With the Turkish conquest of Constantinople in 1453AD, Hagia Sophia became a mosque, and in subsequent years all the interior figure mosaics were obscured under coatings of plaster and painted ornament whereas most of the Christian symbols elsewhere were obliterated. The four slender minarets, which rise so strikingly at the outer corners of the structure, were added singly and at different times; the crescent supplanted the cross on the summit of the dome, and in addition the altar and the pulpit were replaced by the customary Muslim furnishings. Trachtenberg and Hyman comment on this structure:

'If there is one work that realizes the 'ideal' Byzantine model, it is the astonishing church of Hagia Sophia built as the new Cathedral of Constantinople by the Emperor Justinian... He intended it as the keystone of his vast architectural campaign... Hagia Sophia was built in the amazingly short time of five years...The daring of the design, and perhaps the speed of the construction, made the structure unstable. Its first dome fell after an earthquake, and its replacement (in 563, with a higher profile than the original) had to be repaired after partial collapses in the ninth and fourteenth centuries' [12]

Mitchell Beazley in *The World Atlas of Architecture* also comments:

'The choice of plan was...decided and imposed by Justinian himself. Santa Sophia does not have the basilical plan generally adopted for large buildings, but is on the centralized pattern....' [13]

It is notable that the choice of plan, of what was an unusual church in its day, was made

by the Emperor Justinian himself and possibly is an indicator of some knowledge only privy to the elite. In this instance his engineers brilliantly executed it and his construction teams built this building in something like one-tenth of the time it took to build mediaeval cathedrals. Its dome has a diameter of 1.008feet x 100.8 [Michell's short Greek foot] giving a circumference of 316.8 x 1.008feet, again indicating knowledge of a more ancient metrology.

11.21Conclusion

The churches, cathedrals and palaces of Britain and indeed Europe hold a number of figurative secrets. Indeed as we have discovered, not only the churches of Europe but also ancient and not so ancient artefacts and structures utilise the same numerical values. While huge amounts are being spent on the saving of what remains of ancient culture in Egypt and similar places the history of Britain, embodied in the structure of our own sacred buildings is all too often ignored. This is just as important as the ancient material from other countries. The fact that many of the buildings are still in use as places of worship has no bearing upon the subject. Perhaps even more to the point, is that although the Christian religion in this country appears to be generally on the wane, there is no reason to allow the buildings, which were a focal part of worship, to fall into ruin. There is much to be learnt from a study of these buildings, be they a magnificent cathedral or a humble little country church. As demonstrated here, there are a great many information revealing locations that do not come under mainstream examination. When we look realistically at the time that the Romans spent in Britain and compare this relatively short period to the duration of Christianity one has to wonder why far more emphasis has been put to the immortalisation of the arms of a Roman soldier than to the sacred relics of a church which was the focal point of a British rural community, and after the many years devoted to the study of Roman ways and artefacts, the measurements that they utilised are still not fully understood with many conflicting ideas arising within the world of archaeology. If the units of measure were understood and applied, as they have been in the research for this work, historians would be far more knowledgeable.

The Romans had their laws, which they enforced upon an unwilling populace. The church had its standards based upon the teachings of the Bible by which eventually the laws of this country and indeed all Western nations were fundamentally founded. The origination of the information in the Bible is, for the sake of this argument, vitally important and what is not apparently accepted is the validity of the history contained within our own community's *places of worship*. It appears that we need to put far more emphasis upon the upkeep of our heritage in the churches both suburban and rural for in these are to be found the basis of a set of connections which link the distant past with the future. This is living, it is ongoing, as the analysis in our book *Deluge* clearly indicates, and even if faith was completely lost, there is much to be learnt from the fabric of these buildings. The story of the astronomical source of the ongoing Biblical theme is to be found there; it has been revealed partly in this book and partly in *Deluge.* Here we have shown that buildings replicate in stone that which is set out in words. Churches, whether the reader is a believer or not, are valuable assets not to be discarded and thrown away as a threadbare garment. It is the threads that are the historical links. These remain even when the insulation of faith is lost.

CHAPTER 12

The Cradle of Civilisation?

Every man's work, whether it be literature or music or pictures or architecture or anything else, is always a portrait of himself.

(Samuel Butler 1835 –1902)

12.1 Introduction

So far, much has been seen of the use of what we term the measurement system of antiquity in ancient Britain, Greece, Egypt, and indeed, in the Americas, in both ancient and medieval and in some cases, more recent structures.

There has been no trace of a source of the system in our investigation of Egypt. Whilst the Pre-Dynastic period offers no evidence whatever of its use, however, right from the building of the first pyramid, we have discovered that there is ample evidence of the use of the system. Indeed, as was revealed in our companion work *Deluge*, [1] many of the ancient structures including the Sphinx were built in integer values of British feet. It would appear that the system existed before the building of the first pyramid or even the mastaba tomb that was extended into a pyramid. Even if it is found in the future by archaeologists that the system was in use in the Pre-Dynastic era, this would not give any evidence regarding its development only evidence of its use. The European material has not only provided further evidence for the continued use of the units but also background for further study even though it appears to be relatively isolated in terms of cultural aspects associated with Egypt and Greece. The search for the source of the units continues and here a brief metrological examination is undertaken of what has long been termed the 'Cradle of Civilisation', Mesopotamia, the region where the sexagesimal system, *according to convention,* was developed.

12.2 Mesopotamia: Early Historical Overview

South Mesopotamia is generally seen in the literature as being 'civilised' by around 3500 BC, with Egypt following on about 300 years later and India flagging behind at around 2500 BC. Yet this is an inherently flawed idea as up to date investigations are beginning to reveal.

The use of the word 'civilisation' or culture, as it is sometimes termed, in this context, is making an erroneous comparison with a modern concept of the word, which normally considers it to be a network of cities, towns, villages and rural areas. In the case of

Mesopotamia the construct of a 'city-state' is more appropriate [in a similar way to those of ancient Archaic and classical Greece].

It now seems likely that any development in 4th/3rd millennium BC Mesopotamia did not occur in isolation.

Whatever 'development' is defined to be, throughout the whole period of the build up in Mesopotamian culture, trade existed between it and the regional polities in Egypt and India. Trade routes were both inland through Persia and along the coast via the Persian Gulf. The Indian Port of *Lothal* is testimony to the sea trade of that region while in Mesopotamia, *Ur* was known as being 'on the sea', due to a higher sea level at that time than today. The correlation of values of weights seen later in Chapter 13 is testimony to these connections.

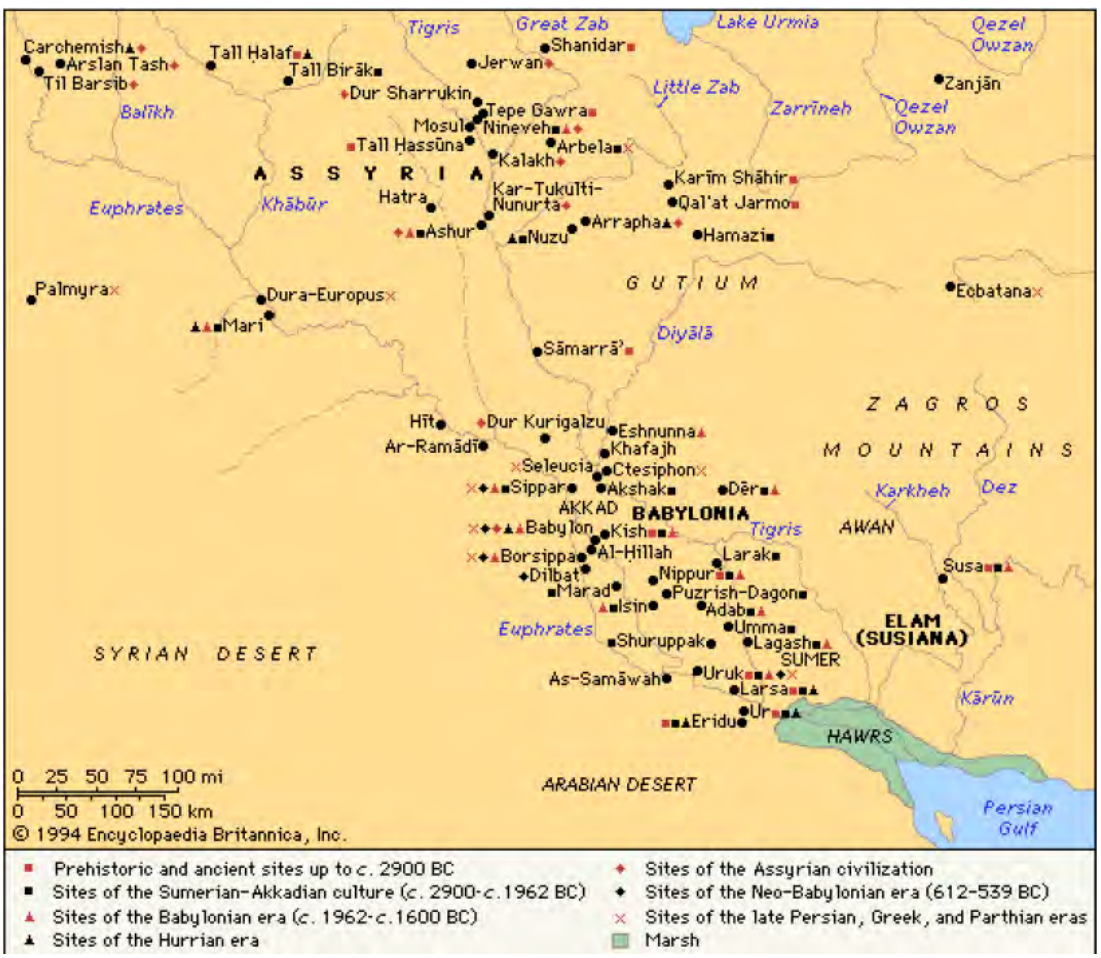


Fig.12.1: Historical Mesopotamia (Encyclopaedia Britannica)

To be specific, at Ur, harbours were built within the city, connected to the Euphrates via canals, indicating not only the importance of trade but also the advanced concepts of civil engineering in this case. So it is apparent that technical abilities were well developed. In this chapter we shall examine the dimensions of some structures that were built in the region.

Building in Mesopotamia certainly developed early in the historical framework. At *Uruk*, for example, by the end of the 4th millennium BC, around 3000BC, there had been constructed a columned hall approximately 30 metres in width.[2] Obviously this entailed the use of precise measures and mathematics. When the records of the remains of the structures throughout the greater area of Mesopotamian and the later Babylonian history are examined, there is further reference to the same measurement units seen elsewhere and again *there is no sign whatever of any source or learning curve*. The above-mentioned hall also indicates that trade for timber was ongoing as rafters or beams would have been essential for roofing purposes. These almost certainly did not come overland but would have been carried by water hence the rivers were used for commerce, as was the sea.

In the ancient city of Ur, according to conventional theory possibly the most ancient city in the world, the earliest known true arch of sun-baked brick was made. Ur dates to between 3500 and 4000BC, a date *approximating to the arrival of a race called the Sumerians*. The arch itself has not survived, but a description of it includes the first known reference to mortars other than mud. Bitumen slime was used to bind the bricks together. However, as all those involved in building understand, forming arches involves a timber framework, known as a 'centre' for the brickwork to sit on until the mortar is set with the locking headstone in place. The complete process, making the formwork, to its removal after the stone or brickwork is set, is known in the carpentry trade as 'striking an arch.' This practice in Mesopotamia indicates that trade in timber and timber crafts must have been ongoing at that early time as they grew no structural timbers of the kind required for this type of work of their own.

We shall now evaluate the dimensions of some of the buildings of the region that at still extant. These structures are all of a period later than that for which we are searching, although the Ziggurat of Ur dates to around 3000BC; nonetheless, the buildings demonstrate the use of the same dimensional system as is found across the ancient world.

12.3 Barsipki

The ziggurat of Nabu at Barsipki has a base of 300feet. [3600 inches] square and is aligned to the cardinal points.

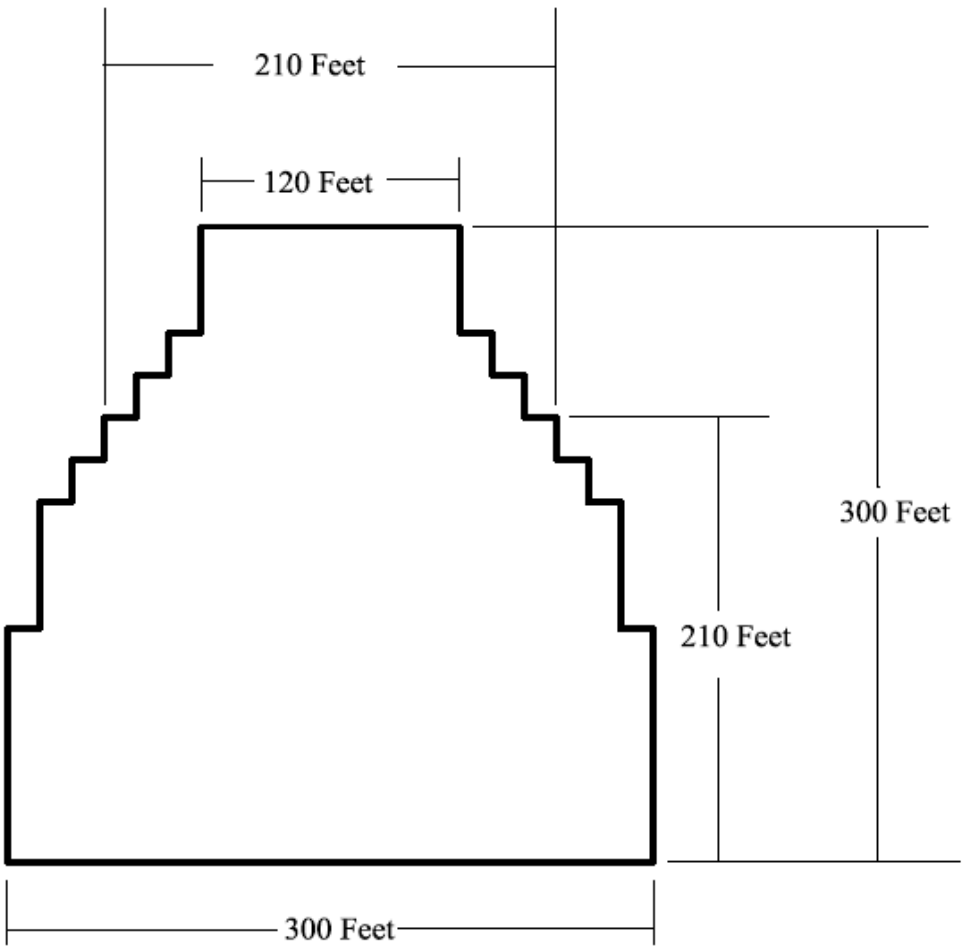


Fig. 12.2: Ziggurat of Barsipki [drawn from a description by David Fasold]

The overall height of the ziggurat is also 300feet. The terraces are each of 15feet per side making a reduction in width at each level of 30feet. [Note the use of the British foot as a base unit value]. The lower terrace is 110 feet above ground level. Above that, the rise is for 60 feet and then 20 feet up until the last rise, which is of 50 feet. Contained within this top structure was the *Temple of Belus*. The fourth level has a side length of 210feet. This level is also 210feet from ground level.

It appears that this value of 210 feet has an importance. According to Fasold[3] who has taken up a suggestion by Maspero, which was furthered by Menon, the edifice as a whole is a representation of the Northern Hemisphere with a single degree equating with 40 inches or 3.333333r feet. If this were the case, then the first terrace would approximate the latitude of Babylon at 33 degrees. The remaining levels indicate 51 degrees [the approximate latitude of Stonehenge] 57 degrees, 63 degrees, 69 degrees and 75 degrees with the top of the structure

indicating the North Pole. This would indicate knowledge of the concept of a spherical Earth. If the 300 feet does indeed represent the Earth's radius in the height of this structure then the scale would be 1: 69,696. [3960 miles / 300 feet = 69,696] [Note: a square British mile has 27878400 square feet and this count / 400 = 69696] Examining the structure in terms of degrees in relation to the North Pole we have correspondences as shown in Table 12.1 below.

Table 12.1 Ziggurat of Nabu: relationship with North Pole

110feet	33 degrees	
170feet	51 degrees	18 degrees difference
190feet	57 degrees	6 degrees difference
210feet	63 degrees	6 degrees difference
230feet	69 degrees	6 degrees difference
250feet	75 degrees	6 degrees difference
300feet	90 degrees	15 degrees difference

This is concurrent with the base representing 360 degrees of arc using the same value for a degree, 3.333r feet or 40 inches. [If this were denoted in 'double cubits' of 3.3333 feet, the foot value would be 1.1111 feet or 1 1/9th feet.] Fasold suggests that the measurement unit of 210 feet is actually that of the *iku*, which would have 120 cubits at 1.75 feet per side and 14,400 in square area.

The so-called 'Great Babylonian Cubit' is generally thought to have been virtually exactly 21 inches. If it were indeed exactly 21 inches then Fasold, as it is believed he has, would have made a correct assumption. It is accepted here that the cubit in use on this structure, at that specific level was 1.75 British feet or 21 inches and that the 210 feet represents an *iku.*[3] [see also Chapter 5: 2 Babylonian Tablets]

At the base of the structure a further count of 144 can be seen in the 14400 inches in the total perimeter. Assuming that the foot measure of 1.11111 feet also applies, the perimeter of the structure would then measure 1080 of these feet.

[300 / 1.11111= 270 and 270 x 4 = 1080.]

At the 210 foot level the count for the *perimeter* would be 756 of these feet where the Great Pyramid of Khufu was 756 British feet *per side length*. The fact that these values interlink in such a fashion is a strong indication that they are correct.

But there may be more to this structure. The *iku* was an important measurement unit and here it is seen in conjunction with a position 27 degrees from the peak of the structure. The constellation *Hercules* could be represented by a square with a leg at each corner, or even without the legs as it basically is square in shape. Between the years approximating 1000BC and 3000C *Hercules* rose and set about 27 degrees from the pole. Could the concept of the *iku* be based upon the shape of Hercules perhaps?

12.4 Borsaippa

In 1998, after 20 years work, archaeologists finally unearthed the foundations of another large ziggurat at Borsaippa, 75 miles south of Baghdad in modern Iraq. This structure, commissioned by the great *King Nebuchadnezzar* some 2,500 years ago, still stands to a height of around 172 feet. Originally, it is thought, it would have been 231 feet in height.

The base side length of this building once more complies with what has been revealed of the ancient measurement system, and indeed has further links to the British Imperial system. The side length is 297feet. Its perimeter is therefore 1,188 feet or 1,000 x 1.188 feet. This perimeter also can be counted as 750 x 1.584feet. An exact perimeter value however is seen in a count of 720 cubits at 1.65 feet, which is 1/10th of the old British 'rod, pole or perch' that the older among us remember from early school learning. The side length would then be precisely 180 of these cubits or, in the relevant foot value, which is 1.1 British feet, the unit that Neal states was of Saxon origin, a further count of 270.

The height of the structure at Borsaippa is now easily understood, and in part confirms Fasold's ideas relating to the Iku at Barsipki. This structure at Borsaippa is 210 x 1.1 or, as the archaeological explorations have revealed, 231feet high.

On-site archaeologist, Allinger-Csollich states that the brick dimensions in use were 13.25 inches on each side and 3.25 inches in depth.[4] Here it would appear highly likely that the target dimension for these bricks would have been 13.2 inches or a repetition of 1.1 feet and 3.3 inches [a quarter of the length] for the thickness. Much would depend upon the moisture content of the bricks when measured against when they were first laid after being dried [for which, of course we have no evidence], and such movement would not be unexpected.

These dimensions are nevertheless quite interesting because looking in another direction the specific quoted length, divided by 1.056 squared or 1.115136, results, within 2 thousands of an inch, in a measure of 11.88 inches. This not only replicates the count of feet in the perimeter but is the length of the bricks seen frequently in India during its later period.

12.5 Babylon: The Dragons at the Ishtar Gate

At the Palace of Nebuchadnezzar a variety of unit measures were use as Joan Oates' work *Babylon* reveals in metric measurement values. Here is an examination of a number of items related on pages 150 – 157 of her work. [5]

Fig.12.3: Dragon at the Ishtar Gate of Nebuchadnezzar

Looking at the figures involved in this structure; firstly the Processional Way leading to the Ishtar Gate of Nebuchadnezzar's palace where adjacent to the gate can be found, among other creatures, a depiction of a dragon 1.3 metres in height.
1.3 metres equates with 51.18110236 ins where:-
4.4 x 11.616 inches [0.968 feet] = 51.1104 inches [Within 0.00179584 of a metre or 1.79 mm. of the stated 1.3 metres.]

The measure of 0.968 or 11.616 inches was seen at both Chartres Cathedral and at Rosslyn Chapel. It occurs within the pyramid of Khufu. The same Great Pyramid was 440 cubits in length.

Lions were also depicted as 1.05 metres in height. In this case, the reported figure links to 2 x 1.718181818 feet [the *royal Egyptian* cubit] within 0.1 of an inch. A further lion, a massive sculpture, which is reported as being 2.6 metres in length is within 0.141 of an inch of 8.8 x 0.968, exactly twice the height of the dragon at the Ishtar Gate and a further use, in an animal sculpture, of the value 0.968 feet.

As to be expected, the Palace buildings contained a number of rooms. Nebuchadnezzar's Throne Room measured [176 x 0.968] x [57.6 x 0.968], resulting in a square area of 10,137.6 square feet with the count in foot units of 0.968 British feet. In square British feet this count is 9499.174502. The number 10,137.6 reflects the number of British feet in the *Long Greek* foot at 1.01376feet, which confirms once more the familiarity and widespread use of the British foot and other units of measure. A further section of the palace utilised a different measurement unit and measured:

[171.81818181821 x 1.1454545454 feet] x [1.7181818181x 105].

Here is found the *royal Egyptian* cubit of 1.7181818181feet in conjunction with its foot value of 1.1454545454feet. [Note the same configuration in the first part of this calculation as seen in the height of the towers at Yorkminster.] The count of 105 could be seen as replicating a reed value of 10.5feet, which relates to the cubit of 1.75 feet. These wall lengths result in a proportional factor of 1.0909090909, which is another common relationship between measurement values found in the ancient world and is the foot value associated with the so called 'Megalithic Yard'.

Another court utilised a different value completely, the foot of 1.1664 feet. This measure is less commonly found but its origin can be seen in the fact that: 108 x 108 = 11,664.

In this room it is noted that the length is comprised of 242 x 1.1664 and the breadth is 220 x 1.1664 giving a proportion of 1:01818. One more court is given in metric measure that accurately translates to: 168 x 1.76 by 216 x 1.76. The area of this room is 100,800 x 1.056 squared.

Hence, at the Palace of Nebuchadnezzar a very interesting and broad array of measurement units from different dimension sets were in use, demonstrating the interchangability of the values and the knowledge of the architects and builders. Certainly this totally confirms that the measures were not regionally inspired as is implied by the names given to them by Michell, Neal and others.

12.6 Sumeria

John Manley[6] has some additional material enabling us to examine the ziggurat of Ur, which, according to the Bible, was Abraham's home town. Ur was in Sumerian territory and the language of the Sumerians was not Semitic as was the lingual basis of remainder of the peoples of the region. There is no *historical* record of the origin of the Sumerians, but modern research has revealed much that previously was unknown. [This is a matter to which we shall return later as it is important to this study]. It was the Sumerians who in that region developed writing and mathematics along with building techniques and city layouts combined with civil structure. They undoubtedly were an advanced people. Yet they were not indigenous to Mesopotamia, contrary to the thoughts of many archaeologists.

The Sumerians were governed by their gods and built large religious precincts in that context, something akin to the notion of the large area surrounding Solomon's Temple described in the Bible. At Ur, the earliest example that has been discovered in this research in terms of measurements of buildings, dating to approximately 2600BC, is the ziggurat excavated by Sir Leonard Wooley.

Unlike the layout at king Solomon's Temple [described in the companion work *Deluge*] and indeed the pyramids of Egypt and many other structures, this building was set out diagonally to the cardinal points with the entrance being at the Northeast face. Here were three sets of steps to the first level on the North East side.

Fig.12.4: The remains of the City of Ur. (The dominating ziggurat is seen in the background.)

The base measurement of the ziggurat at Ur [see Figure 12.4 and reconstruction in Figure 12.5] was 200 feet x 132 feet giving an area of 26,400 square British feet. The narrow side length of 132 feet = 1,584 inches and the step value associated with a cubit of 1.584feet [1.056feet x 1.5] is 2.64 feet; hence there is a symbolic numerical connection between side and square area.

From the above examples it is understood that in Mesopotamia there has been a continued use of the same values, values, as will be seen in later chapters that were also in use in India. But once more, there is no indication of a source, no reference to the origination of the measures that were demonstrably in use in the ancient world right across the Middle East as far afield as Europe and a short [archaeologically speaking] while later even South America. It seems that these may have been simply accepted; they were certainly well known and fully understood. It additionally appears that these units of measurement and the attendant mathematics were familiar to the Sumerians…before their arrival in Mesopotamia.

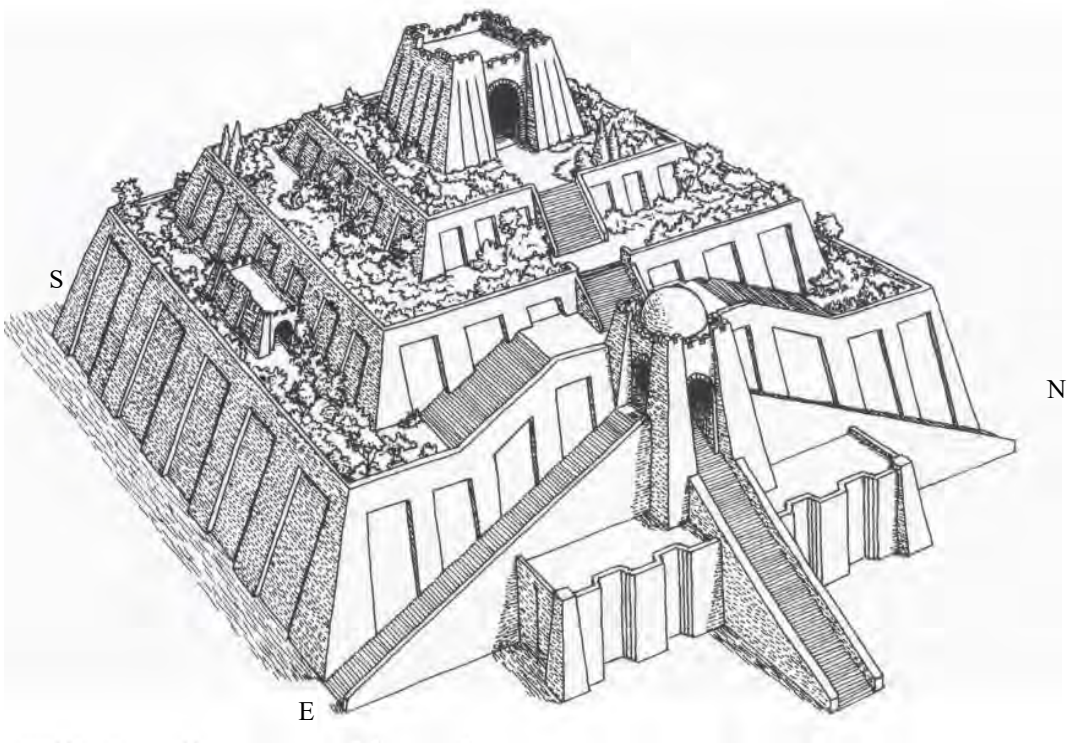


Fig.12.5: Reconstruction of the Ziggurat at Ur

It is noted that there is a difference of academic opinion regarding the origination of the Sumerian people. While many scholars adhere to the development from within the region theory, others look elsewhere to find a source for the Sumerians, those people who are specifically known for their development of writing and mathematics and city building.

The Sumerians are generally seen by archaeologists as a highly developed people for their time. It is their contribution to the development of society in this region, coupled with the Biblical story of the Garden of Eden, which most believe was located here, between the Tigris and Euphrates, that caused the name the 'Cradle of Civilisation' to be applied to the area.

Mathematics was supposedly developed and writing came to the fore under the auspices of the Sumerians. Table 12.2 [7] below gives some idea of the time scales involved. This is a very abbreviated summing up of the mathematical development of the region.

Table 12.2 Development of Sumerian civilisation

3500 – 2400 BC	Small city states Sumeria Centres of power: Ur, Eridu, Lagash, Nippur.)	Development of sexagesimal system (base 60) numerals.
2400-2200 BC	Earliest Mesopotamian empire of Sumer and Akkad (centres of power:Ur, Agade)	Construction of tables for multiplication, division and other operations
2200-1900 BC Conflicts and wars: ruled by city states(centres of power: Ur, Girsu)		
1900-1650 BC	First or Old Babylonian Empire(centre of power:Babylon)	Beginnings of algebra, and subsequent rapid developments
1600-885 BC	Period of unrest and invasion by Hittites, Hurrians and Mittani (centre of power: Babylon)	Astronomy.

While the Sumerians were highly advanced, others may well have been equally developed, as discussed in the next two chapters regarding India. There are questions to raise here. As stated above, there are two schools of thought regarding the Sumerian people, one claim is that they were indigenous and the other that they arrived in the region from elsewhere.

Their written language, when deciphered, was understandable and contained some *Vedic* influence but was foreign to the region and indeed, according to most sources nothing resembling it has been found elsewhere. Linguist John Heise makes the following comments:

'The people responsible for the first monumental temples and palaces, for the founding of the first city-states and most likely for the invention of writing (all in the period of 3100-3000 BCE) are the Sumerians. The first written signs are pictographic, so they can be read in any language and one can't infer a particular language. A pictogram of an arrow means 'arrow' in any language. A few centuries later, however, these signs were used to represent Sumerian phonetic values and Sumerian words…

… The pictogram for an arrow is now used to represent **ti**, *the Sumerian word for 'arrow', but also for the phonetic sound* **ti** *in words not related to 'arrow'. So it is generally assumed that the Sumerians were also responsible for the pictographic signs, or possibly together with (or with a large influence of) the contemporaneous Elamites. If the Sumerians*

aren't the ones who actually invented writing than they are at least responsible for quickly adopting and expanding the invention to their economic needs (the first tablets are predominantly economic in nature).[8]

The evidence seems to indicate that the Sumerians were originally immigrants to the region. If their language was expanded and developed within the area, it would have close similarities to their nearest neighbours to the north of the same country. This is not the case. Their nearest neighbours were the Akkadians who had a Semitic language. Once more, we turn to John Heise:

'The name 'Sumer' is derived from the Babylonian name for southern Babylonia: ***mät umeri*** *'the land of Sumer'. (construct state of mätum 'country' followed by genitive of Sumer; unknown meaning in Akkadian) The Sumerians called their country* ***ken.gi(r)*** *'civilized land', their language* ***eme.gir*** *and themselves* ***sag.gi.ga*** *'the black-headed ones'. [the consonant in between brackets appears in writing depending on following sounds. Compare e.g. French 'les Francais' where in both words the final -s are not pronounced, but they are explicitly heard if a vowel follows, e.g. in 'les Anglaises'.]*

The Sumerian language is not Semitic. It is a so called ***agglutinating*** *language, like Finnish and Japanese (and in fact like the majority of languages in the world). This is a term in the typology of languages that contrasts with* ***inflecting*** *languages, like the Indo-European and Semitic languages. In an agglutinating (or agglutinative) language words are composed by stringing forms together, often into quite lengthy sequences. In inflecting languages the basic element (the root) of the word may change (like 'foot', 'feet' and sing, sang, sung, called internal inflection).*

Sumerian has no known relation to any other language. There seems to be a remote relationship with Dravidian languages (like that spoken by the Tamils, now in the south of India). There is evidence that the Dravidian languages were spoken in the north of India …

Because of the term 'the black-headed ones', it is possible (but far from proven) that the Sumerians are an early branch of one of the people now living in southern India. [9]

There is no doubt that the Sumerians ruled the Acadians yet they insisted on calling themselves the 'Black Headed Ones' thereby drawing a distinct line between themselves and others. These people may have seen themselves as distinctly superior to others and the 'Black Head' was a means of differentiation, an appellation of greatness; they would hardly be putting themselves down by the self appointed title. Alternatively, at some point in the past perhaps they had been looked down on by others and resenting that situation kept themselves apart, denoting themselves as 'Black Headed' and being proud of being different, much as many black people of today in western society do as they are still all too often discriminated against. For as long as this continues these people will feel alienated and hence understandably tend to

put to the fore the obvious differences to the white people as a virtue. This sort of scenario may well have happened with the Sumerians.

There is another telling statement in the above extract, the Sumerians called the region the 'civilised land'. This being the case it is very clearly apparent that they were familiar with another region not at all to their liking…an 'uncivilised land' by their assessment. Once more, this is a clear indication that these people were immigrants who had experiences of another place that was on route from their homeland.

As stated above, the language may be associated with the Dravidian of Southern India. For the moment, the assumption shall be made that the Sumerians came to Mesopotamia from the general region of India. This, as will be seen, was almost certainly a stopping off point on a journey from elsewhere because there is evidence linking the Sumerians to another region entirely.

The Sumerians arrived in the region about 4,000-3,500BC but indigenous people were already there. Ur was an expanding community, re-established after being temporarily flooded out, agriculture was well developed and the Sumerians took over words already in use that would have been alien to them in their native tongue. This is apparent from the written language that developed shortly afterwards. Hence as can be seen from the initial use of a numerical system-using base 60 that complies implicitly with the measurement system, it could be construed that the system was developed here in Sumeria.

However, this journey of discovery is as yet incomplete. Although Sumeria developed very early in the art of city building, we have yet to look at India, a vast area that was one of the most important, perhaps *the* most important trading partner of Sumeria. We do this in the following chapters where it is found that due to the concept of an Aryan invasion, a totally false idea, which has gripped most historians until very recently, India has been seen as something of a backwater. In reality, while the likes of huge ziggurats and pyramids were not a part of the Indian scheme of things, the tall temples came later, there are other considerations to take into account.

Regarding building and hence mathematics and geometry, the three major players of Egypt, Mesopotamia [at this early time being Sumeria] and India were basically all on a par regarding ability in the early 3rd millennium BC. The differences are seen only in the scale and style of structure, not in ability for a given time. People wanted large structures, for whatever reasons, so they developed the means to build them…others did not see the necessity for a ziggurat and so refrained from attempting such structures. But if the people of India at that time desired to commence building in this fashion, they had the ability to do so. That no structures of this nature survive does not mean that they could not build large structures, but simply that they saw no need for them. Their urban layouts, even to efficient drainage systems, tell us that they were equally as capable as the Mesopotamians and Egyptians in civil engineering as will be found in Chapter 15.

We begin Chapter 13 however with an examination of the 'Aryan Invasion Theory' and the proficiency of ancient Indic astronomers.

CHAPTER 13

Ancient India and Internal Development

"Time creates the sky and the earth. Time creates that past and the future. By Time the sun burns, through Time all beings exist, in Time the eyes see. Time is the lord of all."

Atharva-Veda (19.54)

The Moon is that which shapes the years.

Rig Veda 10.85.5

13.1 Setting the Scene: An Invented History

Fig. 13.1 Political geography of the Indian sub-continent today

Much of this chapter is taken from and will be seen to be nearly identical to a chapter in the companion work *Deluge*. As the information here is pertinent to the remainder of this book we include this slightly shortened version.

What was known as *Bharat* or *Bharata*, which we term India today, was in past epochs, which for the purposes here implies before 2500BC, a vastly larger region than that confined by the political boundaries of modern times as depicted in Figure 13.1.

At its cultural peak it covered an area that was larger than that occupied by the civilisations of ancient China, Egypt and Mesopotamia combined and its culture influenced all these regions. It was the Classical historian Josephus who claimed that 'Eden' stretched from, *what the Greeks call the Ganges to what the Greeks call the Nile.* Hence, here we have a chronicler of Jewish history writing during the Roman period and hence long after Alexander the Great, admitting that the enormous sphere of influence of the Indic culture extended even as far as his own ancestors.

The true history of ancient Bharat or India is rarely taught in Western places of learning and even many Indian schools still preach a completely false history devised by Europeans. This false history is that of the 'Aryan Invasion,' an invasion that in reality never occurred.

The basic tenets of this outmoded and incomprehensible theory are that around 1500BC, the fair-skinned 'Aryans' came on horseback and driving chariots from somewhere in the north-west into the region of *Saptasindhu,* [the land of the Seven Rivers]. They then completely destroyed the local society, driving the darker skinned natives to the south of *Bharat*. Around 300 years later the Aryans supposedly began composing what we now know to be indigenous Indian texts, beginning with those that are known as the *Vedas.* Yet there is no mention whatever within the corpus of Indian writings of any of these events, local tribal and family feuds are mentioned but nothing relating to an invasion of any nature. As it is invariably the victor of an invasion that writes the history of a region and portrays it in a manner that displays the writer's viewpoints as correct, this is very strange to put it mildly. In effect, from within the said writings there is no evidence for an 'Aryan' or any other invasion and this argument is supported by *modern* archaeology. [Note: A fuller explanation and history of this 'invasion that never was,' that is still being erroneously taught in numerous regions today, is found in our companion work *Deluge* as it has a larger bearing upon the book's content].

The ancient Indic texts, however, as is beginning to be revealed, hold a large amount of astronomical lore and we continue in this chapter with an examination of evidence for dates that may be applied to these compositions, specifically the Vedas and the Mahabharata.

13.2 Dating the Texts: The Loss of the Sarasvati

In this discussion, we first introduce another researcher into early Indic history, Dr. Koenraad Elst:

'One of the earliest estimates of the date of the Vedas was at once amongst the most scientific. In 1790AD, the Scottish mathematician John Playfair demonstrated that the starting-date of the astronomical observations recorded in the tables still in use among Hindu astrologers, (of which three copies had reached Europe between 1687 and 1787) had to be 4300BC. His proposal was dismissed as absurd by some observers, but it was not refuted by any scientist.' [1]

Note: John Playfair was a member of the Royal Society and an advisor on weights and measures to The Select Committee of the House of Commons.

We have no argument with Playfair's astronomical findings but it must be remembered that the work of the Vedas and other texts as a whole were originally composed as prose, and were *recited*, not written, a talent that was especially important in ancient non-literate cultures. This was a commonly utilised skill among many people, the Hebrews included, where tradition holds that those skilled in memory techniques could remember and repeat up to three hours of recitation or verse. Astronomical events were recorded in what today would be seen as a mythical format, a story, and hence its meaning revolved around characters in precise positions, with the characters, in this case, being celestial objects.

Dr. Nicholas Kazanas has calculated what he terms a 'new' date for the Rig Veda [except for the last book (the tenth) and some accretions], of 3000BC.[2] This date is based upon logical arguments that comply with Indic tradition. However, it is seen in our companion work *Deluge* that even this 'early' time is a lot later than some of the dates that are hidden in related texts.

Given the number of commonalities between scripts one is inclined to query the possibility of a central composition in oral form upon which the remainder of the early works drew prior to being set out in a written format. This concept of a central composition is reminiscent of the idea that the *Synoptic Gospels* of Matthew, Mark and Luke were based on an earlier, singular body of work upon which all three depended, the so-called 'Book of Q'.

The research for *Deluge* revealed a specific date in the Indic *Mahabharata* that is only discovered via astronomical computer programmes. It shows that the skies above India were observed and that the observations were recorded-in what today may be termed a 'mythical' format. This date is then seen to be associated with a cyclical construction that again is dependent upon astronomy and events both celestial and terrestrial.

The information derived from just this one date coupled with other constructs within the same epic implies a far greater knowledge of astronomy than is historically accepted for this or any other region in the era to which it points. Nonetheless, the Mahabharata, while containing some very early material, is a late composition by comparison to the Rig Veda, being composed, according to scholastic thought, by three authors over a greatly extended period.

Another set of writings are the so-called *Puranic* works which are very late [late 1st millennium BC and forward for a couple of hundred years] but as with the Mahabharata contain very early material as is demonstrated in *Deluge* via information contained in the *Skanda Purana*. Some of this data refers to the 7th millennium BC, and the information contained is confirmed via ice core research into ancient climate change. Effectively, we can say that the most accurate dating regarding the composition of the Rig Veda, or perhaps at least *the core material from which many texts and poems were drawn*, is that from Tilak:

'...several scholars argued for a date of the RV much earlier than 1500 [BC]. *Notable among them are H Jacobi and B G Tilak who, working quite independently at about the same period, and examining the astronomical data in the Vedic Corpus, arrived at very early dates. Jacobi (1894: Indian Antiquary 23) gave a date c 4500. Tilak (1893: Orion: Researches into the*

Antiquity of the Vedas) traced some Vedic texts as far back as 6000 [BC]. *In his monumental History of Indian Literature (revised ed 1927 Geschichte der Indiscen Literatur), Winternitz summed up the available evidence and concluded for a date c 2500-2000* [BC]*.'* [3]

The dates [now revised, see above] as seen by Dr. Kazanas for the various compositions are:

'Dates of composition of texts are now given as: RV (RV = Rig Veda) 3500 and before; AV (=AtharvaVeda) and YV (=YajurVeda) not long afterwards; early Braahman-as and Upanishads, c 3200-2600; Suutras c 2800 down to 2000; the core of the epics c 3000-2900 but developed with accretions and set c 100 BC. All these dates are approximate and conjectural.'[4]

While Kazanas, amongst earlier researchers such as Tilak accepts that the bulk of the work is pre-Harrapan, [5] the tenth book of the Rig Veda was composed very much later, verified by the lingual style, and a lack of consistency in its form.[6] Be that as it may, astronomical descriptions in the texts place some observations at close to 7000BC and there are hints of earlier notifications.

In considering the age of the composition of the Rig Veda, one pointer relates to geological events– this is the relationship between the Rig Veda and the now lost *Sarasvati River.* The incorrect historical view of the nature of the so-called Aryan Invasion Theory even extends to the name of this once great river:

'The Indo-Aryans transferred river names from the old to the new country. For example, the Indian Sarasvati was named after the Iranian Hara Vaiti after the migration in India." (Burrow: 1973..pg 126)' [7]

As already seen however, the civilisation of early India and its *miracle river*, the Sarasvati, predate anything of a comparable nature that has been discovered in ancient Iran and this river is definitively associated with the *Vedas,* specifically the early *Rig Veda.* This civilisation, now often termed the *Sarasvati-Indus Culture* or *Civilisation* or SIC, occupied a vast region of the sub-continent at its peak [around 3100–1900BC] - approximately ½ million square miles.

Dr. David Frawley is arguably one of the most important Vedic scholars working today and he [along with others] has shown that the vast majority of early sites are on the banks of the now dried Sarasvati. In fact, this river was dry by around 1900-2000BC and had started losing its copious waters long before 3000BC which indicate clearly the early dating of the settlements along its banks.

The 'Indus Valley' culture with its towns of *Harrap*a and *Mohenjo Darro* is generally regarded as the repository of ancient Indic culture but in fact this culture sprung to prominence *only after* the Sarasvati began drying up. This loss of a great river occurred after geological upheaval had caused it to loose most of its feeding springs and streams in the Himalayan foothills to the Yamuna and Ganges and this, coupled with a change in monsoon patterns, caused the river to dry up. The latest investigations indicate it was not fed by glacial waters

from the higher mountains as some other rivers appear to be. Yet, it was massive, as the literature states and as investigations have revealed.

So in fact, the 'Indus Valley' culture is late in comparison to that of the Sarasvati region of earlier eras as David Frawley relates:

All the antecedents of Harappan civilization have been traced in the Indian subcontinent through various pre-Harappan sites back to the great village complex of Mehrgarh, which was the largest of its time c. 7000 BCE. In other words, ancient civilization in India was advanced and indigenous, comparable to anything in the Middle East at the same time.[8]

Regarding the Sarasvati, modern geological studies, including satellite data and archaeological results show that the Sarasvati, previously a watercourse in many places over 7 kilometres [4.35 miles] in width, had ceased to be a perennial river of any substance long before 3000BC. It no longer was a river that flowed '*from the mountains to the sea*' and by 2000BC was completely dry for '*40 days horse ride from the coast*'.

Further scientific evidence from the *Bhaba Atomic Research Centre* has revealed that,

'...in extreme desert conditions" the water of the Sarasvati "remains available at a depth of fifty to sixty metres", and radiocarbon measurements of some of the water samples have shown them "range from 2400 to 7400 Before Present" with "no modern recharge discernable.' [9]

As another researcher comments on this discovery,

This means that the Rig Veda describes the geography of North India long before 3000 BC. This is further supported by the fact that the Drishadvati River, also described in the Rig Veda, had itself gone dry long before 3000 BC. All this shows that the Rig Veda must have been in existence no later than 3500 BC. There is other evidence from metallurgy and astronomy that lend further support for this date.'[10]

The primary development and expansion of the SIC therefore took place on the banks of the Sarasvati. It would also appear that around 70 per cent of what is sometimes called the *Harrapan Civilisation* existed here. The Sarasvati effectively stopped flowing to the sea, even as a small stream, around 3000-3100 BC, or perhaps earlier and by 2000 – 1900BC was petering out into the desert many miles from the coast.

Before this time, the massive Sarasvati complex of rivers and tributaries was the lifeblood of the region, and the following extracts from the *Rig Veda* reveal its importance to the inhabitants therein.

Pure in her course from mountains to the ocean Sarasvati River bestows for Nahusha nutritious milk and butter. [RV. 7.95.2]

May the glorious seventh (stream) Sarasvati, the mother of the Sindh [emphasis here to show the importance of this river and the possibility that the Sindhus or Indus, itself a large river, may have been a tributary] *and other (rivers) charged with copious volume of water, flow vigorously; come together, gifting abundant food and milk.* [RV. 7.36.6]

As implied above, it has been said that there is a possible interpretation of some of the verses of the Rig Veda that indicate that the Sarasvati had seven major tributaries. In addition, it is said that the verses indicate that the Indus and her 5 tributaries Sindhu [Indus], *Sutudri* [Sutlej], *Parushni* [Ravi], *Asikni* [Chenab], *Vitasta* [Jhelum], *Vitasa* [Beas], were also the tributaries of the Sarasvati.

RV. 3.24.4 is also thought to indicate the possibility that *Drishadvati* and *Apaya* were also tributaries of the Sarasvati. It is small wonder that the Sarasvati River was revered virtually as a Goddess, one that eventually was lost, but would be remembered forever within the hymns of the *Vedas.* [In *Deluge* the occasion that marked the beginning of the reverence of the Sarasvati as a goddess is revealed.]

The sheer scale of the SIC was immense, and as a comparison, nearly $^{2}/_{3}$ of the 2500 'Harappan' settlements that have been found [more may yet be uncovered] were on the banks of rivers connected to the Sarasvati while only 100 have been found on the banks of the Indus.

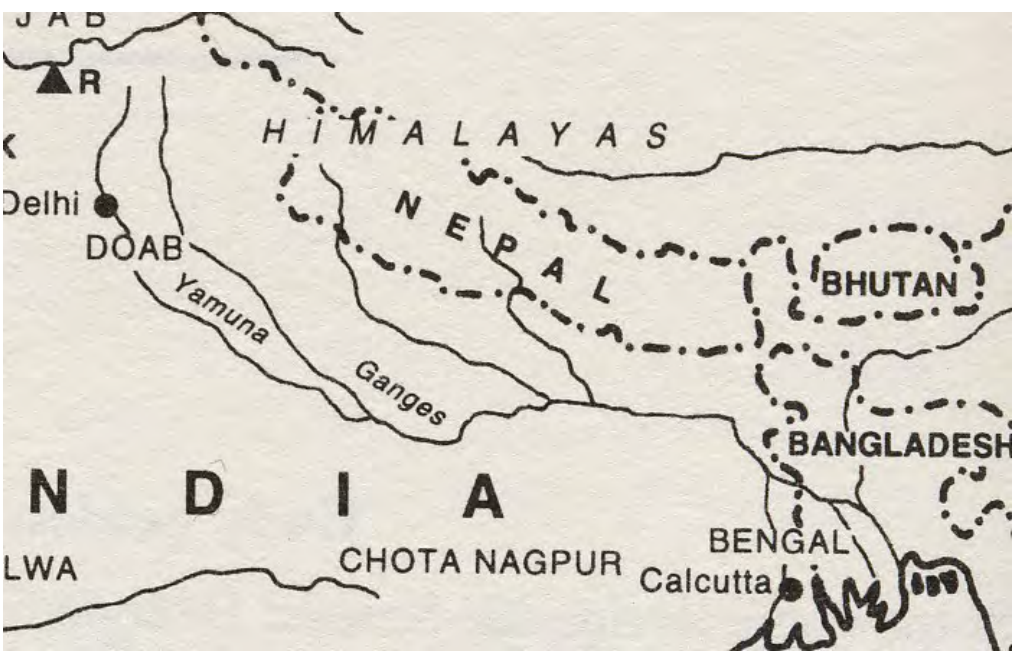


Fig. 13.2 Map indicating the Yumuna/Ganges junction (After J.Fowler)

13.3 The Dawn of Writing: A Different Perspective

Early man communicated with his neighbours easily, so why did he invent writing? The logical answer is that it was trade, which did not lend itself to the memorising of mythical stories containing information that forced the development of permanent records of both a numerical and written form. The carrying of messages in an accurate manner certainly would have contributed to the need for more reliable form of records.

'The oldest and most casual account of the invention of writing is perhaps that of the Sumerian epic Enmerkar and the Lord of Aratta… According to this version of events an emissary was sent back and forth between Uruk and Aratta [Bharata?], but because the messages were difficult to memorize, the lord of Kulaba promptly invented writing… *'In a second Sumerian poem, "Inanna and Enki", the Transfer of the Arts of Civilization from Eridu to Erech, writing is conceived as one of a hundred basic elements of civilization held by Enki, the lord of wisdom. Inanna loaded writing and the other divine decrees on the Boat of Heaven and started an eventful journey back to Uruk.'* [11]

If the 'Boat of Heaven' mentioned above followed the rise and set of the sun, moving East to West, which is a logical theory as this was an Egyptian belief, then it would have been travelling from the direction of India towards Uruk.

Given the similarity between *Aratta* and *Bharatta* the correct name for India, and the concept of a solar boat, also seen in India, the story implies the development of writing due to dialogue specifically between Sumeria and India. Little research into Indian writing systems had been achieved until recently with much work remaining to be accomplished and many still assume that writing did not develop in India until around 500 BC. However, as Professor Subhash Kak states,

'*Written characters are mentioned in the Chhandogya and the Taittiriya Upanishad, and the Aitareya Aranyaka refers to the distinction between the various consonant classes. The voluminous Vedic texts also contain hints of writing in them. For example, Rigveda 10.71.4 says: "One man has never seen Vaak, yet he sees; one man has hearing but has never heard her."… Since Vaak is personified speech, it suggests knowledge or writing.'* [A deaf man cannot hear recitation of verse and hence unless he could read would be unaware; again, a sighted man may well read passages but not understand, not gain knowledge.] … *Another verse [RV 10.62.7] mentions cows being marked by the sign of "8". The Atharvaveda [19.72] speaks of taking the Veda out of a chest [kosh], and although it may be a metaphor for knowledge coming out of a treasure house, it could equally have been meant in a literal sense.*

It is also remarkable that the "fish" sign is used as a symbol for "10" in the Indus and the Brahmi scripts [used without the gills; its such use was determined by statistical analysis], although the Brahmi "fish" for "10" is shown sideways.' [12]

At *Harappa*, 'plant-like' and 'trident-shaped' markings have been found on fragments of pottery dating back 5500 years, giving some reinforcing to the above arguments. The marks were etched onto jars both before and after firing and may have indicated the contents of the jar

or be signs associated with a deity. It has been suggested that this may be the earliest form of writing, but with the Indus language unfortunately now dead and with no *Rosetta Stone* to assist translation, the major problem remains analysis of the symbols.

Fig.13.3 Early 'writing' from Pakistan – it is estimated to be about 5500 years old

Harappa, originally a small settlement in 3500BC expanded rapidly along with *Mohenjo-Daro* [another city of the region] due to the loss of the Sarasvati and by 2600BC became the centre of the great Indus Valley civilisation with a population possibly as high as 50,000. The Brahmi script, while not of a great age, does show compliance with ideas internal to the texts, old traditions, probably dating to the composition of the Deluge story. There is also similarity between Brahmi and early Semitic scripts:

…it should be noted that Indic kingdoms, in which Sanskrit names were used, were prominent in West Asia in the second millennium BC… Just as in the Vedic system, the Ugaritics, a people closely related to the Phoenicians and the Hebrews, have 33[000?] gods. More importantly, Yahvah, the name of the God in the Judaic tradition, occurs as an epithet for Agni in the Rigveda a total of 21 times [yahva in RV 10.110; yahvah in RV 3.1, 3.5, 4.5, 4.7, 4.58, 5.1, 7.6, 7.8, 9.75, 10.11; yahvam in RV 1.36; 3.3; 4.5; 5.16 8.13; 10.92; yahvasya in RV 3.2 and 3.28]. Indus ideas on writing may thus have, through the agency of the powerful Mitanni kingdom of Syria, been influential in the various Semitic traditions of the second and first millennia BC. [13]

Here we should remember that the Rig Veda dates to before 3500 BC.

It is also notable that a series of articles by three academic authors in the Sunday Times of June 16th 1996 indicated that inscriptions on pottery found in various sites from the Mediterranean to the North of Scotland have a similarity of geometrical markings, as if a common use of symbols was in place during the Bronze Age. However, this all seems to have been displaced with the rise of the Roman Empire. There are some similarities to be seen in this early pictographic 'writing' to some of the pictograms of early India.

13.3:1A Common ancient Old World Cosmology

It emerges throughout the companion work to this book, *Deluge*, that there is a widespread cosmological story in antiquity that was well known in many regions.

There can be no doubt that this was greatly enhanced in the second millennium BC by the use of writing. In addition, the 'Great Flood' tale, given the spread of Indic lingual and religious concepts, appears to have emanated from the region of Bharat. Nonetheless, while some details of the story have possibly been misunderstood in various places and interjections have changed other peripheral elements of the narrative, the implication is that it is the same underlying event that is portrayed. Some later chroniclers either wrote in allegory to disguise the material still further, or misunderstood their sources. In the case of most modern historians of antiquity [with some notable exceptions, as seen in this chapter], there seems to be a lack of understanding of the concepts involved here. This is possibly due to a lack of acceptance of the abilities of the peoples of over 5000 years ago and the inability to project their thinking beyond the mindset of today.

One important route for the transference of this Indic cultural influence into the Eastern Mediterranean region may not have been via what might be thought to be the most likely route – overland trade with Mesopotamia as suggested in the Sumerian mythology. Here we look at a different route to the Middle East from India by which the transference of information and culture may well have occurred.

13.4 The Phoenicians: The Cultural Bridge?

It is seen throughout later chapters of *Deluge* that the flood mythology of the Middle East seems to be predated by that of India. The logical route for this cultural transmission would be appear to be via the cultures of ancient Mesopotamia. In Chapter 12 of this work, the mathematical and structural achievements of cultures such as the Sumerians and their possible contacts with adjoining cultures were examined. Suffice it to say, as suggested in the last chapter, that it is by no means clear than any transference of what we would define today as technical information came to ancient Egypt via Mesopotamia [although there was some contact in pre-Dynastic times].[14] Given the doubts relating to both instances of possible cultural transference it seems prudent to ask if there was any other route of contact between the Indian sub-continent, Egypt and the Mediterranean region. In the search for a plausible answer to that question we first return to the Jerusalem of the early 1st millennium BC.

In the Biblical story of the building of Solomon's Temple, the leading character, apart from Solomon, is one who has become known as *Hiram Abiff*. In part, the familiarity of the name can be ascribed to Masonic tradition, because this character plays a leading role in the Masonic story. However, in the Bible we read that Solomon sent a plea to Hiram King of Tyre for timber. Hiram was very willing to assist and also sent a man skilled in metalwork, masonry, engraving cloth and colouring; a true master of all necessary skills. This man was also named *Hiram*, or as the Book of Chronicles spells it Huram and was a son of a woman of Dan.

Solomon's Temple was designed around a pattern utilised by Canaanites, or as they later became known, the *Phoenicians*. There are numerous connotations to this Hiram element of the story into which we shall not immerse ourselves here but the point is that the people with whom Solomon was dealing were the Phoenicians.

The Phoenicians are renowned for their shipbuilding and sailing abilities yet other regions around the same coasts *did not develop* the same skills. This situation appears a little odd as all were daily faced with the same sort of terrain, the same everyday problems and yet it was this group that shone in the skills of sailing and all that related to boat building. If they developed their skills locally then surely some of their neighbours, as all faced the same living conditions, would likewise have evolved similar skills.

It would appear that there is a different source for this shipbuilding / sailing affinity among the Phoenicians. One answer is that the Phoenicians learnt from others, but if this was the case, then who were their tutors and how and why were they in contact, while their neighbours were not? These questions do have an answer, an answer that relates to the design of Solomon's Temple, a design that was from the brain of a Master Mason, in fact a master of many skills. The character we know as Hiram Abiff or 'father' Hiram, denoting his seniority and the origination of the name.

Many researchers state that the Phoenicians initially arrived in the Eastern Mediterranean sometime about 3,000BC, gradually assimilating local customs and traditions, blending in and living alongside the people who would later become known as the *Canaanites*.

It is the source of the Phoenicians that is interesting, because while modern scholars generally state that nothing is known of their original homeland, some studies have indicated that they may have arrived in the so-called *Fertile Crescent* from the Indian sub-continent *long before* 3000 B.C. [15] This region, the Fertile Crescent, is described as roughly an arc-shaped area. It commences at the mouth of the Tigris and Euphrates rivers at the Persian Gulf, and then stretches to the Red Sea.

The people of the region have been classified as Semitic and although this includes the Sumerians, according to recent genetic investigations this particular group were not related to the Semitic race although the earlier, apparently indigenous Ubaidian peoples of the region probably were Semitic.[16] It is this association with the earlier population via land occupation that probably created the impression that the Sumerians were a Semitic people. Ideas are changing though, and in support of the theory of long distance movement of peoples in the equally distant past, it is now known that the Sumerian language contained elements of Dravidian and that genetically the Sumerians were linked to *Southern Malaysia* as also, recent genetic studies reveal, were the Polynesians.

The Semites who lived in the eastern portion of the Fertile Crescent were therefore not inclusive of the Sumerians, leaving just the Assyrians and the later emerging Babylonians.

The eastern region of this area was home to the Amorites, a people who settled in what we today term Lebanon, Syria, and Israel. A generic term of *Canaanite* was applied to these people, a name that the later Greeks changed to Phoenician. The name Canaanite was derived from a very similar word beginning with a K that the Phoenicians called themselves and which meant *trader*.

Phoenician is a Greek term meaning purple, the colour being derived as a dye from the *murex snail*, a shell-fish found in the waters off of Tyre and Sidon and favoured by the Canaanites as colouring on the cloth they manufactured.

As far as back as 3200BC, the people of Gebeil [Byblos] were felling cedar trees in the mountains of Lebanon, to be shipped to Egypt and Mesopotamia. In return, the Phoenicians or Canaanites brought back gold, copper, and turquoise from the Nile Valley and Sinai. Canaanite ceramic pieces have been found in Egyptian tombs dating back to 3000BC. The famous 'solar boat' of Khufu at the Great Pyramid was built with cedar from Lebanon.

Important to this discussion is the Persian tradition noted by Donnelly which relates that the Phoenicians originally migrated from the shores of the *Erythraean Sea*.[17] Ancient Persia was decidedly Indic in religious orientation and while being many miles from the ocean, the seers of the country would have had knowledge of which group of people had arrived from where.

While the notion of the Phoenicians originating from the shores of the Erythraean Sea [as depicted in Figure 8.6], may be an ancient Persian tradition, it seems that it has much in its favour. As described in the *Periplus*, a description of regions and ports by a first century trader, it spanned the region from Egypt to beyond the Ganges [echoes of Eden as described by Josephus] and hence the notion of these people being emigrants from the region appears highly probable.

They were proficient shipbuilders and sailors and they arrived in the region of the Fertile Crescent with these skills and abilities fully developed. We would hazard an educated guess that these people traded between India and Mesopotamia. The Sumerians, who arrived in the south of Mesopotamia probably shortly before 3000BC are not known specifically for their seafaring abilities, and yet from the early days material from India appears to have been in their possession. The same can be said of Egypt.

Hence it would appear likely that the Phoenician's original territory was somewhere *between* the Red Sea and India, or effectively South Pakistan as seen today. This being the case, it would be expected for them to have an affinity to Indic culture and customs.

Indic influence covered a vast area, a region that had extended culturally by the time of the building of Solomon's Temple, [see *Deluge* for further detail] although later the trading nature of India had tailed off due to geological and climatic problems.

This influence caused many from the region to move westward, extending the religious and cultural influences of ancient India. As the flood story had its originations with India it can therefore be understood why there is such a powerful influence of Noah [Manu] at this temple. [It is by means of numerical metaphor as seen in this work and allegory that the truth behind the flood story has been hidden and hence an understanding of the measurement system and its origins is an essential pre-requisite to an understanding of the Deluge tale.]

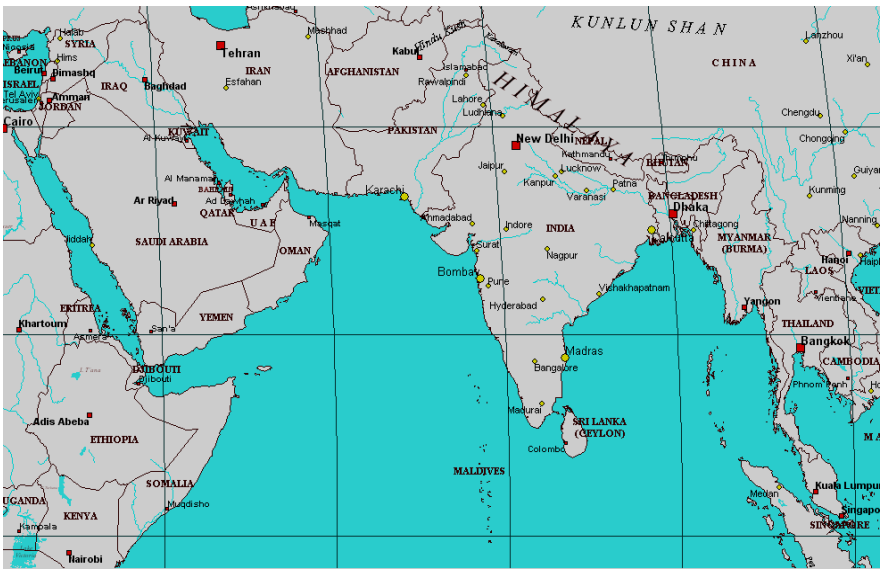


Fig. 13.4 The Area of the Erythraean Sea (as described in the Periplus) Notable is the fact that Josephus describes Eden as stretching 'from the Nile to the Ganges' or effectively from Cairo to Calcutta.

As stated throughout our companion work *Deluge*, the Indian Noah is *Manu*, and each creation and flood had a different Manu while only one is recorded in the Bible, although as seen in *Deluge* there is sufficient reference to a cyclic situation to call this into doubt. Reprising the Srimad Bhagavatum 1:3:28:

All the powerful sages, the godly, the Manus and their progeny, as well as the Prajâpatis [founding fathers] are aspects of the Lord.

From this verse, it can be seen that the Lord can be referred to as Manu and the Earth is in the care of the Lord. As revealed in *Deluge* at Solomon's Temple there is also a depiction of the Earth contained within the Ark of Noah [or Manu] - the Oblation to the Lord. It indicates that Noah, as noted in the earlier text, was more than a flood survivor who was to repopulate Earth.

In Ezekiel's description of the Temple, the Temple designed by a Phoenician who undoubtedly would have Indian elements in his religious background, Noah was described, via the dimensions of the oblation, as the Lord.

The verse from the Indian Srimad Bhagavatum seen above confirms that Ezekiel's approach was correct, that Hiram had allocated his dimensions correctly and that indeed Noah or Manu is regarded as an *aspect of the Lord*. This confirms the Indian relationship to the Old Testament writings, to Solomon's Temple and to the flood story in particular. It implies that

the factor attributed to Noah in the Bible, *1056*, should occur in Indian evaluations. Although not immediately apparent, this is the case, as revealed in *Deluge*.

13.5 The Antiquity of the Zodiac

An example of Indian astronomy and a hint of a calendrical use is seen early in the Rig Veda 1.164.11, [now dated to 3500BC or earlier] where reference to the 720-paired sons of the wheel of time, which has twelve spokes is a clear reference to the zodiac [*Authors Note*: The translation of the *Rig Veda* used throughout *Deluge* and *Measurements of the Gods* is the Ralph T. H. Griffiths version]:

Formed with twelve spokes, by length of time, unweakened, rolls round the heaven this wheel of during Order. Herein established, joined in Pairs together, seven hundred Sons and twenty stand, O Agni.

Here is seen the 720 *days and nights* of the 360-day 'civil year' or 'lunar-solar' year plus the twelve divisions of the zodiac. In addition, in Rig Veda 1.164.48 we are explicitly told of the 360 parts of the wheel of time:

Therein are set together spokes three hundred and sixty, which in nowise can be loosened.

Taking this division of the skies a little further, one can also find reference to quadrants of ninety degrees [or days] as seen in Rig Veda 1.155.6:

He like a rounded wheel, hath in swift motion set his ninety racing steeds together with the four.

Such metaphorical descriptions occur elsewhere in [slightly later] Indian literature of the age, but the above extracts are from an early part of the Rig Veda. In a total contradiction to conventional learning it is abundantly clear that the division of the year into 360 parts, with a further division to 4 equal astronomical sections of 90 days was known long before the rise of Babylonia, and long before dynastic Egypt. This implies not only time but geometry and degrees, and to make the necessary calculations, the existence of maths from an even earlier period, a time very greatly predating any era when mathematics in any form was supposed to have been discovered and have been used by humans in such a manner. Yet there are numerous references to wheels in Indian lore and what is a wheel if not geometrical? It will also become clear that these constructs were not only applied to the duration of the year but even at this early time, long before dynastic Egypt, were also utilised in conjunction with precession. This long term time count of 25920 years was understood at least at 3500BC [and as we shall reveal, far earlier] and as this is the case, the zodiac was also a part of common understanding.

Given the new view of the age of the Rig Veda and other ancient Indic texts, [and not forgetting that these were drawn from very much older material], it is clear that astronomy in India is indeed a very ancient practice predating the texts themselves, as there had to be a learning curve, which is not apparent in the narratives. This also obviates the long held idea by scholars that sexagesimal maths [based around counts of 60's] developed around 3000BC in Sumeria, this date is in the region of, at the very least, 6000 years out as shall be explained.

By careful reading of the Rig Veda it is found that the months are set out in a format that complies with the modern Western zodiac. Some indications of the similarities are found in the verses shown in Table 8.1, which was compiled by Professor Subhash Kak of the Louisiana State University in the USA, who amongst his many interests is that of a scholar in ancient Indic astronomy. The simplest to identify are The Bull, The Archer, The Ram [Indra] which correspond to modern Western zodiac entities. Here then is evidence of the familiar zodiac dating back to the time of the Rig Veda in ancient India, which according to Kazanas, dates to before 3500BC. Conventional learning would have this being developed in Babylonia and copied by the Greeks. What evidence is there that the Indians also understood the 25920-year cycle of precession?

Table 13.1 The Ancient Indic Zodiac (After Subhash Kak)

Vaisakha	= Taurus	= Bull or Cow	R.V. 8.33.10
Jyaistha	= Gemini	= Twins	
Asadha	= Cancer	= Crab	R.V. 1.155.6
Sravana	= Leo	= Lion	R.V. 4.16.14
Bhadrapada	= Virgo	= Virgin	R.V. 5.3.2
Asvini	= Libra	= Balance = Scales	R.V.2.39
Kartika	= Scorpio	= Scorpion	
Margasira	= Sagittarius	= Archer	R.V. 2.33.10
Pausa	= Capricorn	= Goat	
Magha	= Aquarius	= Water Bearer	
Phalguna	= Pisces	= Fish	R.V. 10:68
Caitra	= Aires	= Ram	R.V. 1.51.1

It could be argued that the knowledge of the zodiac above only applied to the year and is not evidence of any awareness of the slow, backward, a degree in 72 years or Sun diameter in 36 years west to east movement of the precessional cycle. We can demonstrate otherwise.

The Egyptians looked for the heliacal rising of Sirius to warn of the imminent annual Nile flood. As a star such as Sirius slips backward due to precession, it becomes less visible against the light from the morning Sun until, eventually, it cannot be seen in that position. Many different stars have been used in such a fashion for different reasons, some as a heliacal rising and some against a backdrop of the horizon. In 72 years the star will move Eastwards a single degree but in just 36 years the half a degree difference can be seen as the visual diameter of the moon and hence the change would have been easily noticed over a lifetime.

Knowledge of such stellar movement was very important and any such deviation would have been noted. This continued for generation after generation and the knowledge of the ancestors was added to as it was handed down. Hence, the loss of a star would have been well known. It would not have taken long to understand the time elements involved. To quote the so-called father of archaeoastronomy, Sir Norman Lockyer: *'The telescope of early times was the line of the horizon.'*

While Hipparchus is credited with discovering precession in 127BC, precessional movement was known long before his time. There is a verse in the *Srimad Bhagavatum* [5:22:1] regarding precession:

'King Parīksit inquired from Śukadeva Gosvāmī: My dear lord, you have already affirmed the truth that the supremely powerful sun-god travels around Dhruvaloka with both Dhruvaloka and Mount Sumeru on his right. Yet at the same time the sun-god faces the signs of the zodiac and keeps Sumeru and Dhruvaloka on his left. How can we reasonably accept that the sun-god proceeds with Sumeru and Dhruvaloka on both his left and right simultaneously?' [18]

The terms *Dhruvaloka* and *Mount Sumeru* [or more usually Mount Meru], mean respectively the Northern Pole Star and the mythical heavenly, or 'World Mountain.' The latter is thought to be the mountain to the north, which is directly beneath this heavenly point.

The Srimad Bhagavatam is admittedly a later *Puranic* text, but this literature makes great play of the wisdom of the Vedas and other early verses and does not claim any discoveries by its authors. In any case, as the reference is to the Pole Star, it had to have been composed when there was such a star, ie, 1600-2600AD which encompasses the present era - clearly this is not applicable, the work is from a much earlier period, or 2300-3300BC when Thuban in Draconis was the Pole Star, which is a far greater possibility, or 8100-7100BC with Tau Hercules in the constellation Hercules as the accepted pivot of the heavens and which in fact is graphically represented in the Mahabharata. [Again, here we refer readers to *Deluge* for details.] Hence this text is a replication of an earlier narrative or a folk memory-because at the time of its academically supposed composition *there was no Pole Star.*

In the quotation above, the question relates to the Sun apparently going in two directions simultaneously. Yet this is what visually happens with the constellations slipping backward due to precession. In the short period of a year the Sun is visually travelling forward through the zodiac with the direction north on its right but precessionally, over the lengthy period of 25,920 years, it is seen to move a full circle in the opposite direction, with north on its left, hence over the period of 72 years, the Sun will have moved backward by a day or one degree in precessional terms. In the ensuing verses of the Srimad Bhagavatum, the seer explains this to the said King Parīksit.

13.6 Some Key Aspects of Ancient Indic Astronomy

Subhash Kak reminds us that:

'The idea that India did not have a tradition of observational astronomy was refuted convincingly by Roger Billard more than thirty years ago. In his book on Indian astronomy, he showed that the parameters used in the various siddhantas actually belonged to the period at which they were created giving lie to the notion that they were based on some old tables transmitted from Mesopotamia or Greece.' [18]

In a 1980 paper, which was titled *Two Treatises on Indian Astronomy*, B.L. van der Waerden examined the views of David Pingree and Billard. He ruled thus:

'Billard's methods are sound, and his results shed new light on the chronology of Indian astronomical treatises and the accuracy of the underlying observations. We have also seen that Pingree's chronology is wrong in several cases. In one case, his error amounts to 500 years… [20]

The Indian literature mentions a number of celestial events between approximately 4000 – 2000BC and some scholars have suggested even earlier events are also recorded. It additionally appears that the Indian astronomers may have pre-empted the notion of a sun-centered solar system as seen in *Aitreya Brahmana* 2:7:

'The sun never really sets or rises. In that they think of him –He is setting, "having reached the end of the day, he inverts himself; thus he makes evening below, day above. Again in that they think of him-He is rising in the morning" having reached the end of the night he inverts himself; thus he makes day below, night above. He never sets; indeed he never sets.'

As Kak comments on this text:

'One way to visualize it is to see the universe as the hollow of a sphere so that the inversion of the sun now shines the light on the world above ours. But this is impossible since the sun does move across the sky and if the sun doesn't set or rise it doesn't move either. Clearly the idea of inversion denotes nothing but a movement of the Earth. [21]

As asserted above, several in-depth studies of these ancient texts have made it clear that observational astronomy was practiced in India long before they were in Classical Greece, Babylon or Egypt. Kak additionally states that it is noticeable that the development was in *stages*, visible in the different layers of Vedic texts, the Brahmanas and Vedanga Jvotisa. Kak further comments:

'The Mithuna rashi/Gemini is said to destroy darkness and to be basis [budhna] of heat [tapas] (RV 3:39:3). During Gemini's heliacal rising in 4000 BC, the sun was in Cancer,

then coinciding with our month of May, in northern India the first month of summer (May-June), a season of drought and extreme heat. During Leo's heliacal rising, around summer solstice in 4000 BC, the rainy season began. Therefore, verse 5:83:3 says: "Like the charioteer driving the horse by the whip, he releases the messengers of shower. From afar the roars of the simha declare that the rain-god is making the sky showering." It could not be clearer'.[22]

This is also confirmation of the zodiacal picture seen earlier. A further comment from other scholars in this field notes that the dating of Indian astronomical knowledge is being pushed back further and further in time:

'The analysis of astronomical references in the Taiteriya Brahmana [3-1-15], where Brushaspati [Jupiter] crossed the Pushya constellation, gives a date of 4650 B.C. The Taiteriya Brahmana points to dates to the order of 6000 B.C.' [23]

Note: Pushya was the seventh naksatra of the zodiac [see Fig 13.5]. The configuration was changed from 27 to 28 naksatars before 3000BC and probably at around 3076BC.

Naksakras

In ancient Indian astronomy, the circle of the Moon's orbit was divided into 27 units known as *naksatras* [approximate days], which results in 13.33333 degrees per naksatra. These naksatras were themselves further divided in the same fashion into 27 *upanaksatras.* Hence, there are now 27 x 27 [729] units divided into the circle of the lunar orbit of 360 degrees. This results in 0.49382716 of a degree or 29.62962963 minutes of arc of the lunar orbit.

Visually this is the diameter of the Moon [or the Sun] - half a degree or 30 minutes of arc approximately and thus appears to be the astronomical unit in use, which was then probably further subdivided via some sighting device to give finer divisions. [However, it should be noted that we do not have any archaeological evidence for such instrumentation] Here, the Moon physically represents the month in that the value of 30 civil days equates with the 30 arc minutes of its diameter. Indeed, in ancient India we see a counterpart to this concept - a day was also divided into both 30 units or *muhurtas* and 60 units or *nadis.* Hence, if these divisions were applied to the apparent lunar diameter, the astronomers of the day could have been working in units of 1 minute of arc.

The month was additionally seen as both 27 and 28 days.

The 27-day month was the *sidereal month* [actually 27.3217 days] where the same location among the fixed stars is the beginning and end point of the observed orbit.

28 days is a mean lunar month, [more accurately 28.425 days but anciently utilised as 28 days] which relates to the sidereal value and the *synodic month* of 29.53 days. This synodic month was divided into the 27 naksatras hence the naksatras do not represent the 27 day month but are locations in the sky, various stars that divide the *synodic* month into 27 units. The moon will reappear at the same place a *synodic* year [354 days] later than the initial observation. Occasionally in some branches of Indian astrology a 28th naksatra is added but that has no place here. The 30-day [30 *tithis*] month was associated with the 360-day year. Each of the

naksatras had a name, as did each of the 12 divisions of the zodiac hence the naksatras cover the 360 degrees of lunar orbit…in the synodioc period. Each naksatra is 360/27 = 13.3333 degrees in arc across the sky.

In Figure 13.5 the Naksatras are seen in the 27 per month format with corresponding deities' names. The western zodiac names have been added for clarity here. Also shown are the lunar segmental titles and the names applied to the divisions of the Solar Year. Some of the naksatras are actually *asterisms* [groups of stars that are parts of constellations] that lie near to the plane of the ecliptic, and in Subhash Kak's *Babylonian and Indian Astronomy: Early Connections* he explains in more depth than Figure 8.6 what they are now thought to represent.[24] The naksatras have two divisions, those that revolve from the north and those that revolve from the south. The *devas* are said to have their abode at the North Pole and *yamas* at the South Pole. They each revolve from opposite directions, hence the deva naksatras revolve south of the North Pole and the yama naksatras revolve north of the South Pole indicating seasonal changes.

David Frawley claims that the naksatra commencement was in the region of 6500BC which counters Kak's third millennium or earlier or earlier.

There is much more relating to Indian calendars in the book *Deluge: From Genesis to Atlantis.*

As is seen in Fig 13.6 we have the new moon actually *in* the Pleiades or Krittikas at seven days prior to the vernal equinox at 3256 BC. However this is in the spring and the sequence is meant to start with the northerly movement of the sun and that takes us back very close to Frawleys approximation. This is detailed in *Deluge.*

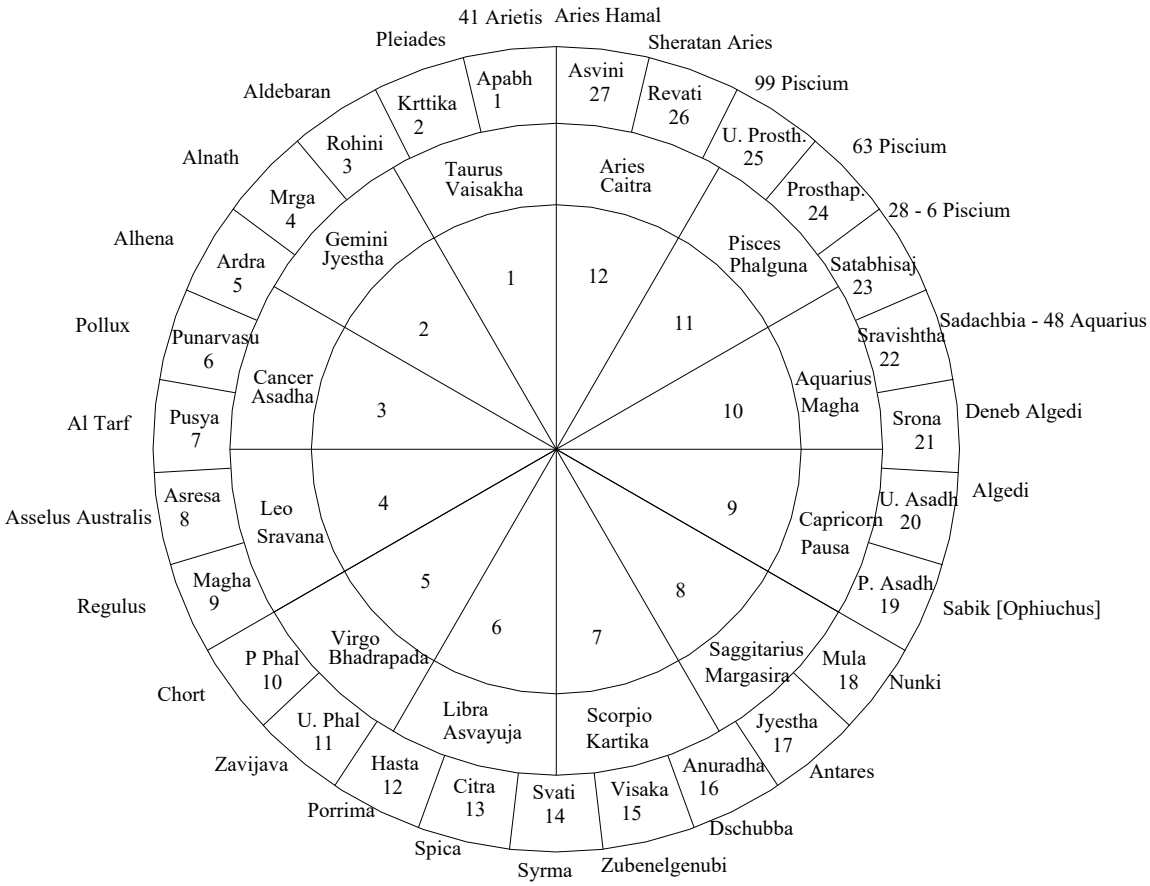


Fig. 13.5 The construction of the Naksatras and their positions [after Prof. Subhash Kak]30 degrees covers approximately 2.25 naksatras. Here we see the relationship of the Naksatras to the lunar months. Additional info from Dr. S. Balakrishna [NASA].

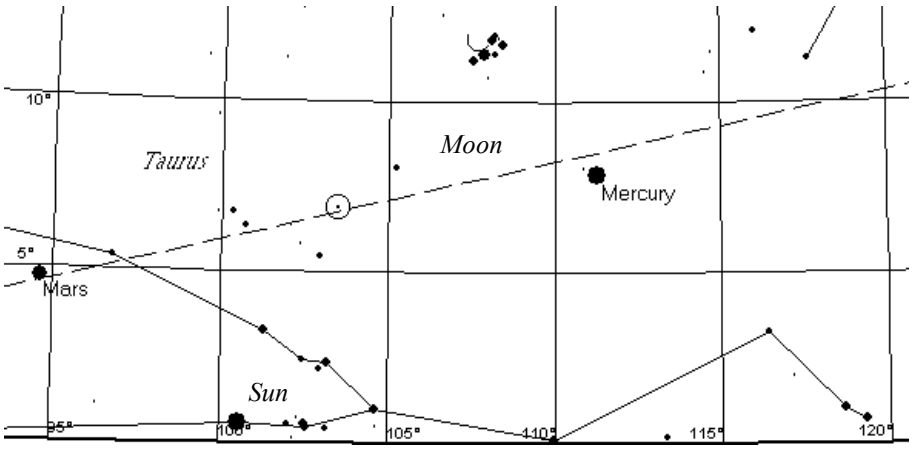


Fig. 13.6 The New Moon in the Pleiades (Krttikas) with Sunrise in Taurus 7 days before the spring equinox in 3256BC.

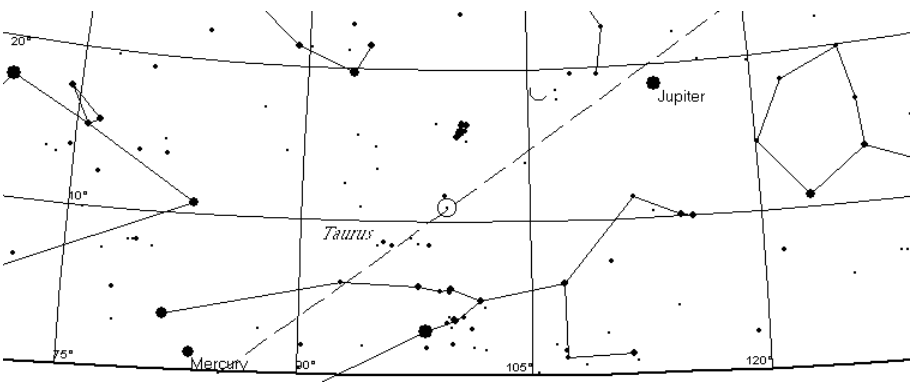


Fig. 13.7 Demonstrating the 95 year cycle of 5 times the Metonic cyle, here we see the New Moon adjacent to Pleiades [Krttikas] with the Sunrise in Taurus 7 days before the spring equinox in 3161BC. This is 95 years after that shown in Figure. 13.6 and hence is a correct conjunction of Sun and Moon.

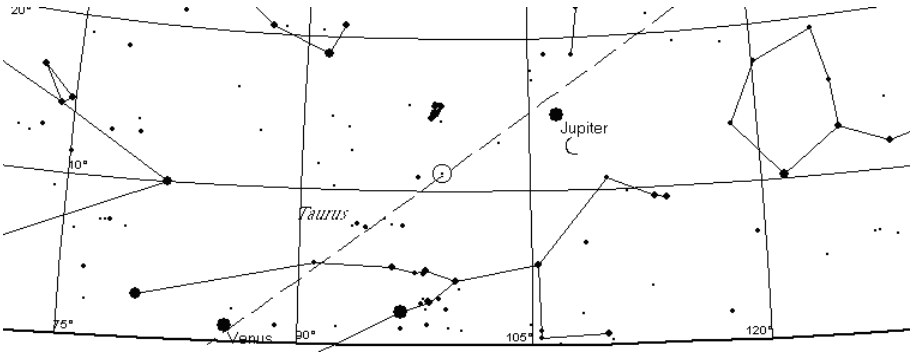


Fig. 13.8 [For comparison with Figure 13.6] For an extensive period this loose sun / moon conjunction was repeated every 95 years and here we see the sky over India at the same time of year in 2971BC, three of these 95 year cycles after the date of 3256BC when a perfect Pleiades/Moon conjunction occurred.

The naksatras here can be seen to work as indicated in the diagram from Kak in that in Aries there is a 'no moon', in Pleiades there is a new moon and things follow henceforth for the remainder of the month…but long prior to the 3256 date seen above.

Another useful point is that the day was seen to commence in the evening and not at midnight. This effects the new moon first visibility dating and the astronomy programs give the precise date for new moon so allowing for positioming we need allow a usual two days after the moon is new for a first sighting

In the book of Enoch there is reference to a calendar that divides the day into 18 parts and which has its lunar start in winter and solar commencement with the vernal equinox.

It is also a handy rule of thumb in these astronomical investigations to remember that for every 1000 years back in time one has to move the day of the equinox forwards about seven days. This is an approximation and the value is fractionally less than seven days. [With the change in calendar in Europe from old Julian to Gregorian this gets confusing as ten days were 'lost' in the process of changeover, but it works for these early calculations.]

Taurus took over from Gemini as the constellation of eth vernal equinox at around 4500BC and continued until the onset of Aries in approximately 1900BC. This makes the culmination of Taurus and hence the Pleiades at around 3200BC, a date that, as has been seen, fits with the verses regarding '*the Pleiades continually rising in the east*'.

There is an alteration from 27 naksatras to 28 which is to be found, Kak informs us, in *Maitrayani*, *Kathaka Samphitas* and in the *Atharvaveda*.[25] The 27 appears to have been the main player throughout the ages however with the 28 divisions being applied, as indicated above to some forms of astrology.

Returning to the 30 tithis [or days of the civil or lunar / solar month] in a month, a tithi [also spelled *thithi*] was the the time taken for the longitudinal angle between the Moon and the Sun to increase by 12 degrees. Tithis begin at varying times of day and vary in duration from

approximately 19 to approximately 26 hours. The average was 22.5 hours, a value seen to be associated with the symbolic 2.25 naksataras/12 month relationship seen in Figure 8.6.

It is evident from this arrangement that intimate knowledge of the lunar movement had been gained by the time that the Vedas were composed. The deities' titles are seen in Rig Veda 5.51, therefore dating this knowledge to earlier than 3100BC, and almost certainly to before 3500BC which again seems to back up Kazanas's views.

There is further evidence of the great antiquity of Indic astronomy that relates to a very ancient calendar indeed – the so-called *Saptarsi Calendar***.** Whilst this is very early it is still in use in several parts of India today. According to Kazanas, the term *Saptarsi* means 'Seven Seers' which refers to the seven *Rsis* [or Rishis]. This is of course the constellation of the *Great Bear* or *Ursa Major*, which was important to many ancient cultures. The term Saptarsi is interesting in that it reminds us of the term in the *Chambers Dictionary* 'Septen'trional' in Archaic Latin, which means 'Northern'. Similarly, *Septentrio'nes* referred to the seven stars of the Great Bear or the 'plough oxen'.

What is surprising about the Saptarsi calendar is that according to the Classical Greek historians Pliny and Arrian, during the time of the *Mauryas* the Indians remembered more than 150 generations of Kings spanning over 6,000 years. This *Puranic King List*, as it is known, commenced in 6676BC. However, what is important here is that according to the Greek historians *this was also the start date of the Saptarsi calendar*. It therefore appears to be the earliest calendar *currently recognised as such anywhere*, it is derived from ancient India and as seen in *Deluge*, it also has connections with the flood epic and lunar and metrological configurations. However, the Greek interpretation gives a date 111 years earlier than the Indian and this commerorates the birth of Dionysus. In fact both dates can be seen to commemorate the start of the Age of Gemini.[See Deluge Chapter 8]

The Saptarsi calendar had a cycle of 2,700 years, probably following the naksatra monthly division of 27 days. Its current beginning is taken to be 3076BC when its format was altered to one of 3,600 years as against the earlier 2,700 years. [Here we see a similar alteration as that noted in conjunction with the Naksatras…and the change occurred at about the same time.] Kak notes that there is reference to this calendar construct in the *Satapatha Brahmana* where there is a story of the Seven Sages [the Rsis or seven stars of Ursa Major] and the Krttikas.

The tale is later elaborated in the Puranic literature where it is stated that the Rsis stay 100 years in each Naksatra. As there are 27 Naksatras [giving 2700 years in total] this can only be a reference to the Saptarsi count.[26] In fact this appears to be a mathematical construct as seen in *Deluge*.

Calculations and constructions with astronomy programs tell us that the Saptarsi calendar commenced life at the spring equinox of 6676BC, a year that marked the beginning of the *Age of Gemini*. [Again, more detail is seen in *Deluge*.]

There is one other consideration to take into account in association with this calendar and that is derived from ancient Egypt, where another intriguing piece of evidence links to the above dating. In the preface to her translation of Jean Richer's *Sacred Geography of the Ancient Greeks*, Christine Rhone states that:

In Egyptian astronomical tradition, there was a type of calendar where the beginning of the year was related to the helical rising of Spica.[27]

6676BC is a date that fits the described Egyptian calendrical event extremely well if the Egyptian year is seen to commence at midsummer when Spica would have risen above the horizon 35 minutes before the Sun. This astronomical vision would not have been available for long however, and at the time of the onset of the first dynasty of Egypt, the Sun was rising around three hours before Spica. Hence the *Egyptians may have inherited an Indian tradition,* because plainly, by the time of dynastic Egypt this calendar implication had long ceased to have any meaningful correlation.

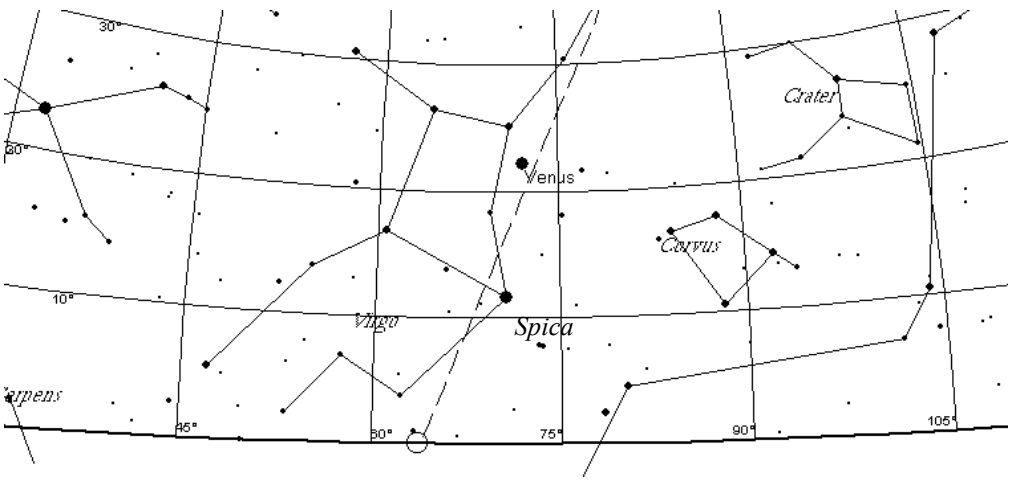


Fig. 13.9 Heliacal rising of Spica in the Midsummer of 6676 BC

If we note once more the attribution to Indian king lists dating to 6676BC then it is also obvious that this heliacal rising did not feature very highly in Indian importance, having been noticeable from as early as 8200 BC when Spica rose some 80 minutes before the Sun. In fact, by 5600BC, Spica and the Sun were rising in conjunction at midsummer and hence Spica would have been invisible at that time.

The mean of these two dates is 6900BC when the difference in rising times was 45 minutes. This time difference does not have to be precise and was in any case getting less year by year. This leads us to the conclusion that this Spica-orientated observation is derived either from the Saptarsi calendar commencement year, or from another calendar commencement year of 6681BC that is detailed in *Deluge*.

There can be no doubt that early India far surpassed other regions of the era in technical ability. Due to the factors of connectivity and restraints of space, much of the evidence is found not in this volume but in the companion work *Deluge*. A combination of the two volumes results in a collection of powerful evidence that indicates a revision of historical

thinking is long overdue. Indeed the information in these wprks leads to the conclusion that a former educated group kick started India into its developments at circa 7000BC. These more advance folk would have had their origins in Sundaland or South Malaysia…they were flooded out of their homes and went on the move to more stable regions.

Before we leave this brief examination of ancient astronomy we would like to give another, more indirect indication of long observations of the heavens. The star Arcturus was one of the few stars-including Sirius and Procyon-whose positions shifted enough since ancient times to enable Edmond Halley, in 1718, to discover the proper motions of stars moving through space. Arcturus appears to move toward the constellation Virgo by about one degree [which is about twice the apparent width of the Full Moon] in 1500 years. Some suspect, however, that Halley was not the first to notice this phenomenon. In Job 38:32 is this intriguing statement:

‘ . . . or canst thou guide Arcturus with his sons?’

Could this refer not to the star's nightly travels across the sky because the same comment could be made about any visible star, but to its proper motion, which during the millennia spanning ancient times was certainly great enough for careful observers to notice? Here we find that Arcturus has been very specifically singled out. We may never know for sure, but there can be little doubt that records of the day would indicate the observable movement. The star had been tracked.

CHAPTER 14

Genetics, Linguistics and the Sarasvati

People store genes in their gonads and pass them to their children through their genitals; they store grammars in their brains and pass them to their children through their mouths. Gonads and brains are attached to each other in bodies, so when bodies move, genes and grammars move together. That is the only reason that geneticists find any connection between the two. We know that the connection is easily severed, thanks to genetic experiments called immigration and conquest, in which children get their grammars from the brains of people other than their parents.
[Steven Pinker1994. *The Language Instinct*. William Morrow. P258]

14.1 The Travellers

The latter pages of Chapter 12 included a review of development in ancient Sumeria, and it was stressed that the Sumerians were not native to the region. What can archaeology tell us about their migration route? The map in Figure 14 seems to show that the Sumerians travelled westwards from the East. It seems logical then that it is in that direction where we must look next for the source of Sumerian knowledge – to the ancient cultures in the Indian sub-continent.

Again, in this chapter we focus on what archaeology can tell us about this region in antiquity. We also introduce genetic and linguistic considerations into this examination and as this is a work whose focus is metrology, look what ancient measurement values found here can tell us.

14.2 The Harappan Culture

From an archaeological standpoint, the culture in this region began its expansion and development at about 6500-7000BC or perhaps even earlier.[1] This development, initially in the region of the town of *Merhgarh*, spread over the whole of the area of the Indus [correct name being Sindhus but we shall adhere to the more familiar Indus] and Sarasvati's catchments areas, with the entire region eventually, by the peak of the expansion around 2600 BC, covering close to ½ million square miles. David Frawley enlarges on the above statement below:

'The history of the subcontinent of India begins with the mysterious Harappan culture, which was certainly one of the great wonders of the ancient world. Harappan culture, as revealed by hundreds of archaeological sites, was the largest and most sophisticated urban civilization of the world at its time, the third millennium BCE (c. 3100 -1900 BCE). It occupied a vast geographical region from the Amu Darya River in Afghanistan in the northwest across *the Ganga in the east. In the southwest it stretched to the coast of Iran and down nearly as far*

as Mumbai, with important coastal sites in Gujarat and Kachchh. It contained not only the two large cities of Mohenjo-Daro and Harappa but nearly a dozen comparable large urban sites. While Harappa and Mohenjo-Daro are about 100 hectares in size, Lakhmirwala and Rakhigarhi are about 225 hectares, Gurnikalan is about 145, Hasanpur is about 100 and Ganweriwala is about 80. All these sites are in the Sarasvati heartland with Rakhigari in the Kurukshetra region itself, northwest of Delhi.

Harappa and Mohenjo-Daro are certainly not the largest, though they remain better excavated because of the longer period of work on them. Yet, still textbooks talk of Harappa and Mohenjo-Daro, as if these remain the most important. They still refer to the culture as the 'Indus Valley', though the great majority of the sites are on the dried banks of the Sarasvati. In short, there has been an attempt to freeze the archaeological picture to Harappa and Mohenjo-Daro in spite of new evidence that these were more peripheral than central to the greater Sarasvati civilization.

These Harappan, or better called 'Sarasvati' cities, were better planned, organized and interconnected than those of Egypt or Mesopotamia of the time, both of which regions could have fitted comfortably in the boundaries of Harappan India. Writing also arose in India before 3000 BCE or by the same time as in the Middle East. All the antecedents of Harappan civilization have been traced in the Indian subcontinent through various pre-Harappan sites back to the great village complex of Mehrgarh, which was the largest of its time c. 7000 BCE. In other words, ancient civilization in India was advanced and indigenous, comparable to anything in the Middle East at the same time.[2]

It appears that this timing is verified by Indian literature, specifically the corpus of books known as the *Vedas* of which the *Rig Veda* is the most familiar and earliest. [The latest dating for the Vedas puts the Rig Veda at circa 3500BC]. In our companion work *Deluge* it is seen that astronomical dating in the Mahabharata gives information relating to very shortly after the early development of Merhgarh, with one specific date of 6681 BC being distinct and unmistakable. The Saptarsi calendar, recognised by the Greeks had a commencing point at 6676 BC.] Many have commented that texts have reference to astronomical events of the 3rd millennium BC and even earlier.[3]

However, by 1900 BC geological and climatic problems had greatly altered the flow of the Indus and other rivers, and the great Sarasvati now petered out in a desert hundred of miles from the sea. This was the end of the line for the region as a vast enterprise and people moved on and out. Again, this is seen in the Indian texts. Other investigations inform us that the ruling line of Egypt that ended with the family of Akhenaton was of Mitanni origin and that they in effect were a tribe that came from the peripheries of North West India. Hence there is continuity; a recorded history [the important elements of which can be seen in *Deluge*] that begun well before 6000BC with the Sarasvati, the 'Mother of All Rivers' flowing to the sea. It finished with the movement out from India around 2000BC to pastures new, including Mesopotamia, where numerous trade links had been ongoing for over a thousand years.

Given this scenario and the fact that the undeciphered writing systems of the earlier period apparently would not have enabled complex and lengthy literary efforts to be recorded, it would appear that initially the whole corpus of texts must have been handed down in some format by word of mouth, unless there was some content-rich written language in existence of which archaeology is unaware. Prose and poetry, nonetheless, can contain a vast amount of factual information in verse format, a method of transference of knowledge utilised by the likes of the followers of Homer. If astronomical events were recorded in such a fashion then it would appear logical that other historical matters should be found contained within the pages of these mammoth works. Certainly, the latest investigations, some of which involve satellite imagery of long dry riverbeds, confirm that indeed, the geographical references in the *Vedas,* although seemingly not committed to writing until a much later period, depict the region as it was circa 5,000-8,000 years ago. The principle river of the earlier period in question is not, in reality, the Indus, but the Sarasvati. These were both parts of a vast river complex.

There can be found elements within the corpus of texts, which indicate that living conditions and the locations of the authors changed over the years. The mighty Sarasvati and Sindhus changed from being the huge watercourses described in earlier sections of the prose and other regions were now the home of the authors. The Sarasvati has all but disappeared from view, it ceases to exist in its previous form, while the Indus has changed course and is much depleted. Effectively, the *Vedas*and other texts trace the history of what we shall, for the purpose of identification, call the Indus society, from long before its peak, long, long prior to 3000 BC, to its downfall about 1900 - 1500BC. This was a loss that was created partially by a change of climate and principally by geological upheaval.

14.3 Paleolithic and Mesolithic India

Initially perhaps it would be pertinent ask about the population of this region, who were the people who lived here at 6500BC and even earlier than this. This is long prior to the civilisation with which we are familiar in Egypt, even earlier than the great Mesopotamian developments.

Modern humans began developing tools and expanding out of North East Africa and the Middle East roughly between 60,000 and 40,000 years ago. According to genetic dating, at some point relatively early in this period humans moved into Asia. This is evident because the dating suggests that circa 48,000 years ago, plus or minus 1,500 years Indian specific DNA split from a proto-Asian ancestor[4]; hence from sometime in the region of 45,000 – 50,000 years ago there was what can be accepted as an indigenous Indian population. [But see note and comments below.]

Flint and Pottery

The Rohri Hills are a limestone plateau 25 miles long and 10 miles wide, some 31 miles to the northeast of Mohenjo-Daro. They are surrounded on three sides by the alluvial plain of the Indus River and are deeply dissected by erosion. In 1880 William Blandford reported the presence of flint cores and flakes in the hills near Sukkur and Rohri on the Indus

River. It was much later realised [shortly before World War II] that these flints were very similar to those discovered at Mohenjo-Daro.

Fig 14.1Rohri Flint Quarries

Ensuing investigations have revealed that the source for the flint for virtually the entire region of the Sarasvati / Indus civilisation of the region was the Rohri Hills. Excavations carried out by Bridget Allchin in 1975-76 revealed several Palaeolithic and Harappan sites [dating from *100,000BP* to 2500 BC] located primarily at the northern and south western ends of the Rohri Hills[5]. It must also be noted here that the figure of 100,000BP [98,000 BC] makes a mockery of the genetic dating for the movement of people into Asia! Genetic tracing may be accurate but not any attached dating. Clearly, there is much that requires clarification regarding early hominid development and movement. These hills, however, were exploited for their materials throughout the flint-using period of the history of the region. From large early implements to very fine narrow tools of the later periods, used for drilling purposes, all apparently came from the Rohri Hills.

Pottery apparently did not develop unto about 6000BC. Development, as seen from the results of archaeology appears to have been as seen in Table 14.1.

Table 14.1 Neolithic and Bronze age periods in India

Pre-ceramic Neolithic	8000 - 6000 BC
Ceramic Neolithic	6000 - 5000 BC
Chalcolithic	5000 - 3000 BC
Early Bronze Age	3000 -1900 BC

However, we should refrain from being complacent regarding the abilities of our Neolithic forebears as shall later be revealed.

14.4 Genetics and Linguistics

It has to be admitted that in this section we are postulating a little; nonetheless, if the information with which we have worked is as correct as the relevant disciplines can make it, and it appears that this is the case, then it is felt that we have arrived at a reasonable conclusion that answers a few more of the questions regarding the early history of India. Considering the brief mentions of the so called 'Aryan Invasion' in the Chapter 13, comment must be made on the concept of European genes appearing in India. This is a matter that only recently has been discovered via modern research and in fact is denied by some geneticists. Undoubtedly it was instigated by some authority desirous to show that indeed there was an 'Aryan invasion'. It would appear, however, that if this in fact did occur [and it is doubtful] then the occurrence would have been at a much earlier period than that usually portrayed by those who defend the Aryan Invasion idea and indeed, for a totally different reason. While for the sake of argument we shall accept that genetic studies have shown that these genes exist, the discipline does not indicate when the merging took place. Some of it may have been later, after the demise of the Sarasvati when people moved out of their homelands. Such a blending of genes would be after 2000BC and then we have to ask how many moved back to India where the examinations took place and the samples were taken? The major mix would certainly have been very much earlier and any case the 'Aryan' element would not have been derived from the Middle Eastern regions where the displaced Indians could be found at that period.

Lingual studies, regarding dating, are notoriously inaccurate. Linguistic archaeology is related to changing elements of language over a long period and is not given a great deal of credence by methodologists who are more conventional. It is not that the methods employed regarding the development of language are erroneous but that the time taken for change cannot be accurately assessed. According to two of these studies, contemporary Hindu Indians [another confusing term, Hindu does not refer to the geographical area, or to a people's genetic identity],

… are descendents of primarily West Eurasians who migrated from Europe, the Near East, Anatolia, and the Caucasus 3,000-8,000 years ago. [6]

In reality, the movement of people described here perhaps is not inaccurate as the original exodus from Africa of modern humans and indeed earlier migrations had to pass

through the region of Mesopotamia on route Eastwards. Hence this dating from lingual sources dating can be seen as being far too late. In any case, such an argument as this could not be utilised to bolster the 'Aryan Invasion Theory', which is commonly termed the AIT. The lingual element is probably the result of movement into Mesopotamia when the rivers of India began to dry up and the Harappan civilisation was disintegrating. Many people moved back to India along with some of Mesopotamian origin, and many went eastwards toward the Ganges. For a period, there was much movement of population which of course meant migrations of genes, language and culture.

There is no doubt [according to some studies] that there is a definite European element in the Indian DNA, specifically in that of the upper castes.[7] [Here we have to query what is seen as European?] Genetic studies in this respect, while revealing what exists, are similar to lingual studies in that concepts of dating are frequently inaccurate. The *Vedas* were eventually written down when the written language of the region had sufficiently developed, possibly as late as circa 1500-500BC. While these texts plainly have evidence of observed astronomical events of a much earlier era, these and other texts additionally have references to conditions in specific geographical locations not evident at this later time of circa 1500BC when the facts were recorded in writing. Therefore, this material must have been handed down, generation to generation in a rote-based verse format, which was continually updated. Logically one would expect the same language to have been utilised for recitation and rhyming purposes although over such an extensive period adaptations would have occurred.

The texts not only contained a considerable amount of historical and astronomical lore, but additionally, elements of mathematical instruction. The count of verses and lines, which in the *Vedas* is seen as important, must have additionally specified particular numerical connotations. The numerical frame of their structure contained much information. Given the length of these texts, this is a remarkable feat, even greater than that of a similar nature, applied millennia later to the work of Homer. But there is no reference within the *Vedas* or later literature to invasion by outside tribes and the texts reliably relate known events as far back as around 3000 BC with astronomical recordings, king lists and other information stemming from a far earlier date, a date shortly before the beginning of the Saptarsi Calendar.

So, according to some studies there is evidence of the existence of European genes in the upper castes of India, and the Indian texts relate other information as far back as before 3000BC, but have no indication of 'the coming of the Aryans' whatever. So from where did this addition to the Indian gene pool derive, and when? And given that these texts are quite informative, why is there no record of the incursions?

It appears highly probable that such an event was either long prior to the Vedic era or after the writing of the texts books. Yet even later Indian material has no reference to any such event, no marriages outside the region of other means to explain this irregularity and any such invasion after around 500BC would have been well known across the Eastern World. By the onset of the material development of the region, it seems, according to the Aryan Invasion Theory [AIT], that the Indo-European assimilation had taken place which again points to an earlier period, and which of course does not comply with what is understood of the region. This theory of an invasion does not allow for a very early time frame as the invasion is supposedly a relatively recent event; 1500BC is an average accepted date...long after the country had risen

greatness and so how could the invasion be deemed to be root of development? However, as there is no evidence to support this theory it is necessary to find an earlier period for any incursion of people from European regions into Northern India and a reason for the occurrence, supposing that it did occur and in fact few geneticists have made the claim while many have studied the human history of the region. So let us speculate a little.

In reality most people chose to move locations to better themselves, or in extreme cases, simply to survive. In the past whole tribes have uprooted and moved because of climate change and depleted resources as happened in Europe during the Ice Age. Climate change is the most probable culprit in this case.

It would appear that the genetic study results discussed above might well relate to events much further back than most academic scholars would care to admit. Jonathon Adams of Oak Ridge National Laboratory, USA, suggests the possibility that the movement of people and hence lingual changes may have occurred due to climate change prior to the onset of agriculture at 9,000 years ago in Merhgarh in Northern India. Note that this is reference to language and not genes. It is possible that the 'wave of Europeans' spread across the region before this period. An obvious contender, states Adams, assuming that climate change was the reason for these migrations and hence would also apply to genetics, would be the period known to climatologists as the Younger Dryas.[8]

It is proposed that the most probable period for incursion into the Sarasvati region of people from outside the district, the 'Europeans', was the Younger Dryas. This was an extremely cold period of around 1000 years that commenced circa 10800 BC [12,800 BP]. Current thinking is that the cause of this sudden severe downturn of climate was a comet exploding in the atmosphere over North America. Sediment found at numerous sites appears to confirm the theory.

In the table below are seen climatic changes over an extended period. From circa 18,000 years ago, Last Glacial Maximum [LGM] the world commenced slowly warming from its deeply frozen state in a gradual, albeit spasmodic manner. Then rapid changes began to occur. It is commonly understood among climatologists that many or most of these changes occurred on a timescale of several decades or less.

Although these climatic changes were seen primarily in Europe and America, there is no doubt that at higher latitudes the changes were felt most dramatically. In our own times we are aware of climate change, the Global Warming of which we hear so much, and not only hear but are now experiencing. Since the 1960s, among other signalling features, snow cover has decreased in general by as much as 10% in the mid and high latitudes of the Northern Hemisphere.

Perhaps the most telling piece of information from studies of modern changes that can be applied to ancient climatic alterations in the lower latitudes is that the lower reaches of the river basin would not have been fed by snow or rain because these cold periods are also very dry periods and the upper reaches of such rivers would have frozen. Alternatively, during a warmer epoch, not only would the glaciers melt, allowing an excess of water to flow until some sort of normality was reached but the climate, specifically at high altitudes would also become much wetter, hence flooding would have been a commonplace event.

If the above genetic hypothesis has any basis in fact, and logically there would have been movement of people at the stated time, the early incomers to India who were escaping the depravations created by cold conditions to the North would have mixed with the indigenous Dravidian people who naturally utilised their own various Dravidian languages. The newcomers would have had to adapt to such situations or remain isolated. Probably, assuming that the studies are valid, elements of the European linguistic roots of the incomers remained in small isolated pockets where the people had settled. Interestingly, due again to the influence of others, Latin and Greek traces are commonplace in the English language which is also classed as Indo European. [It is interesting to note here that some Greek words have their roots in Sanskrit, possibly derived from the region at the time of Alexander, and Sanskrit appears to have been developed from a Dravidian source, hence indirectly parts of the English language, are associated with Sanskrit. Little happens in isolation!] We still have a problem nonetheless because this was over 10000 years ago and the genetic findings are for European genes in the upper castes and not the lower echelons of Indian society…after 10000 years it is difficult to imagine that the genes had not spread outside the upper classes to those seen as lesser mortals and this in itself casts doubt upon the study.

Table 14.3 Northern Hemisphere Climate over last 15,000 years (Table derived from information from Adams: *in* Current Anthropology). [9]

14,500 BP. - rapid warming and moistening of climates. Rapid deglaciation begins.
13,500 BP. - Climates at least as warm and moist as today's
13,000 BP. 'Older Dryas' cold phase (lasting about 200 years) before a partial return to warmer conditions.
12,800 BP. (+/- 200 years)- rapid stepwise onset of the cold, dry Younger Dryas.
11,500 BP. (+/- 200 years) - Younger Dryas ends suddenly over a few decades, back to warmth and moist climates (Holocene, or Isotope Stage 1)
9,000 BP. - 8,200 y.a. - Climates warmer and often moister than today's
About 8,200 BP. - sudden cool and dry phase lasting about 200 years, about halfway as severe as the Younger Dryas.
8,000-4,500 BP. - climates generally slightly warmer and moister than today's.
(But; at 5,900 BP. - a possible sudden and short-lived cold phase corresponding to the 'elm decline').
Since about 4,500 BP. - climates fairly similar to the present

Nonetheless, the classification of European genes among the Indian is seen in the upper castes almost exclusively. One wonders if this could be traced to early colonisation of the east by Europeans and not be the result of an ancient climate driven migration at all because

'European' is far too broad a description to be of great value. The incursions into Britain have been traced to their various sources in Europe and hence this equally could be done in India giving regions from where the immigrants were derived…so why the generality of European? The question has to be raised:-Is this merely a last stand of the Aryan Invasion Brigade?

14.5 A Question of Writing

Prior to the discoveries in India of the remains of a great civilisation and the subsequent realisation that an ancient language was in use, there were two main scripts for written language, *Brahmi* and *Kharosti*. The *Brahmi* script, although its origins are uncertain, initially developed, it is commonly thought, around the seventh century BC. It has a considerable amount of Semitic influence in its structure. Semitic influence should not be a surprise however, as trade between Mesopotamia and India was ongoing since probably before 3500BC.

The period around the fifth century BC saw the further development in North West India, then under Persian rule, of the Kharosti script, which is commonly accepted as a direct descendant from the Aramaic alphabet.

The direction of writing in the Kharosti script is as in Aramaic, from right to left, and additionally, to confirm the pedigree of origination, there is also a commonality of many signs having similar phonetic value to the Aramaic.

Brahmi has since given rise to eight varieties of scripts of which three, the early and late Mauryas and the Sunga – are seen as the prototypes of the scripts in northern India in the 1st centuries BC and AD. From these developed the *Gupta* writing, which was employed from the 4th to the 6th c. AD. The first epigraphic evidence of Sanskrit is seen in 150 AD and this inscription is in the Brahmi script.

During the 6th century AD the *Siddhamatrka* script was developed from the western branch of the eastern Gupta character. The Siddhamatrka was the predecessor of the *Nagari* script, which is currently used for Sanskrit. This script developed between the seventh and ninth centuries AD and is essentially unaltered today.[10]

Historically developed in the 5th century AD, originally *Grantha*, a Dravidian language, was used for writing Sanskrit only. Sanskrit was later transliterated with Nagiri after the 7th c. AD. Modern Tamil is derived from Grantha.

The bibliographical evidences in extant versions of the Vedas indicate that they are written in both the Grantha and Nagari scripts. These, as seen above, are Dravidian languages, and according to tradition a certain Veda Vyasa, a Dravidian, compiled and wrote the Vedas. The Grantha script belongs to the southern group of scripts and Veda Vyasa would certainly have used it. Since the earliest evidence for Grantha is only in the fifth century AD, the Vedas were apparently written down in these languages rather late.[11]

Once more there is problem however, because as we have stated, the Vedas are a vast collection of verses, much more than one person could memorise and essentially more than a small group of people could collectively memorise. If we add the other literature of the period, then the whole corpus becomes enormous. Essentially, the enormity of the task implies that these texts *must* have been written down in another script prior to this period. The probability is that these texts were recorded in a very early version of the Brahmi script, which as seen

above was utilised to convey Sanskrit and Sanskrit was also seen in Grantha, a Dravidian language. But it is thought that recognisable Brahmi only takes us back to 5 – 700 BC at most. What happened prior to that period? We can only guess, as there are no extant records, but it is certain, given the size [and accuracy] of the volume, those records existed in other languages of the day. Hence as noted earlier in this book, the history of writing is far from complete.

It appears that the original language of the Sarasvati / Indus civilisation has been lost, seen only in undeciphered inscriptions seemingly related to other Dravidian languages. The beginnings of this loss probably occurred sometime not very long before 1800-2000BC when people began communicating in other scripts as they were now, in many cases, moving from their homelands and in much greater contact with people from other regions. Inscriptions from this era and earlier that are definitively Indian have been found in Mesopotamia and India was trading weaponry and other goods with Mesopotamia and hence there can be no doubt that there was something of a commonality among 'written' languages at that time; today we cannot understand this but the mindset of people regarding signs and symbols was different then than now. It is also probable that a large sharing of knowledge occurred around this period, and Indian scholars acquired some of the astronomical lore of others, while thinkers of other regions appreciated some Indian material. The indications are, however, that others appropriated Indian learning to a greater extent than Indians benefited from the knowledge of others.

The Vedas and other texts such as the Mahabharata, therefore, if they were recorded earlier than the presently known versions in a written format, were ultimately written down in a Dravidian related language. But we do not understand what it may be. The history of the Sarasvati, from being a mighty river outpouring into the ocean, to a dried up riverbed in the middle of a desert hundreds of miles from the sea is recorded in the texts. There is much information in these works and given that the eventual drying up of the Sarasvati occurred circa 2200-1900BC one wonders if this was initially recorded in Dravidian or in one the Mesopotamian languages, as many Indians were now living in that region, having lost their sacred river.

But let us stop for a moment and consider what has happened in India between, say, 3200BC and 1900BC. We not only have extremely extensive poems which effectively were full of valuable information regarding philosophy, religion and astronomy, but fire alters [one of which is examined in the next chapter], were built in such a complex manner that it would take a genius to accomplish all the calculations in his head. However, the oral tradition enabled great detail to be remembered via the use of easily remembered stories where the main characters were important elements such as the lights in the sky, the Sun, Moon and stars. Given the enormity of the corpus of material involved here though it certainly does seem that there *was* an effective written language, which not only consisted of words and signs, a pictorial, perhaps hieroglyphic like affair, but also a method of mathematical denotation.

14.6 A Vast River Complex

Before moving on to an examination of the numerical aspects of ancient India it is worth looking at what the people of the Sarasvati region actually thought of their river system.

These thoughts are valid and are recorded in the *Rig Veda,* which as we have seen, dates very conservatively to 3500BC.

Fig. 14.2: Harappan Sites showing density of townships along the line of the Sarasvati River

The Sarasvati was the lifeblood of the region, it was a vast complex; the following extracts from the *Rig Veda* reveal the importance of this river and its tributaries to the inhabitants of the region

Pure in her course from mountains to the ocean Sarasvati River bestows for Nahusha nutritious milk and butter. (RV. 7.95.2)
May the glorious seventh (stream) Sarasvati, the mother of the Sindh and other (rivers) charged with copious volume of water, flow vigorously; come together, gifting abundant food and milk. (RV. 7.36.6)

It has been said that there is a possible interpretation of some of the verses of the Rig Veda that indicate that while the Sarasvati had seven tributaries, the Indus and her 5 tributaries Sindhu [Indus], Sutudri [Sutlej], Parushni [Ravi], Asikni [Chenab], Vitasta [Jhelum], Vitasa [Beas], formed six of them.[12]

RV.3.24.4 also is thought to indicate the possibility that Drishadvati and Apaya were also tributaries of the Sarasvati. Effectively, this region was home to a huge river system with the mighty Sarasvati the central figure in a cast comprised of many lesser, but still large rivers.

The Indus, which at this time, as noted above, was possibly a tributary of the Sarasvati, has a flood plain up to 100-120km to the East and Southeast. This being the case, how large was the Sarasvati? It is small wonder that the river was revered virtually as a goddess, a goddess that eventually was lost, although remembered within the hymns of the Vedas and Mahabharata.

But what would happen to such a system in times of a great freeze? As much of the flow was derived from the watershed of the Himalayas and came from high altitudes, this flow from high level would cease as the springs and streams feeding the system froze. In addition, there would be less rain to feed the rivers at lower levels. The Sarasvati would lose much of its flow. It is thought by many that this situation is recorded in the Vedas.

This work has hinted that allegory and metaphor are seen in religious myth. [This is seen to a far greater and clearer extent in our companion work *Deluge*.] Here, others are making the same suggestion regarding sections of the Rig *Veda*. It is within this explanation that we just may see the glimmerings of what modern science is recently beginning to reveal, hidden among the metaphors created by Indian sages thousands of years ago. Some of the Rig Vedic hymns, specifically RV 1.32.10-13; 1.54.10; and 2.30.3 have been explained in terms of a battle between freeze and thaw, ice ages and the warmer in between periods. But of course we cannot be looking at the hundreds of thousands of years time span between ice ages proper, however, if times such as the last ice and its rapid thaw, a thaw which was stopped in its tracks by the Younger Dryas period are taken into account then what possibly emerges is a period war between Indra and Vritra. In this explanation the frozen rivers high in the mountains, which would be visually occupying zig zag passages may have been envisaged as the great serpent Vritra. If the return of a warm climate brought storms as it certainly would, then Indra as a storm god would be seen to be overcoming Vritra, the rivers would thaw and once more flow as in earlier times.

A verse that gives the flavour of the idea reads

Mastered by the enemy, the waters held back like cattle restrained by a trader (Pan.i). Indra crushed the Vritra and broke open the withholding outlet of the river. (RV. 1.32.11)

This evidence, internal to the Rig Veda, but consistent with conditions in the region over an extended period, a period already discussed in this work, has been suggested to be indicative that before the generally accepted time of the Vedas, before the earliest social group recorded by archaeology in the Sarasvati region, in fact during the cold period of the *Younger Dryas*, people were actually recording climatic events and conditions. It would appear possible, indeed as the Vedas apparently record folk memories of such events, plausible, that the movement of European people into India occurred as has been suggested here, either at the beginning of or previous to, the Younger Dryas, and these records are from that period.

Yet Indra is a storm God. Hence a different picture could be painted here, one of a release of waters *after a period of severe drought as is recorded in the ancient texts to have happened on more than one occasion.* Once, the narrative recalls, the Sarasvati was the only river not to dry out and even then it occasionally went underground and emerges lower down its course. [Again, due to space restraints we have to refer readers to *Deluge* for details at this point.]

A final point here regarding the Sarasvati and age of the Vedas. While it is known that the Sarasvati finally dried up in its lower reaches and eventually petered out into the desert *40 days horse ride* from the sea, at around 1900BC, the latest scientific work reveals that it ceased reaching the sea at around *or before* 3000BC. Yet the Indian texts are full of praise for this mighty river, this goddess that flows into the sea. The majority of towns and cities are along the remains of the banks of the Sarasvati which was a major trading route, a river which *effectively* ceased to flow long before an Egyptian Pharaoh even dreamt of building a pyramid. India was a great nation long before the so-called 'Cradle of Civilisation' of Mesopotamia built its first ziggurat or even began to work with the sexagesimal mathematics for which it is famed. The culture of the Sarasvati region of India was truly an ancient and great civilisation.

CHAPTER 15

Archaeology and Metrology

Facts are stubborn things; and whatever may be our wishes, our inclinations, or the dictates of our passion, they cannot alter the state of facts and evidence.

John Adams, 'Argument in Defence of the Soldiers in the Boston Massacre Trials,' December 1770

15.1 Archaeological Evidence

The generalised picture of material development of the Northern Indian region is usually seen as being in three phases, namely an 'Early Phase' between 3100 - 2800BC, a 'Mature Phase' between 2800 - 1900 BC and a 'Late Phase' between 1900 - 1400BC. Agriculture, however, appears much earlier with pottery following shortly afterwards and it is the region of *Mehrgarh* that appears to show the first signs of these activities.

The history of excavation and investigation of this enormous region, seen in the map Fig 14.3 in the previous chapter, stems back to the first brief excavation by Sir Alexander Cunningham. This occurred in 1872-73, which was around two decades after brick robbers carried off what would have been the visible remains of the city for railway ballast. Cunningham is said to have found an Indus seal in the region, which, being of unknown origin assisted to spark off his interest in the area.

Contrary to a frequently portrayed idea, the famed archaeologist Sir Mortimer Wheeler was not the man who brought notice of this ancient civilisation of the Indian sub-continent to the world at large. This honour is allotted to Rai Bahadur Daya Ram Sahni who first commenced serious excavations at *Harappa* in 1920. He revealed to the world the traces of a highly organised and complex society that had been lost for thousands of years. His work and contemporaneous excavations at *Mohenjo-Daro* first brought to the world's attention the existence of the forgotten Indus Valley civilization as the earliest urban culture in the Indian subcontinent.

The investigative work of Madho Sarup Vats, who was also of the Archaeological Survey of India and working later in the same decade, enhanced that of Rai Bahadur Daya Ram Sahni. It was Vats who first excavated what has been termed the 'Granary,' and who eventually in 1940, published the results of his and Sahni's excavations. Explorations by other archaeologists continued in the 1930's, and 1940's when Sir Mortimer Wheeler excavated the so-called fortification walls and in 1946, discovering the first pre-Indus Valley civilization [*Kot Dijan*] deposits in the process.

While at the time that this town was experiencing its heyday, the Indus was flowing past its Western side with the Ghaggar-Hakra to the East, the Indus now passes to the East and the Ghaggar-Hakra has dried out.

There is an enormous amount of brick built work for examination in this area. Perhaps one of the most enigmatic structures, of which a numerical analysis is seen below, is that of the 'Great Bath'. Brick altars were commonplace with geometry and mathematics seen to be intimately associated with the religious structures of the region.

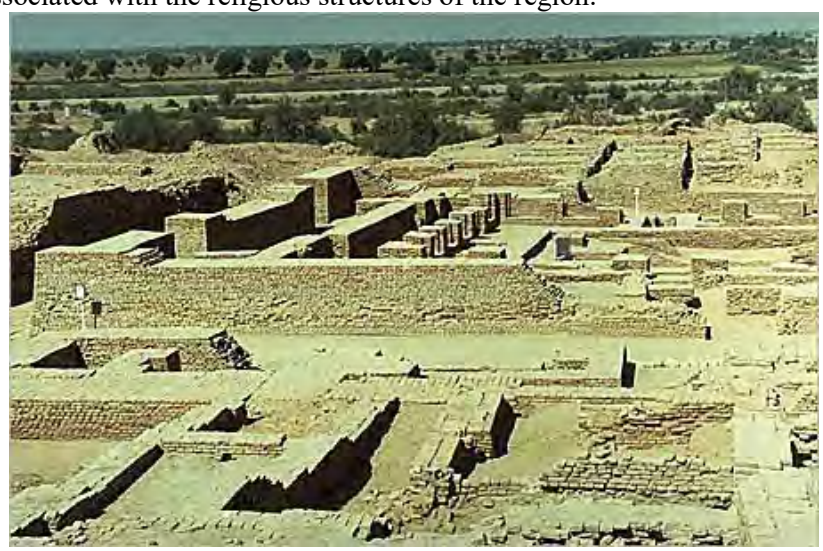


Fig. 15.1: Mohenjo-Daro town

The Great Bath of Mohenjo-Daro [2600-1900BC]

The Great Bath at Mohenjo-Daro [see Figures 15.2 and 15.3] measures 39 feet x 23 feet and its enclosing building has dimensions of 230 x 78 feet, 20 times the area.[1] Recalling the output from our companion work *Deluge*, the perimeter of the building equates at 616 feet, exactly half the perimeter of Noah's Ark as evaluated from the information in Genesis and the on-site surveys of the geological anomaly in Eastern Turkey that was recorded by the 3rd century BC chronicler Berossus as that believed to be the 'vessel of salvation'. This Indian structure apparently contained 8 rooms, which it is thought were changing rooms. Coincidentally there traditionally were 8 people aboard Noah's Vessel.

The foot value employed here at Mohenjo-Daro is 1.232, which is counted 500 times in this outer perimeter. The bath itself at 39 x 23 feet has a perimeter of 124 feet. Only the brickwork and indications of a former waterproof bitumen coat remain, there is nothing to be seen of the finishes that would certainly have existed originally.

Fig. 15.2: The Great Bath of Mohenjo-Daro

Fig 15.3: Fine Quality Brickwork at the 'Great Bath' of Mohenjo-Daro

Given that this structure, if indeed it was a bath, would have to have had a finish, and that it would have had a relevant thickness, it would appear justified under the circumstances to hazard the guess that this thickness was 1.2 inches, about right for an effective plaster and bitumen coat or bitumen and tile of some description. This would mean that the perimeter of the bath would be 123.2 feet, a further representation of the mythical Ark of Noah.

Noah, according to the story, or in the Indian version, Manu, although aboard his vessel, was effectively saved by water. Was this bath designed for ritual bathing in a representation of the ark, are we looking at the original concept of Baptism, of being saved by water? Baptism is certainly a widespread idea and actually long predates Christianity. The concept would certainly fit with the nave of a church being derived from the Latin *navis* for boat.

Lothal

By 3200 - 3000BC the major towns of the Indus Valley region were beginning to be built up. The principle sites of this civilisation were at Mohenjo-Daro and Harappa, which were initially unearthed between 1921 and 1923. But although the *principal sites* have been archaeologically recorded as being located in the Mohenjo-Daro and Harappa regions, the whole area encompassed some 1.2 million square kilometres or virtually half a million square miles. This not only included the Indus Valley but sections of East Punjab, Utter Pradesh, Northern Rajasthan, Guejerat [containing a third of the large urban settlements of this region] and the major port of the Indus, *Lothal*, which although close to the river, is now well dried out. In addition, the culture enveloped northern areas near the Persian Border. The theory has recently been developed that many of the smaller, more rural centres were manufacturing bases supplying the larger complexes. This is a network effect, which can be seen across the modern manufacturing world. There is no doubt that trade was ongoing along the coasts of the Arabian Sea, primarily from the Port of Lothal and additionally by overland routes.

The fact that the port of Lothal, with another series of complex and accurate brick structures exists at all, indicates that there must have been a sizable river to service the complex. Without this, to state the obvious, it simply would not have existed. It is easy to visualise the docks at the port of Lothal when Figures 15.4 – 15.7 are examined.

Fig. 15.4: Lothal Dock in summer

Fig. 15.5: Lothal after Monsoon

Fig. 15.6: Lothal drainage system

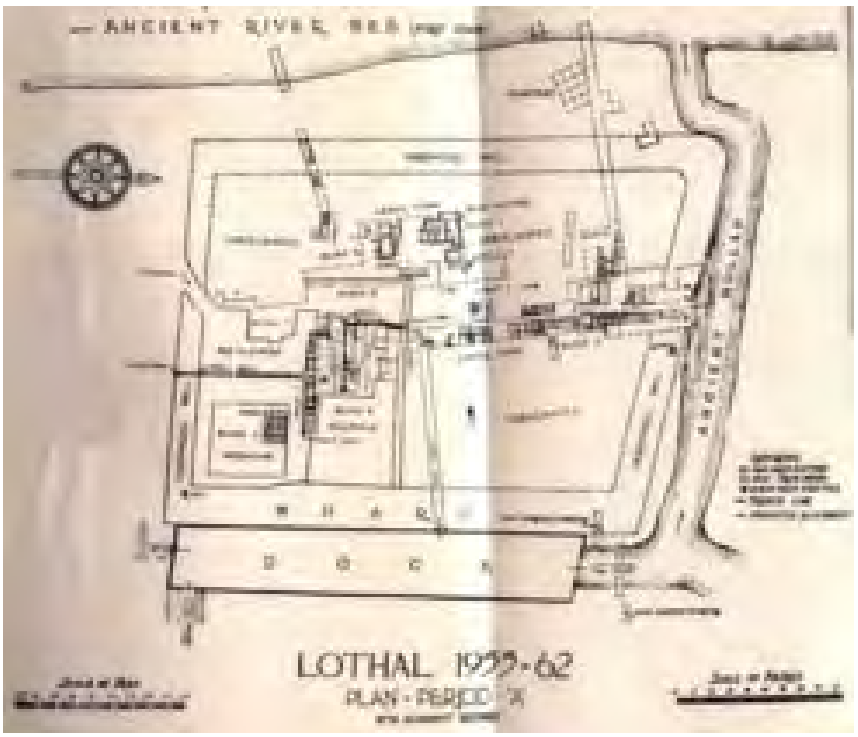


Fig. 15.7: Layout at Lothal Dock

Mehrgarh

There is one specific ancient metropolis in the Indus area which has previously been mentioned, that of Mehrgarh. This was the earliest of the area to develop materially. At Mehrgarh, dating to the 7th millennium BC can be seen brick dwellings with the bricks constructed to a surprising accuracy. Incredible as it may seem to the modern mind, while the people of Mehrgarh were building in brick, they initially had no pottery; in other words the culture was totally aceramic. Pottery was introduced at a later date in conjunction with other parts of this vast area. Straw and reed containers lined with bitumen were utilised as water carriers.

There is something about this region that although perhaps not of a geographically centralised position, certainly appears to have something of a central driving force to its nature. The earliest bricks were found at Mehrgarh and it appears that agriculture and farming commenced development in this part of the region. Of necessity we shall therefore return to Mehgarh later in the work. To maintain some semblance of sequence however, we shall continue moving toward the more distant past via other elements of the study.

15.2 Metrology in ancient India and China

Scales and rules have been discovered [detailed below], indicating the use of a complex numerical system which utilised very precise units of measurement. These units, dating to between 2500BC - 3000BC are demonstrably aligned to those of the British Imperial system.

In addition, altars at the time were constructed on a strictly geometrical and numerical basis [See example in Figure 15.8].

Fire altars were constructed from the time of the earliest major developments, circa 3200 BC or even earlier. Michell [2] reminds us that in a completed altar there would have been 10,800 bricks and it should be noted that fire altars were invariably completely surrounded by 360 bricks.

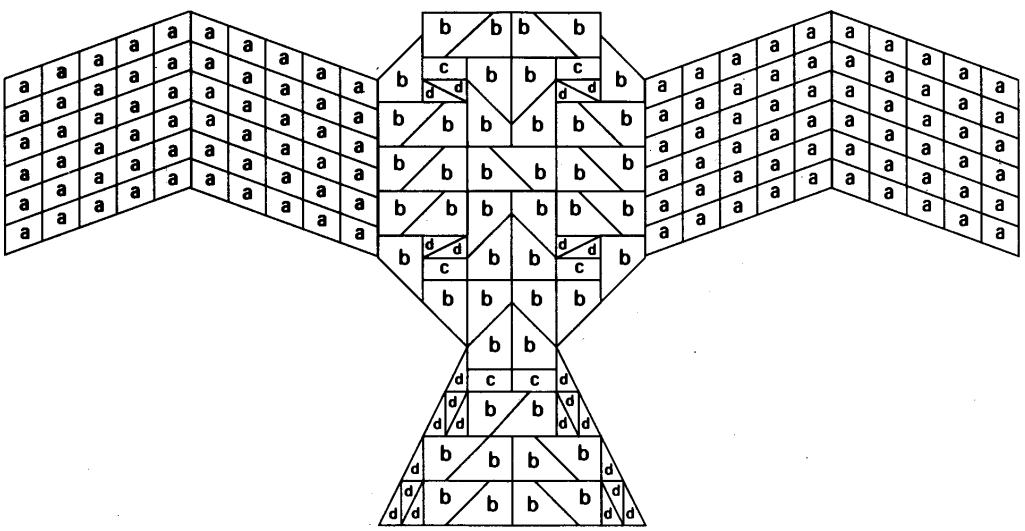


Fig. 15.8: The first layer of a Vedic Sacrificial Altar in the shape of a falcon-facing East. The wings are made from 60 bricks of type A, the body from 46 bricks of type B, 6 type C and 24 type D. [After Thibaut 1875][3]

A comment at this point: contrary to popular thought, it was not the people of India who learnt from the Greeks but in many cases, the Greeks who learned from the Indians. As noted earlier, there are lingual connections in this context to be seen.

'The English word 'Geometry' has a Greek root which itself is derived from the Sanskrit word 'Jyamiti'. In Sanskrit Jya means an arc or curve and Miti means 'correct perception or measurement.' In ancient India, geometry was known as 'Shulba' or 'Rajju'.. The word 'shulba' itself is derived from the Sanskrit root 'shulb' meaning 'to measure' and hence its etymological significance is 'measuring' or 'act of measurement'. The word 'Rajju' literally means a 'rope' or

an instrument of measuring. The rules of geometry itself were known as 'Shulba-Sutra', the Sanskrit word 'sutra' meaning 'aphorism' or a short rule. [4]

It is easy for the sceptic to assume from this quotation that the inference of 'rope' implies approximation. However, do we not still apply the term 'horsepower' to highly technical and mechanically superb engines? Given the evaluations of the scales and dimensions of the bricks seen below, the term rope can probably be seen as much as a term from a previous age in India as that of horsepower for which the fuel was grass or straw, is to the modern engineer.

Before examining the bricks, which are among the principle pieces of evidence from this region for their dimensional connectivity, an examination of the scales that have been found and the associated connectivity is desired. These demonstrate the existence of measures by the divisions physically scribed onto the artefacts. At Mohenjo-Daro in the Indus Valley, amongst a series of weights that are analysed in the next chapter, a scale has been discovered which, it has been assumed, was composed of ten inches at an individual value of 1.32 British inches.[5]

Interestingly, there is similar report of a scale from Lagash, Sumeria which implies the same measurement unit and count. Both of these date to at least around 2500 BC, or earlier. The Indian rule could be at least 500 years older as the *mature* Indus Valley culture was spread over a period from circa 2800 BC to 1900 BC implying a build up to this stage of urban complexity from smaller conurbations. However, there is little sign of a learning curve, brick built dwellings and complex city/town layouts are seen right from the start of the period, the only primary difference being the size of the villages. Whatever was happening prior to building in brick in these regions, specifically around parts of the lower Indus Valley, is lost to archaeology. This is partly because the lowest levels are below the modern water table. In itself, this is evidence for tectonic movement of the sort that upset the whole region. There are ruins beneath the sea of the Gulf of Cambay in northwest India and perhaps this situation is related to that.

Nonetheless, this artefact, the scale with a proposed length of '13.2 inches' [10 x 1.32] was incomplete, and whether the decimal count was involved in the suggested fashion is far from certain. As the 'inch' units of 1.32 British inches were subdivided into five units of 0.264 inches, it is generally reported that the overall length would be 50 of these small units, a decimal multiple.[6] Nonetheless, as will be seen, a count in sixes, the *sexagesimal* system was also highly relevant.

It is easy to make assumptions in these matters, tending to overlook the anomalies in our own familiar systems. Why should it follow that because this 'inch' was divided into fifths that a decimal count would necessarily follow? Let us assume that 5,000 years into the future, the broken and shortened remains of an imperial rule with the inch divided into tenths was discovered, what was known as an engineering rule. We, at the beginning of the 21st century, know that there was traditionally an accepted 12 inches to the foot but that there were varieties of divisions of the inch, as with the engineering scales. Following the reasoning applied to the Indian artefact, some future archaeologist may well make such a similar discovery and arrive at

the erroneous conclusion that the British Imperial system had a *standard* foot value of 10 inches.

In reality, the Indian rule was merely 2.6062 inches long. It was made of shell. There were 2 lines marked at 1.32 inches with the stated divisions of 0.264 inches [1/5 of the stated inch] but that is as much as is available for evaluation.[7]

If a sexagesimal count did apply in this instance, then the rule would be not as indicated, but 60 x 0.264 inches in length or a familiar count of 12 inches albeit with the inch units equivalent to 1.32 British inches.

This foot value would then be seen as 15.84 British inches or 1.32 British feet. 1584, as is becoming apparent from earlier chapters, [note: Chartres and Rosslyn and their representations], is one of the key numerical values to deciphering the ancient measurement system and specifically matters relevant to the Bible. As will become even more evident, the value of the count in sixes and sixties simply cannot be overestimated. A decimal count was also in use, but a decimal count closely aligned to a count in sixes.

In the earlier chapters, repeated mention has been made of the foot value of 1.056 British feet. Keeping in mind that a cubit is 1.5 feet of whatever foot value may be in use, a cubit created from this value of 1.056 feet would be, as seen previously, 1.584 British feet in length. A multiplication of 1.32 by the factor 1.2 [12] results in 1.584. Further to this, the step value [2.5 feet] of the 1.056 foot is 2.64 feet. The rule at Mohenjo-Daro had an inch value of 1.32 British inches subdivided into units of 0.264 inches. How much of this is coincidence?

At the *archaeologically supposed length* of the Mohenjo-Daro scale, 13.2 inches, another connection can be made. This distance is exactly 1.1 British feet, or 1/15 of the familiar British rod, pole, or perch, the unit length seen at Borsippa Ziggurat in Iraq and termed Saxon by Neal. Utilising the decimal fraction of 1.5 to convert from foot to cubit, it is apparent that the cubit length associated with this foot of 1.1 feet is 1.65 feet, or 1/10 of the rod measure. This unit actually can be discovered in a number of places and the situation is a good example of the coherence of the measures. Although the length of 0.264 of an inch can be seen as 1/ 90 of the 1.98 foot cubit, it is also, as other sources have stated 1/50 of 13.2 inches. The value of 1/50 occurs in the evaluation of the weight systems appertaining in the region. Additionally, this foot value creates a step [2.5 feet] of 33 inches [165 x 0.264 of an inch]. Could it again be coincidence that Joseph reports a measure known as a *gaz* in Northwest India that is exactly this length? [8]

Joseph also reports that half the 1.32-inch unit or 0.66 of an inch [1/50 of 33 inches] is the Sumerian *shusi*. However, other sources would have the step or *gaz* take this name. Neal, as noted, claims that these values related to the Sumerians in reality are Saxon units… until the linguistics are finally understood, and the language of the Indus Valley has yet to be deciphered, we cannot be certain of the names given to these units, if indeed any name other than cubit, step and suchlike was in use. In any case, as stated repeatedly in this volume and demonstrated via example, the ancient measurement units were basically universal and not nationalistic in any way.

The evidence of the bricks.

At *Harappa* two dominant brick sizes have been revealed: 30 x 15 x 7.5 centimetres and a larger version at 40 x 20 x 10 centimetres.[9] These bricks are reported as having virtually no dimensional variation. The earlier parts of the city, dating to circa 2800BC and earlier were constructed generally utilising the larger bricks with proportions of 4:2:1 and dimensions of:

- 40 cm or 15.7480315inches, within 0.0919inches [2.336 mm] of 15.84 inches or 1.32 feet
- 20cm or 7.874015748 inches, within 0.045984216inches [1.168 mm] of 7.92 ins or 0.66 feet
- 10 cm or 3.937070078 inches, within 0.022992126inches [0.584 mm] of 3.96 inches or 0.33 feet.

Working in inches it is therefore clear that 3.96 x 2 = 7.92 and 7.92 x 2 = 15.84. Consequently, it can be seen that these bricks were designed with a doubling of dimension across the three planes.

The later bricks, dating to circa 2400BC– 2,000BC had the same proportions albeit via a reduction from the earlier dimensions by a factor of 1.3333r. Here are seen dimensions of 11.88 inches, 5.94 inches and 2.97 inches

The *earliest measurable archaeological evidence* relating to the region comes once more in the form of bricks. These man made building blocks, crafted from the local clay are from Mehrgarh and *date from some 9,000 years ago. This is by far the oldest evidence for the accurate practical use of any mathematical or numeral configuration that has been found.* These bricks apparently had virtually no dimensional tolerance; they were, in effect, all the same size. How that was achieved is unknown but the site reports from the area relate this information. Under other circumstances one may perhaps be a little sceptical about such accuracy at a time as early as this; however, the credentials of the reporter of this information should be taken into account. The information is available in the volume *Indus Age: The Beginnings.* [1999.] written by Gregory Possehl, one of the most respected people in his field who is Professor of Archaeology at the Department of Anthropology at the University of Pennsylvania in addition to being the Curator of the Asian Section of the Pennsylvania Museum and having spent a considerable time on excavations in the region. It is therefore felt that these brick dimensions can be safely utilised as an analytical tool in the tracing of the ancient measurement system.

The dimensions of these 9,000-year-old bricks are given as 33 x 14.5 x 7 cms.[10] This, in essence, tells us absolutely nothing. So again, the next step is to translate into British Imperial measures. When this is achieved, the discovery is of an amazing accuracy and a correlation with the system of measure prevalent in the ancient world.

- 33 cm, or 12.99212598 inches is within 0.032125984 of an inch [0.816 mm] of 12.96 inches or 1.08 feet
- 14.5 cm, or 5.708661417inches, is within 0.006261417 of an inch [0.159 mm] of 5.7024inches or 0.4752feet.
- 7 cm or 2.755905512 inches, is within 0.005905512 of an inch [0.15 mm], of 2.75 inches or 0.2291666r feet

All these brick dimensions have been assessed to average dimensions and rounded to the nearest centimetre, yet the fit to what we now understand to be dimensional values that were in use in the distant past is nothing short of phenomenal. Comments made regarding these bricks indicted that there was virtually no dimensional variation. This being the case, the standard here is nothing short of amazing.

Prior to a comparative analysis of the values of the three different brick sizes, at this point is included a description of the British standard for brick dimensions as a comparison. One element will be sufficient, that for length. According to BS 3921:1985 the overall measurement of 24 random bricks can be between 5,235 mm and 5,085 mm, as much as 150 mm between 24 bricks. This should be compared to the accuracy of these 9000 year old bricks. The bricks in ancient India were almost unbelievably precise in size; no one could have expected the finesse in manufacture that this dimensional appraisal is revealing. So it is clearly apparent that high technology is not essential to produce accurate artefacts. It is also apparent that some form of standardised measurement unit was in use, even at this early period. That unit links to the units in use at a later period as shall now be revealed.

Fig 15.9 Brickwork at Mehrgarh

Already it appears that a close correlation with known values is beginning to appear. 1.08 feet, the length of a Mehrgarh brick, is familiar and perfectly acceptable and is within 0.816 of a millimetre of the stated length given in centimetres. Stacked end to end, 700 of these bricks would exactly form the base length of the Great Pyramid. These bricks are 1.09090909[$1^1/_{11}$] times the length of the smaller, later bricks of 11.88 inches.

At 0.4752 feet for the width, [4,752 being 1188 x 4 and therefore another familiar number in the context of measure], or 5.7024 inches, we have another acceptable value which is 0.44 of the length of these bricks. This again is close to the stated 14.5 centimetres, within 0.159 of a millimetre. There were 1600 of these measures in the socket line length of the Great Pyramid, there are precisely three of these measures in the Cambodian *hat.* This brick measure is two handbreadths of the cubit revealed as the Cambodian *hat* with its foot value of 0.9504 feet being that utilised by Herodotus in his 800 foot description of the Great Pyramid.

The final value is that of 2.75 inches which is a mere 0.15 of a millimetre away from the 7 centimetre published figure and which when multiplied by 1.08 results in the thickness of the smaller bricks from the later 2400BC– 2,000BC period. The accuracy here is nothing short of astounding, this is a thin pencil line away from the stated value! As a memory jog, the following numerical connections apply.

- 108 x 2 = 2160 = canonical precessional month of which there are 12 in the precession of equinoxes. 12 x 1.111111111[$1^1/_9$] = 1.08. 1.08 has been used as a foot value in its own right.
- 5.7024 inches or 0.4752 feet is exactly 1/3 of the 1.584-foot cubit/ 1.11111r [1.4256 feet with foot of 0.9504] that was utilised at the temple of Angkor Wat, and which is directly related to the British values and to the count of 1056.
- 2.75 inches is the handbreadth of a cubit of 1.65 / 1.2 or 16.5 inches. It is also exactly 1/72 of the Old English rod, pole or perch. This value multiplied by 6.912 [replicating the number of British miles in a degree of Earth's circumference] results in the same 1.584 foot cubit.
- Calculations related to the above show that within 0.000443 of a centimetre [0.0001744 of an inch] in all directions, the volume of the smaller of the two brick sizes at Harappa equates as 1.008 times the volume of the bricks at Mehrgarh. The value of 1.008 British feet is the *Short Greek* foot. This count is significant because 1.008 seen as the diameter of a circle in conjunction with the use of π at 22/7 means the circumference is calculated to be 3.168, which is a circular representative of the square of the Earth [7920 x 4] in British miles. Centreline of the Sarsen circle lintels of Stonehenge = 100.8 feet diameter and 316.8 feet circumference. The values were commonly understood by that time.

The primary fact that we wish to emphasise here is that these bricks do not merely correspond with the evidence of measures from the later period along one side.

All three dimensions of the brick faces, length, breadth and thickness, have a precise correspondence to the measures seen at a period of 4,000 years later. This combination of three

correspondences could not be coincidence if the early measurements were based, for example, on the cubit being the length of a forearm. We therefore have to conclude that the measurements in use 9,000 years ago at Mehrgarh were ultimately based upon the same criterion as those very precise and exact units of later millennia. As the Mehrgarh units were in existence first, it is a matter of logic that the later measures were ultimately based upon these 9,000 year old units at Mehrgarh. Further to this, as to date we have absolutely no evidence of the measurements usage earlier than circa 3000 BC in any other region, it is a another logical step to accept that the knowledge stemmed from or through Mehrgarh…or developments at Mehrgarh stemmed from the source of the knowledge.

An evaluation of the ancient weight system seen in India and elsewhere is seen in Chapter 16 and here, via information in that chapter we find there is yet another correlation to take into account.

The volume of one of these Merhgarh bricks is exactly 15.84 times the volume of a chert weight that is the equivalent of the weight of a pint of water.

Catal Hoyuk

There is some other very early evidence of standardised brickmaking at the Neolithic site of Catal Hoyuk, Turkey, which again dates to an early period of around 6000 BC.

The bricks at this location, however, bear none of the hallmarks of accuracy seen at Mehrgarh as the measurements below reveal. These were long bricks with a wide variation in size. Nevertheless, we can take mean values and deduct a likely target dimension for these clay blocks. The length of the bricks varied between 76 and 100 cms or a mean of 88 cms. Here we have a length of 2.88 feet [within 0.85 inches]. The breadth of the bricks was between 29 and 30 cms making the measure 0.968 feet [within 0.0018 inches]. The height or thickness measured between 8 and 10 cm with a mean value of 3.52 inches [within 0.023 inches]. Given the inequality between length and breadth of brick and its thickness it not surprising that such variation occurred, the drying process would ensure that bricks so thin for their length and breadth would be certain to warp and shrink unevenly. Having said that however, the median value should indicate a target dimension and hence in all probability the suggestion here would be correct, as measurement units that were part of the same system were all in common use in India at around the same time.

There is another genetic connection here in that according to the investigations of Oppenheimer, there is evidence of a line of descent from emigrants from Sundaland in South-east Asia. [Note: This is explained in Chapter 17.]

Sometimes in the line of research one finds an abundance of evidence for a specific argument. Here the dimensional arguments are reinforced by the existence of the Indian bricks. Praise to the bricks and the brick manufacturers of ancient days! Bricks are found in abundance, and although bricks in the general region were also manufactured to dimensions other than the sizes above, those quoted were by far the most common. [Mehrgarh is a separate issue.] In itself this suggests that the measurement units in use were widely understood, and not a specialist entity. Averages can be made when numerous examples are available; this is not the case when only a single item is found and the evidence then is not so firmly rooted.

However, given the numbers of these bricks in existence in the region as a whole there can be no doubt whatever that the design or target dimensions were as stated above and that they fit within the margins stated to the ancient system being investigated in this work.

Unfortunately not all investigations into metrological matters are seen as clearly as the bricks of India. A bronze rod was discovered at Harappa and note was taken that it was marked in lengths of 0.367 of an inch. [11]

[We are not given an overall length in this report and presumably it was only a part of the whole scale]. The people writing up the reports which were replicated by later researchers claimed, erroneously, that this was half a digit of a cubit that was widespread in Asia and Egypt.

With that general assumption, there is no argument as a possible explanation but when one attempts to confirm the evaluation with the stated value of the cubit, 20.7 inches, the whole argument falls apart. 20.7 / 0.367 = 56.40326975. This is supposed to be a half digit of a cubit and handbreadth [seven handbreadths] evaluation where there would be 56 to the cubit. Obviously, the assessment is incorrect.

It is obvious that an attempt to relate this unit to a 7-handbreadth, 28-digit cubit has been made but it is clearly apparent, with the half digits not evaluating to a neat 56, that the units have not been sufficiently evaluated. Here we are dealing with an approximation because there should be an *exact* number of divisions into the cubit.

The cubit value to which the report refers can be seen as the *royal Egyptian* value of 1.718181818 feet reduced by the factors 441/440 as utilised by Neal, Stechini[12] and ourselves and the ½ digit value [56 units] being a theoretical 0.367346939 of an inch. Below is a table setting out the elements of a dimension set where there are seven handbreadths to the cubit with the cubit here at 1.75 feet.

Table 15.1 The Cubit and a Handbreadth (7 handbreadths) Evaluation using 1.75 as example.

Foot	Cubit	Step	Reed	Stadia	Mile
1	1.75 feet	2.916r feet	10.5 feet	583.3r or 700 feet	5,833.3r feet
12 ins	21ins	35 ins 1.6r cubits	126 ins 6 cubits	7,000 or 8,400 ins 200 or 240 step	70,000 ins 3333.3r cubits
16 digits @ 0.75 in	28 digits @ 0.75 ins	46.6r digits	168 digits		
4 hands @ 3 ins	7 hands @ 3ins	11.6r hands	42 hands		

Further evidence of the early use of measurement units coherent with Earth measurement is derived from ten signs presented on a monolithic signboard, which was

discovered at Dholavira [Kotda], Kadir Island in 1991 by R.S Bisht, Director of the Archaeological Survey of India.[13] The investigators of these signs were primarily concerned with the study of language, but the dimensions of the plaques are most intriguing. Ten signs all display the same precise height. This is given as 37 centimetres; widths vary and are stated as being 25 to 27 centimetres. Made of a crystalline rock, white in colour, they were apparently set out on a wooden board around three metres in length.

The height measure of 37 centimetres is within less than 0.8 of a millimetre of 1.216512 feet, 1/5,000 of a minute of arc of Earth's circumference, the Ptolemy foot. This equates as 1/108,000,000 of the Earth's circumference. 25 centimetres, the lower width value, equates as 0.820209937 feet. At 0.821333r, [within 0.01348 of an inch] we find 2/3 of the foot value 1.232, another measure in relatively common use, specifically in conjunction with religious artefacts. 27 centimetres, the maximum width, is 0.885826771 of a foot. 0.88 of a foot, which is within 0.0699 of an inch of this value, is exactly half of 1.76 feet or 1/12 of 10.56 feet.

15.3 Metrology in the Maldives

Since the popularisation of Plato's 'Atlantis' tale, many different theories have emerged regarding the origination of the story and the location of the original land.

Some Indian sources have suggested that the Maldives may have been the source of the myth, the low lying, tiny islands apparently being all that is left of a large area since the sea rose after the last ice age. Hence, at this point is included what is known of numerical evidence from the islands of the Maldives, where evidence of the 'Ptolemy or Posidonius mile', the minute of arc of the Earth's circumference again emerges.

Thor Heyrdahl, in the 1980's headed a team researching into the pre Islamic cultures of the Maldive Islands.[14] Some of the metrological results of this research are listed below. Within margins of error generally deemed acceptable for the general internal structure of the Great Pyramid, within 1/5 of an inch, the following was deduced from Heyardahl's notations in metric measure.

A square structure was uncovered, measuring 34.56 feet per side. It was oriented to the cardinal points. The *Long Egyptian* cubit of 1.728 British feet [evidence for which has been found in the Indus Valley] can be counted 20 times in this side length. It could also be seen as 21.6 x 1.6 feet.

The first Mosque to be built in the region was constructed over the base of another pre-existing temple of unknown, but probably Hindu provenance. Within 0.18 inches of the survey figure we find 34.56 x 1.2345679 or 42.666r British feet seen also as 12.8 inches x 40. This is interesting because $1^1/_9{}^{th}$ [1.111111] squared = 1.2345679. The value of nine seems to have some connectivity here because the larger building side dimension divided into the smaller results in the fraction 0.81. It would seem that this concept of nines [81 / 9 = 9] has been seen to be of importance in the past.

Another numerically intriguing ninth factor here is that $^1/_9$ of the smaller building's side length is 3.84, which divides exactly $11^1/_9$ [100/ 9] times into the side length of the larger structure. The numerical connection can be seen in that: 11.111111111 / 9 = 1.2345679. [See

above] and 128 [See above] x 3 = 384. While it is, of course impossible to physically measure to such a refined degree on an old [or for that matter a new] building, the results of the survey, which, as shall become apparent, was very accurate, lead us in this direction.

If one takes the value of the minute of arc, the Ptolemy mile, increased by its 1/9 part to 6758.4 [as in Piri Re'is scales] and divide by the stated building width above of 42.666666 the result is 158.4, where 1.584 is a familiar cubit value in British feet.

Two circular ceremonial baths have also been uncovered by this expedition. One of these had a diameter that again involves the Ptolemy mile increased by its 1/9 part and thereby implicates the Piri Re'is scale. This was measured on site at 20.6 metres, which converts to 67.58530184 feet. At 67.584 feet, within 0.0156 of an inch or well under half a millimetre, we have a scaled down version of this now familiar value of 6758.4 British feet. A further circular ceremonial bath had a circumference that calculated as the diameter seen above multiplied by 2.16. Perhaps it is coincidental that in a circle there are 21600 minutes of arc.

A further building was discovered, at least its remains below ground level, which was another square structure orientated to the cardinal points. Within an inch, which is by far the greatest tolerance allowed in these dimensions, most are within less than a tenth of an inch, its foundation stones gave an outline measure exactly 1/10 of the structural base line of the Great Pyramid, that of Khufu.

15.4 The Indian Yojanas

The Paitamaha School of Astronomy, according to Pingree, evaluated the world's circumference at 5,000 *yojanas.*[15] To discover the value of this *yojana* simply multiply the familiar minute of arc, the Ptolemy or Posidonius mile of 6082.56 feet by 4.32. Perhaps the easiest way to memorize this value is as 5.184 Greek miles because 5.184 x 5,000 = 25,920 which is the Earth's circumference in Greek miles.

Contained within the length of one of these *yojana* measures are 50.4 stades of the value utilised by Erastothenes in his Earth measure. The square of the Earth in a circular format, as seen in miniature at Stonehenge in Chapter 7, has a radius of 50.4 British feet. 50.4 x 2 = 100.8 and 100.8 x 22/7 = 316.8. The full size version has a circumference of 31,680 miles.

It would seem that these measurement units and indeed not only the units but the numerical values themselves, are of prime importance, and were utilised in a symbolic manner.

At 5,000 *yojanas* to the Earth's circumference the value of a *yojana* is 4.97664 British miles, 5.184 long Greek miles, 5.4 long Roman miles or 4.56192 long Egyptian miles . [Almost certainly unknown in those days but nevertheless a neat ironic coincidence is the fact that at 864000 miles diameter the sun measures 4561920000 feet.]

However, there was more than just one value for the *yojana.* In fact there were three *yojana* lengths. This part of the investigation turns to the work of Richard L. Thompson for guidance where he cites two variations. Thompson has accomplished much in the deciphering of Indian texts, specifically in the realms of astronomy. However, as will be seen, Thompson and others mentioned have not been working with the circumference value from Michell, which

has been demonstrated to be that in use in the ancient past and in consequence, these researchers do not have the correct *yojana* lengths.

Thompson notes that the *Surya Siddhanta*, some of which is examined below, can be firmly dated to the 15th century AD. That its content greatly predates this is not in doubt, but its provenance is, unfortunately unknown. As will be seen in extracts from the work of Burgess its translator, and quotes from the material itself, this work is not as accurate in some respects as that of its predecessors. Therefore we can be sure that greater was the knowledge and almost certainly the skill of those who, in Indian astronomy and geodesy, went before.

In Burgess' 1858 translation of the *Surya Siddhanta* [i 58] is found a comment relating to planetary movement that is interesting and in fact reinforces the concept portrayed earlier in this work…that of forgotten method and knowledge. Burgess writes: -

'…not a little violence is done to the natural construction. This would seem to require that it be rendered: "and the rest are in whole signs (have come to a position which is without a remainder of degrees); they, being of slow motion, are not stated here. But the actual condition of things at the epoch renders necessary the former translation…We cannot avoid conjecturing that the natural rendering was perhaps the original one…' [16]

One cannot but agree with Burgess. As stated earlier, accuracy is imperative in geodetic work and perhaps even more so in astronomical observations and calculations. Ultimately, as will be revealed later in this work, geodetic measure was initially based upon the results of astronomical observation. As the geodetic measure is being seen to be accurate, the implication is that the early astronomical observations and recordings were treated equally as carefully. [i59] of the *Surya Siddhanta* tells us that:-

Twice eight hundred yojanas are the diameter of Earth: the square root of ten times the square of that is the Earth's circumference.[17]

The *yojana* length derived from this is close to one of the correct measures, although still an approximation, as indeed Burgess has commented upon some of the calculations seen within the text that refer to another, earlier or 'natural' set of figures. However, if Earth's diameter is taken at 7,920 miles, which was the accepted figure, and divide by 1,600 we have a *yojana* length of 4.95 miles, which is close to the correctly calculated value of 4.97664.

To continue with the instructions in the verse, the square root of ten times the square of 1,600 yields 5,059.644256 *yojanas*. At 4.95 miles per *yojana* this results in a circumference of 25,045.23907 miles. Although reasonably close, this is some 162 miles over the size of the Earths circumference. It has been demonstrated that the Earth's circumference was understood long before the composing of this work and it is suspected that a series of approximations over succeeding generations since the advent of recording these matters in writing have led to compounded errors. Even the bricks in India implicate more accurate work than this. In [i60] of the *Surya Siddhanta* Burgess adds a very extensive footnote. In part, he states:

'There is the same difficulty in ascertaining the exactness of the Hindu measurement of the Earth as of the Greek; the uncertain, namely, of the unit of measure employed.' [18]

This is a now familiar concept, which thankfully, after much effort in research it is now possible to throw some light upon.

There are various interpretations of the diameter of Earth in terms of *yojanas*. Returning to Burgess footnote of (i 60) of the *Surya Siddhanta*:

'Aryabhatta ...states the Earth's diameter to be 1,050 yojanas: Baskara...gives it at 1,581: the latter author in his Lilavati (i,5,6) makes the yojana consist of 32,000 cubits.' [19]

To this we can add that other sources [mathematics department of St. Andrews University for example] state that Aryabhatta's estimate of the Earth diameter was $1581^{1}/_{24}$ yojanas and for the circumference 4967 yojanas. However, according to Burgess in the notes to Surya-Siddhanta 1:58-60, it was Bhaskara who calculated the circumference at 4967 yojanas.

We are back in familiar territory here. The academics and historians and most surprisingly even Burgess simply haven't a clue to the distances involved and make what can only be described as guesses to the value. It would certainly appear that 5 miles has been taken as an approximation of the yojana length and the other counts seen in the old texts but not fully understood have been taken to be the number of yojanas in the circumference or diameter of Earth. However, further evidence below will go a long way in confirmation of the suggestions made here.

But before that there is another matter which requires attention, the π value that Burgess claims was in use. According to the footnote, the value for π that was in use in the calculations was 1:√10 or 3.1623. Burgess further comments that this was inconsistent and inaccurate. This work concurs with Burgess, but is in disagreement with his statement regarding the value that was in use of 3.1416 for these astronomical and geodetic matters.

A number of variants such as 3.142662285 were occasionally applied, [see Atlantis evaluation in our companion work *Deluge*]. It is claimed here however, and the numerical results and connections seen throughout the work reinforce the argument forwarded in Chapter 6, that both the values 3.1418181818 and 22/7 [3.14285714285] etc were most commonly in use. The latter is demonstrated in the evaluation of the 'Brazen Sea' at Solomon's Temple and the weights system seen in a later chapter fits perfectly to that evaluation.

In Cunningham's *The Ancient Geography of India* of 1871[20] quoted by Thompson, one reads that the Greek historian Strabo [ca 63 BC-24 AD] cited the Greek geographer Megasthenes [ca 350-290BC] evaluation of the position of pillars set up along the length of the royal road to the Indian capital of Palibothra [near modern Patna]. Strabo stated that these were set at ten *stadia* spacings and Cunningham thought that these were at intervals of one *krosa*.

The *yojana* was itself split into smaller units as seen here with the use of the krosa. Effectively the *yojana* was comprised of four *krosa* which were subdivided into 2,000 or 1,000 *dhanus* of four *hastas* where a hasta of 24 *angulas* corresponds to a Western cubit.[21]

But what is meant by a 'Western' cubit? This evaluation begins with an assessment of what the *yojana*, at 5,000 to the Earth's circumference as denoted by the Paitamaha School of Astronomy should be.

Earth's circumference = 24,883.2 miles

24,883.2 miles / 5,000 = 4.97664 British miles = 5.184 *Long Greek* miles.

A *krosa* related to this value would therefore be 1.24416 British miles = 6569.1648 feet = 1.296 *Long Greek* miles. This is interesting because the Earth's circumference is made up of 129,600,000 *Long Greek* feet, here is a further reference to the same number. Therefore the *krosa* to which Cunningham was making reference would have been 10 stadia of 648 long Greek feet.

In British measure 1/1000 of the *krosa* for the *dhanu* is 6.5691648 feet [1.056 feet x 6.2208] where 622.08 miles is 1/40 of the Earth's circumference, or indeed, 6.5691648 feet is 1/20,000,000 of Earth circumference.

A *hasta* of this measure now can be seen to be 1/16,000 of the *yojana*, or 1.6422912 feet, [termed a cubit this has a foot value of 1.0948608 which is 1.08 times the long Greek foot of 1.01376 as designated by Michell]. This *hasta* is exactly 1/80,000,000 of the circumference of the Earth. Divided into 24 *angulas* a value is now discovered of 0.8211456 inches, which is 1/1,920,000,000 of the Earth's circumference.

From this, it can be seen that the 'Western cubit' is the *hasta* of 1.6422912 British feet [1.62 *Long Greek*] with an inch count for the foot value of 13.1383296 where the circumference of Earth is 131,383,296 feet [12.96 *Long Greek* inches where the circumference is seen as 129600000 feet]. The foot value is 1.08 *Long Greek* feet where as is clearly demonstrated in *Deluge*, 1.08 was valued as an important factor for mathematical change in India in these times. In other words the foot value of the so called 'Western Cubit' divides into the circumference of Earth as denoted by Michell, exactly 120,000,000 times.

Hence it has been shown that the Indian measurements, when applied to the correct value in use in the ancient world for the circumference of the Earth, which was evaluated and published by Michell, fit precisely. There can be no mistake, as further evaluation will clearly show.

Summing up we can state the the yojana lengths of:-

4.608 miles	= 4 minutes of arc of Earth circumference
4.97664 miles	= 4.32 ditto
8.64miles	= 7.5 ditto

15.5 India and China plus America: Numerical Connections

This accurate knowledge spread to China, presumably from India. To further quote Burgess in his footnotes to (i, 60) of the *Surya Siddhanta*:

'Lliuen- Thsang, the Chinese monk who visited India in the middle of the seventeenth century, reports (see Stanislas Julien's Memoires de Hiouen- Thsang (i, 59etc.) that in India 'according to ancient tradition a yojana equals forty li; according to the customary use of the Indian kingdoms, it is thirty li; but the yojana mentioned in the scared books contains only 16 li' [22]

This caused some confusion. However, by applying what has been learned about the ancient values a little enlightenment can be thrown onto the matter. It has been stated above that there were three values for the yojana or a variety of counts of *li.* We shall [as in *Deluge* we show this to be correct] assume that there are three different yojana lengths.

According to Thompson, the *krosa* of the short *yojana* is one minute of latitude at the equator and the modern nautical mile is defined in the same way. The long *yojana* is seen to be 7.5 minutes of latitude.[23]

Thompson also argues that the *hasta* was 460.7 millimetres, an element of a degree of latitude at the equator that was used in India. This value is 18.13779528 inches or 1.51148294 feet. In fact, the *Short Greek* cubit is 1.512 feet and this does relate to a degree of latitude at the equator. In this evaluation then, although not correct according to Thompson's interpretation of the ancient evaluation, we have a figure that is very close. However, the notion that this should divide equally into the *yojana* is in error, it does not. It is when the *long* Greek measures, based upon an *average* degree of latitude or to be more specific, *a degree of the globe of the Earth at the ancient circumference*, are divided into the *yojana*, that are seen the correlations in measure. This is clearly apparent in that: -

In the Earth's circumference are 25,920 long Greek miles. In the yojana evaluated above of 4.97664 British miles are 25,920 long Greek feet or 17,280 long Greek cubits. Hence, it is certain that as with the other early measures, it is this circumference of Earth and the degree and minute divisions of that circumference with which the geographers of ancient times were working.

Earth circumference = 24,883.2 miles
24,883.2 / 21,600 [for minute of latitude] = 1.152 miles = *krosa*.
1.152 x 4 [for *yojana*] = 4.608 miles.

This is different from the 1/5,000 of Earth circumference evaluation seen above, it is 1/5,400 and yet still fits exactly to the ancient values, as it complies with the natural divisions of the circle. Effectively a connecting value between these two measures that is highly canonical should be found, and indeed it is:-
4.97664 / 4.608 = 1.08.

108 is a highly valued number in India and in most parts of the ancient world. It seems that here we have the short *yojana* value. A third, longer *yojana* length is seen in the 7.5 minutes of arc of Thompson's long *yojana*, which results in 8.64 British miles or 9 Greek miles. Table 14.5 shows some of the connections between these values. Here are the three yojana lengths with their derivation in British, Egyptian, Greek, Roman and Sumerian miles. Further reduction to cubits and feet would show even more connectivity to the ancient values.

Table 15.2 *Yojana* lengths in miles

Yojana	British	Egyptian	Greek	Roman	Sumerian
short	4.608	4.224	4.8	5	4.42368
medium	4.97664	4.56192	5.184	5.4	4.7775744
long	8.64	7.92	9.72	10.125	8.2944

Table 15.3 Fractions of Earth circumference of *Yojanas*

Yojana [British units]	4.608 miles	4.97664 miles	8.64 miles
Fraction of Earth circ.	4 minutes of arc	4.32 minutesof arc	7.5 minutes of arc

Let us return to the quotation above regarding numbers of *yojanas* in the Earth's *diameter*.

Aryabhatta …states the Earth's diameter to be 1050 yojanas: Baskara…gives it at 1581: the latter author in his Lilavati (i, 5,6) makes the yojana consist of 32,000 cubits

At 4.608 miles per yojana we find 1718.75 *yojanas* in the diameter of Earth.
At 4.97664 miles per yojana we find 1591.435185 *yojanas* in the diameter of Earth.
At 8.64 miles per yojana we find 916.66666666 *yojanas* in the diameter of Earth.

These do not work with the polar diameter of the Earth either. However in the *circumference* of Earth there are:

5,000 at 4.97664 miles to the *yojana*
5,400 at 4.608 miles to the *yojana*
2,880 at 8.64 miles to the *yojana*

Hence, given these neat correlations we can see that the value of the yojana was definitively based upon the circumference of Earth and not its diameter. The comment regarding the 32,000 cubits to a *yojana* would be in error for any of the shorter *yojanas,* as the resultant calculation would give a foot measure and not a cubit. However, when the *yojana* asserted here to be 8.64 miles in length is utilised in this fashion a totally different picture emerges.

8.64 miles = 45619.2 feet = 32,000 x 1.4256feet = 1.5 x 0.9504 feet or 11.4048 ins and this is the relevant foot value which is directly linked to the basic system. The cubit is a reduction from 1.584 by the factor 1.111111111 as indeed is 1.584 from 1.76. This is the cubit of Angkor Wat in Cambodia and it has the same foot value as applied to the Great Pyramid by Herodotus. The three *yojana* lengths have their divisions to establish, hence Tables.15.3 – 15.5 show these divisions in foot units from various dimensions sets.
. As a reminder, the *yojana* was comprised of four *krosa* which were subdivided into 2,000 or 1,000 *dhanus* [here 1,000] of four *hastas* and a *hasta* is 24 *angulas.*

It is seen that the short *yojana* complies well with the long Greek measures as 24 of the associated digits of 0.76032 inches = the cubit of 1.52064 feet. The *krosa* is the long Greek mile x 1.2

Table 15.4 Short *yojana*

	British	Egyptian	Greek	Roman	Sumerian
krosa	6082.56	5280	6000	6250	5529.6
dhanu	6.08256	5.28	6	6.25	5.5296
hasta	1.52064	1.32	1.5	1.5625	1.3824
angula(ins)	0.76032	0.66	0.75	0.78125	0.6912

Table 15.5Medium *yojana*

	British	Egyptian	Greek	Roman	Sumerian
Krosa	6569.1648	5702.4	6480	6750	5971.968
Dhanu	6.5691648	5.7024	6.48	6.75	5.971968
Hasta	1.6422912	1.4256	1.62	1.6875	1.492992
Angula(ins)	0.8211456	0.7128	0.81	0.84375	0.746496

Table 15.6 Long *yojana*

	British	Egyptian	Greek	Roman	Sumerian
Krosa	11404.8	9900	11250	11718.75	10368
Dhanu	11.4048	9.9	11.25	11.71875	10.368
Hasta	2.8512	2.475	2.8125	2.9296875	2.592
Angula(ins)	1.4256	1.2375	1.40625	1.46484375	1.296

As can be seen there is a repetition of some familiar numbers among these lists. By converting into cubits etc there is great deal more to be found as shown with the short version and the connectivity of this ancient system can be seen well.

A little further analysis is required. The brick dimensions seen earlier can be evaluated against some of these measurement units. When evaluated against the long *yojana* we find that the brick *lengths* divide in the following manner: -

8.64 miles / 1.32 feet = 34,560
8.64 miles / 1.08 feet = 42,240
8.64 miles / 0.99 feet = 4,608

Now we shall examine the Chinese connection to the above values and the evaluation is based upon the interpretation by *Lliuen- Thsang* seen earlier. There is a confused list of unsubstantiated Li measures available on Wikipedia. It is found far more informative to make more practical evaluations than to rely on metric conversions of values that are not

substantiated with the metric conversions being approximations. Hence we make our own calculations based upon what we have seen to be correct.

There were three different values for the *li* which as there are three *yojana* lengths must be more than coincidental. The words used in description were *ancient traditional*, *customary* and *sacred* with the divisions in the same order of 40, 30 and 16. It would initially appear, given that both systems have the element of three measures that only one of the Chinese measures applies to each *yojana*. To understand which is liable to be the correct value, here will be included the same divisions of each *yojana* for numerical comparison.

Table 15.7 Yojanas and the Li (in British units)

Yojana[British units]	4.608 miles	4.97664 miles	8.64 miles
40 *li* division	608.256 feet	656.91648 feet	1140.48 feet
30 *li* division	811.008 feet	875.88864 feet	1520.64 feet
16 *li* division	1520.64 feet	1642.2912 feet	2851.2 feet

Looking at this table, however, ALL of these variations are equally valid. It is therefore proposed that each *yojana* had its Chinese subdivisions of *li* and these divided into the Earths circumference as seen in table 15.8.

Table 15.8 Yojana and Li ratios

Yojana	4.608 miles	4.97664 miles	8.64 miles
40 *li* division	216,000	200,000	115,200
30 *li* division	162,000	150,000	86,400
16 *li* division	86,400	80,000	4,608

Table 15.9 For comparison, the division into the Earth's circumference of the smaller sub units of the *yojanas.*

	Short *yojana*	Medium *yojana*	Long yojana
Krosa	21,600	20,000	11,520
Dhanus	21,600,000	20,000,000	11,520,000
Hastas	86,400,000	80,000,000	46,080,000
Angulas	2,073,600,000	1,920,000,000	1,105,920,000

Given the fact that the ancient people of all nations and cultures were watching the skies intently it is no surprise that recently an ancient Chinese observatory has been discovered near to Linfen in Shanxi toward the east of China.[24]

This site dates to 2100 BC and comprise an arc of 13 columns taking up slightly over a semi circle with the centres of the spaces between columns 1and 2 and 12 and 13 marking the semi circe's beginning and end. These pillars were used, according to the report by archaeologists to *'mark the movement of the sun through the seasons.'* The setting out here was for the winter and summer solstice positions indicating the semi circle. While the summer period equinox to equinox is slightly longer than the winter period this will make no difference

to the setting out of these columns, the difference is too small. The sun was sighted at the centre of the space between columns hence there was a tolerance here. The centres of the columns were set at 16 x 1.17333 feet or 18.7733333 feet between their centres. The diameter of the semi circle was cited at 40 metres, in fact when accurately investigated [assuming that the reports in the media are accurate with the figures] it was some 2.79 inches wider than this.

This would also be useful in tracking the moon, although only for around half a month at a time!

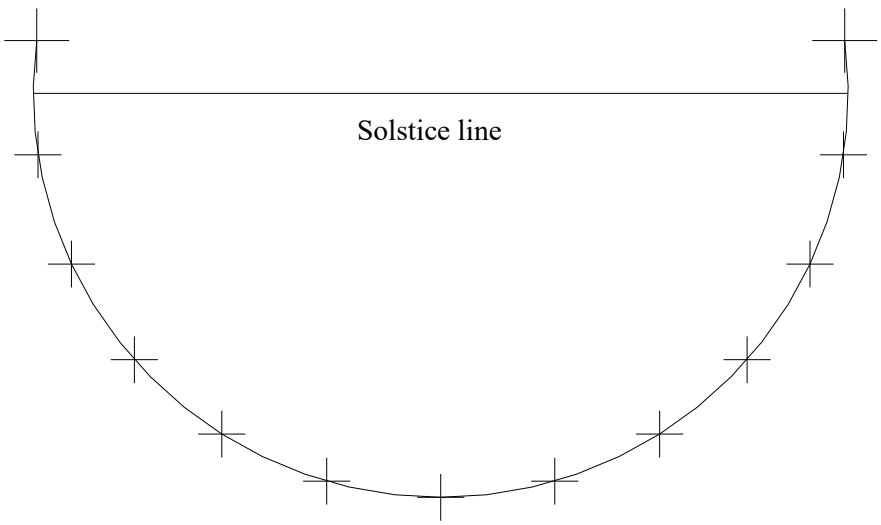


Fig 15.10. Line diagram showing the setup at the observatory.

Regarding the size of this observatory, the 'instrument' as stated had a diameter of just over 40 metres and 12 spaces around its perimeter of 18.7733333feet.

This last value relates very well to the three Chinese Li values that are related to the 4.608 mile joyana from India.The resultant numbers seen in the table here are familiar from across the spectrum of the ancient measurement system.

Table 10

Yojana[British units]	4.608 miles		Li division into Earth circumference.
40 *li* division	608.256 feet	= 32.4 @ 18.7733333	216000
30 *li* division	811.008 feet	= 43.2 @ 18.7733333	162000
16 *li* division	1520.64 feet	= 81 @ 18.7733333	86400

As seen above 18.7733333 = 16 x 1.1733333 where 1.1733333 is the foot value of the 1.76 foot cubit and hence 1/9 of the10.56 foot reed measures. This evaluation therefore fits with whole of the measurement system of antiquity.Additionally the spaces between the centres

of holes at the Aubrey Circle Stonehenge were 16 feet, British and not at 1.17333333 but still a count of 16…why the commonality?

Given that this was erected circa 2100BC it is abundantly clear that there was contact between China and India before this period, or perhaps other regions who by then were familiar with the measures. This also goes a long way toward verification of the concept of the Chinese visiting America and taking the measurement system with them seen earlier in Chapter 4.

So let us look further into the possibility of a relationship betwee the Indian and Chinese measures and that evidenced in Meso America, Michell's 'sacred rod' or the Mayan Hunab as denoted by Hugh Harlstone in the 1970s when he calculated from numerous surveys, the primary unit employed at Teotihuacan. If we can find connection sin addition to the possibility seen above then we can be reasonably certain that the expeditions described in Pale Ink are indeed genuine records as we know of no other such early exploratory moves in the direction of America, from any direction, by people who could have carried the knowledge of the measures with them.

Table 11 **4.608miles = 7000 hunab**

Yojana[British units]	**4.608 miles**	Hunab at 3.475748571	Chi[1500 per Li]
40 *li* division	608.256 feet	175 hunabs	0.405504 feet
30 *li* division	811.008 feet	233.33333hunabs	0.540672 feet
16 *li* division	1520.64 feet	437.5 hunabs	1.01376feet

Table 12 **4.97664 miles [1/5000 Earth circ] = 7560hunab**

Yojana[British units]	**4.97664 miles**	Hunab at 3.475748571	Chi[1500 per Li]
40 *li* division	656.91648 feet	189 hunabs	0.43794432feet
30 *li* division	875.88864 feet	252 hunabs	0.58392576 feet
16 *li* division	1642.2912 feet	472.5 hunabs	1.0948608feet

Table 13

Yojana[British units]	**8.64 miles**	Hunab at 3.475748571	Chi[1500 per Li]
40 *li* division	1140.48 feet	328.125 hunabs	0.76023feet
30 *li* division	1520.64 feet	437.5 hunabs	1.01376feet
16 *li* division	2851.2 feet	820.3125 hunabs	1.9008 feet

Given the numerical connections seen here, specifically as the divisions give other familiar values and 175/1.75 =100, 472.5/1.75 = 270, 437.5/1.75 = 250,252/1.75 = 144 there is such a series of confirmatory numerical associations that we can confirm that the work Pale Ink, is virtually certain to reflect genuine expeditions to the Americas. There are other associated numerical values to be found via these tables and some of these emerge as counts of Hunab at Teotihuacan.

Each of these values seen on the pages in these two books, the current work *Measurements of the Gods* and the companion work *Deluge: From Genesis to Atlantis*, is highly important in the ancient numerical system and can be found in numerous places. It is the numerical values with which one should be concerned. But again, other measures were in use in China as we have seen but they were related to the system in general. Circa 9 AD, the Xin dynastic rulers interrupted the Han dynasty for a period. To the south of Changan, during

this period, a number of ritual structures known as *Pi Yong* came to be erected. At this era a Li of what has been recorded at 415.8 metres was in use but in reality the value was 415.7472. This gave a count of 1.76 x 775 and the Li/1.76 or 775 feet was the length of the outer square of the development seen below.

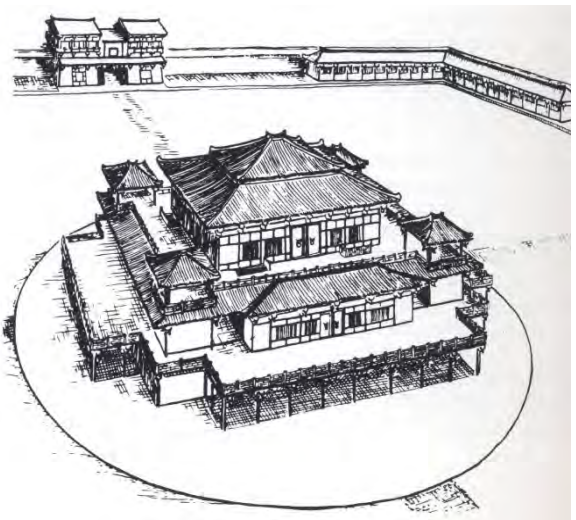


Fig. 15.11 The Ritual Buildings of Pi Yong

As John Manley[25] relates, the *Pi Yong,* according to Confucian rituals, 'is *where the emperor performed various rituals and played music'.* The areas contained a number of structures as seen in Manley's illustration replicated below. These involved a square security/screening wall and attached buildings surrounded by a circular ditch and embankment. In the centre of the area was a square building on a raised circular platform**.**

An outer ditch, according to Manley, measured 1,188 feet in diameter. This means that the perimeter of the circle was 2160 x 1.728 with pi at 3.14181818, the ancient value which is closer to the modern 3.141592654 than the 22/7 version. The outer square[seen in the illustration] is recorded as measuring 775 feet per side. The dimensions of the square inner building are not given but the circular platform is said to be "nearly" 200 feet. If this value was 199.584 then it would read as 1.98 x 100.8 giving a circumference [22/7] of 316.8 x 1.98. [1.98 feet as a cubit is fitting because its reed measure is 11.88 feet or 1/100 of the outer circle's diameter.] And for a final confirmatory note, 1188 x 12 = 14256 where the cubit at Angkor Wat was 1.4256 feet giving yet another correspondence between the ancient measurement units.

This section can be concluded in the statement that there can be no doubt whatever of the widespread use of, and early understanding of, these linear measures and indeed the importance of the numerical system itself. All the values were interlinked and were intimately related, although perhaps this is not always immediately apparent. Most of the units are related to the circumference of Earth as understood prior to the French calculations made for the metric system development of 24883.2 British miles, or to the 7920 British mile diameter of the Earth.

The few values that remain are intercalary values, factors. How the initial measuring was achieved, and where and when this momentous occurrence happened, is the fascinating subject matter of Chapters 17 and 18. Suffice to say here that while there is clear evidence of its usage in China, it is also evident that China was not the source, as numerous historians relate that Chinese mathematical development came after that of Mesopotamia.Hence we look to an era of around 3000BC and shortly afterwards.

This investigation has taken us back in time 9,000 years to find the earliest evidence of the use of what we have termed the *measurement system of antiquity*. Yet even then, although there is clear mathematical connection to later evidence, there is no sign of a learning curve in this respect, merely the use of a mature system of linear measurement seen in the brick dimensions of the Mehrgarh. This raises the possibility that even in India the system was imported from elsewhere. Hence, it is necessary to examine the inhabitants of this region of India at 9,000 years ago in a little more detail to take the history back any further. This is done in Chapter 17, but before then we introduce another input to the study of ancient metrology, that of ancient *weights.* Here we find corroboration with much that has been previously stated in this work and much that will contradict convention.

CHAPTER 16

Weights and Measures

I am convinced that everything has come down to us from the banks of the Ganges, astronomy, astrology, metempsychosis, etc....

Voltaire, *Lettres sur l'origine des sciences et sur celle des peuples de l'Asie* (first published Paris, 1777), letter of 15 December 1775.

16.1 Imperial and Metric Weights and Volumes

Many younger readers may be unfamiliar with the relationship between and general history of, the relative historical weight systems and so a brief refresher of units relevant to this chapter is included below.

As discussed in Chapter 3, the *Imperial units* or the *Imperial system* is a set of English units that collectively became official via the Weights and Measures Act of 1824. They were later refined [until 1959] and reduced. The units were introduced in the United Kingdom and its colonies, including Commonwealth countries [although today, most Commonwealth countries are now fully metricated], but excluding the then already independent United States. Systems of Imperial units are sometimes referred to as *foot-pound-second*, after the base units of length, mass and time.

In 1824, Britain adopted a close approximation to the ale gallon known as the Imperial gallon. This was not a new measure, merely one that at that time was chosen as the official gallon. The Imperial gallon was defined as the volume of 10lb of distilled water weighed in air with brass weights, with the barometer standing at 30 inches of Mercury and at a temperature of 62 Fahrenheit. In volume this was calculated at 277.274 cubic inches [Encyclopedia Brittanica]. As detailed in Chapter 3, by utilising a different temperature than the $56^1/_2$ degrees Fahrenheight Select Committee recommendation of 1816, the values of these weights in terms of weight / liquid / volume altered. Again, during the period when Britain commenced 'going metric', notably in 1963, this value of 277.274 was further refined to 277.421 cubic inches [Encyclopedia Brittanica] complying with the new description of the gallon which revealed its properties as 'the space occupied by 10 lb of distilled water of density 0.998859 g/ml weighed in air of density 0.001217 g/ml against weights of density 8.136 g/ml'. Using the value of 61.02374 cubic ins per litre found in the Dent Dictionary of Measure, this works out to exactly 4.545964591 litres, or 277.421cubic in. The Weights and Measures Act of 1985 finally switched to a gallon of exactly 4.54609 litres [277.4194142 cubic ins]. Table 16.1 summarises the basic Imperial/Metric volumetric relationships as seen in these latest versions.

Table 16.1 Imperial and Metric Volumetric units

	ounce	gill	pint	quart	gallon	litre
1 (fluid) ounce	**1**	$^1/_5$	$^1/_{20}$	$^1/_{40}$	$^1/_{160}$	0.028 413063
1 gill	5	**1**	$^1/_4$	$^1/_8$	$^1/_{32}$	0.142 065313
1 pint	20	4	**1**	$^1/_2$	$^1/_8$	0.568 26125
1 quart	40	8	2	**1**	$^1/_4$	1.136 5225
1 gallon	160	32	8	4	**1**	4.546 09

Britain used three different weight systems in the 19th and 20th centuries, namely *troy weight*, used for precious metals, *avoirdupois weight*, used for most other purposes, and *apothecaries' weight*, now virtually unused since the metric system is used for all scientific purposes. The use of the troy pound [373.2417216g] was abolished in Britain on January 6, 1879, with only the *troy ounce* [31.1034768g] and its decimal subdivisions retained [which is still used in the precious metals industry]. In all the systems, the fundamental unit is the pound, and all other units are defined as fractions or multiples of it.

It is the avoirdupois weight system that we will focus on at this point whose relationship with the metric system is summarised in Table 16.2.

Table 16.2 Avoirdupois weight relationships

			Metric
1 grain			64.798 91 mg
1 drachm	1/16 ounce	1/256 pound	1.771 845 195 312 5 g
1 ounce		1/16 pound	28.349 523 125 g
1 pound	7000 grains		453.592 37 g
1 stone		14 pounds	6.350 293 18 kg
1 quarter	2 stone	28 pounds	12.700 586 36 kg
1 hundredweight	4 quarters	112 pounds	50.802 345 44 kg
1 ton	20 hundredweight	2240 pounds	1016.046 908 8 kg

Note that the British ton is 2240 pounds [the 'long ton'], which is very close to a metric tonne, whereas the ton generally used in the United States is the 'short ton' of 2000 pounds [907.18474 kg]. Note both have 20 hundredweights.

To reiterate the discussion in Section 7 of Chapter 3, in the United States and in a few Caribbean countries, the US customary units, which are similar to Imperial units based upon older English units and in part share definitions of them, are still in common use. Imperial units have been generally replaced elsewhere by the SI [metric] system. Most Commonwealth countries have switched entirely to the international system of units. British law now defines each Imperial unit entirely in terms of the metric equivalent.

The relationship between weight and the associated volume of water in the definitions above will be found later to have great relevance to this chapter.

16.2 Solomon's Temple and the Molten Sea

In an attempt to rationalise the many weight measurement units in use in antiquity, initially it is essential to look to the Biblical description of King Solomon's Temple in Jerusalem, which the Bible researchers date to the 10th century BC. While the Temple, its dimensions and its relationship to another Biblical icon, the famed *Ark of the Covenant*, are discussed in a chapter in our companion work, *Deluge*, there, one specific item was left out because its analysis is critical to the understanding of the weight system which is detailed in this chapter and had no importance to the story of *Deluge*. This is what is termed the 'Molten Sea' which is commonly thought was a ceremonial washing facility for the priesthood. The *Molten Sea* or *Brazen Sea* was a bronze hemispherical bowl filled with water. It is important in the context of a study of ancient weight units because it relates liquid volume and hence liquid weight and according to the Biblical description it contained 2,000 'baths'. It will be found that there are connections between this unit of a *bath* and a variety of cubic weights made of the quartzite mineral, chert, which were discovered in India. These connections extend to other systems across a wide area over thousands of years.

The relevant cubit for general Biblical use was that of 1.584 feet with a foot length reflecting the numerical value of Noah's year of birth at 1.056feet. This is known in the description of the temple as the 'first cubit'and the derivation is fully explained in *Deluge*.

The first book of Kings reveals the following; Chapter 7 verses 23 to 26:

23 And he made a molten sea, ten cubits from one brim to the other; it was round all about, and his height was five cubits; and a line of thirty cubits did compass it about.
24 And under the brim of it there were knops compassing it, ten in a cubit,
compassing the sea round about; the knops were cast in two rows, when it was cast.
25 And it stood upon twelve oxen, three looking toweard the Nrth,and three looking toward the West, and three looking toward the South and three looking toward the East:and the sea was set above upon them, and all their hinderparts were inward.
26 And it was an handbreadth thick, and the brim was wrought like the brim of a cup, with flowers of lillies: it contained two thousand baths.

The circumference of the Molten Sea, therefore, 30 cubits at 1.584 feet, calculates to 47.52 feet. Utilising 22/7 for π there is a diameter of 15.12 feet derived from this circumference. Yet the text also states that it was ten cubits from one brim to the other. The formula for circular measure, that known as π, was certainly not seen to be 3 [although some uninformed commentators have referred to this Biblical text in that manner], it is therefore necessary to look at things from a more logical angle, as denoted by the measurement units. Ten cubits is then 15.84 feet. The 15.12 feet is evidently the internal diameter comprised of what John Michell terms *Short Greek* cubits with 15.84 feet diameter being a reference to the outside. The 30 cubit circumference is a reference to the inside from which the volume was calculated.

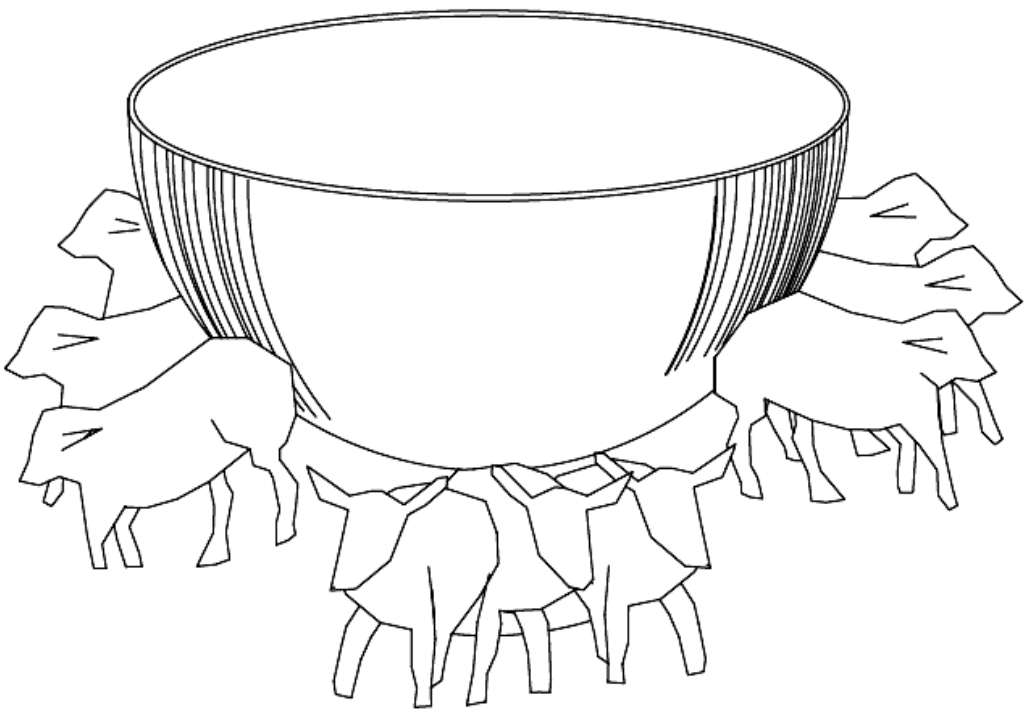


Fig 6.1 The Molten Sea of Solomon's Temple

15.84 feet less 15.12 feet = 0.72 feet or 8.64 inches. This is divided in two for a final single thickness of 4.32 inches, inclusive of the knops. From this is deducted the thickness of one handbreadth, the actual thickness of the casing of the bowl. A handbreadth of the 1.584 foot cubit is 3.168 inches. A thickness for the knops of 1.152 inches is left, which in fact is a *Long Egyptian* inch related to the now familiar cubit from Egypt of 1.728 feet. Setting out of the knops was neat; they were small, ten to a cubit. The centres of these decorative supports were therefore 1.9008 inches or a tenth of a cubit of 1.584 feet apart, and there were therefore 300 knops to the perimeter of the vessel.

Hence here is the *Molten Sea.* [We shall not examine the oxen as they have no part to play other than being supportive.] From the dimensions given in the Bible, via our accrued knowledge of the units of measurement in use in the ancient world, we are now able to calculate its volume.

The internal diameter of this vessel = 15.12 feet = 181.44 inches. The radius therefore is 90.72 inches. The volume of a sphere is calculated by the formula $4/3\ \pi\ r^3$ hence for a hemisphere the volume is $2/3\pi r^3$.

When the volume of this hemisphere is calculated the number of pints contained in the volume is revealed and divided by 2,000 the value of a bath emerges.

[Note: The capacity of the Biblical 'bath' was first evaluated by Harry Sivertsen BEFORE the 1985 change in the value of a gallon. This was the fourth different interpretation of the same gallon since the 1790s! Therefore the pint volume of 34.677625 cubic inches [gallon of 277.421 cubic inches] was applied. This has been utilised throughout the chapter as the difference is inconsequential to the evaluations. It also serves to show how these spasmodic changes in what has been a constant throughout the ages can cause great confusion to those who are unaware of the history of weights and measures.]

90.72^3 = 746636.3412

746636.3412 x 22/7 = 2346571.358

2346571.358 x 2/3 = 1564380.905 cubic inches in hemisphere

1564380.905 / 34.677625

= 45112.11206 pints

Therefore there are 45112.11206 pints of water contained in this hemispherical bronze bowl. However, this is measuring exactly to the rim, an impractical situation because as soon as even a slight breeze disturbed this water, it would overflow. Putting one's hands in the container would considerably lessen its volume for the same reason. It can be concluded from this that the precise volume as calculated is not what was implied by the Biblical description.

If it is assumed that the intended volume was the equivalent of 45,000 pints of water then there are 112.1120607 spare pints in our calculated volume = 3887.78 cubic inches.

Divided by the surface area of water of 25866.08639 square inches this results in 0.150304145 of an inch or approximately 1/6 of an inch. This is the distance from the surface of the water to the lip of the vessel. It may not sound much, but is, given the surface area, a practical tolerance for this vessel's capacity. For all practical purposes, it can therefore be stated that this container has 45,000 pints, which fill it to within 1/6 of an inch of its brim. It contains 2,000 *baths*, and given the above evaluation a bath can now be seen to equate as 45,000 pints / 2,000 = 22.5 pints.

16.3 Ancient Weights in India

A series of weights were unearthed at a variety of sites such as Mohenjo-Daro and Harappa in the region of the Indus Valley. These weights were, apparently, consistent and accurate. Various units were discovered with denominations of: - 1, 2, 4, 8, 16, 32 etc. up to 128 units, each unit being twice the previous. As an aside, it is interesting to note the same system of doubling as is seen here was also utilised in a count of time in the *Yugas* or world ages in the Indian tradition.

Some of these weights were small enough to have been utilised by jewellers, yet others, which were directly connected mathematically, would have required ropes and block and tackle

to hoist into the air. Larger denominations of weights in 100's carried the system up to 12,800 of the base units, indicating a decimal count in addition to the concept of doubling the previous number. There is, nonetheless, much discussion regarding these units of weight and their denominations. The multiples have been given slightly different, but still coherent numerical values by different researchers. But in reality, the set-up is somewhat similar to the familiar imperial weight system and in fact, there is a direct relationship between the two methods, and indeed the weight units themselves.

The base unit, according to the researches of Feuerstein G., Kak S., & Frawley D. was 0.85 gram[1]. Encyclopaedia Britannica put the *calculated* value at 0.8565 grams[2]. However, Bisht quotes it at 0.8525 grams[3]. Bisht additionally relates a further series of lesser values, the base unit being 0.83575 gram[4].

Yet another series of weights from Lothal have been noted as having a base, which itself is divided into lesser units, of *approximately* 27.584 grams. This is in multiples of 1/2/5/10/20/50 etc up to 500[5]. There is no reason, however, why this sequence or those previously described, cannot be extended. In practise, it would simply mean a multiple of weights. As in this specific case, the largest is seen to be 500 of the base units, this single unit could be counted as many times as one wished, as with a pound weight for example. Larger denominations of the fine weights would have existed simply for practical reasons. The same obvious criterion applies to all the weights in the various series.

It is self evident, when examining the interpretations of the Harappan series, that there is a diversity of opinion. Between two interpretations can be found a difference of 0.0065 of a gram and if one accepts the smaller figure as a rounding of the value, there still remains a discrepancy of 0.004 of a gram. The implication is that this value is more theoretical than practical. The statement in Britannica of the *calculation* of the base weight and a decimal series of doubling supports this argument. If we add that the evaluation of the linear measurement units seen in Britannica, with the exception of the reference to the scales, which can be measured, also has its errors, then the situation becomes a little clearer. It would appear that much of this is approximation due to calculations made from insufficient samples and a lack of knowledge of these ancient units of measurement.

Fig. 16.2 Selection of weights, scale and balance from India

As others have utilised calculation to arrive at their conclusions, so also shall we. However, we have the advantage of a more coherent knowledge of the ancient linear systems of measure and the canon of numerical values involved.

The Dent Dictionary of Measure gives the ounce as being 28.349523125 grams[6]. To confirm the equation, a gram, in the same reference book, is given as 0.03527296 ounces and 28.349523125, multiplied by 0.03527296 = 0.999999944 which is as near to being 1 as matters for this calculation. So the calculations required for conversion to ounces, the more familiar [to us] and imperial based units are thus:

28.349523125 / 0.85 = 33.35238014 (Feuerstein, Kak, & Frawley)
28.349523125 / 0.8565 = 33.09926809 (Britannica)
28.349523125 / 0.8525= 33.25457257 (Bisht)

The mean of the three evaluation of the base unit is 1/ 33.23540693 of an ounce.

A correlation of numerical values is beginning to emerge. It would now appear that we are looking at a unit weight that was very close to being 1/33 of an ounce. Much trial and error was involved at this point but the final result was an agreement of the base Harappan weight evaluating at 1/33.3333333 of an ounce [0.03]or 0.48 of a dram or in the metric value, 0.850485694 of a gram. This value is within 0.0979 of a gram of the mean of the three descriptions calculated above. There is a variation of 0.234 of a gram between the largest and least values discussed; hence this is a reasonable assessment.

The lesser value calculated by Bisht, of 0.83575 gram has been evaluated at 0.820298701 of a gram, or 1/34.56 of an ounce [0.028935185], which is even closer to the stated value than the Harappan units, and is therefore certainly within acceptable margins, i.e. 0.015451299 of a gram. Between these two values lies an interesting conversion factor. 34.56 / 33.33333r = 1.0368 where the reed value in the *Long Egyptian* dimension set is 10.368 British feet. [Note also that prior to 1824 there were 34.56 cubic inches in the British pint.] Weights from Lothal have been evaluated here at 0.972 of an ounce where the stated *approximation*, converted from grams, gave 0.972996966 of an ounce. For purposes of identification, we shall term the three different weight units as Harappan, the lesser values connected by the value 1.0368 as the Bisht measures and the remaining elements as the Lothal weights.

At 0.48 of a dram, the basic Harappan weight, the units are seen in their doubling context as a series thus: 0.48: 0.96: 1.92: 3.84: 7.68: 15.36 drams etc. Similar criterion regarding a doubling applies to the lesser Bisht unit. An additional factor of interest is that 15.36 / 12 = 1.28 and the weights increased by a factor of 2 up to 128 units. There were 7 doubling of the values to reach this number.

Having ascertained the imperial values of these weights we shall avoid the dreaded metric weights as far as possible as they only serve to confuse the issue. Our ancient values concur with the familiar imperial measures.

Although the weights found at Harappa were of a cube made of chert, it seemed useful to evaluate these units in conjunction with the volume of a pint of water. One requires a universal element as a gauge for measurement.

Water is the universal essential.

Chert is measured by specific gravity and is given as 2.6 - 2.7. We shall adopt the 2.7 value. Water is the base of specific gravity and is given a value of 1.

Hence to find the size of a weight in chert equivalent to a specific volume of water, we divide by 2.7. The value with which we shall initially work is a pint which weighs 20 ozs. A pint of water occupies the space of 34.677625 cubic inches. The equivalent weight in chert would have a volume of 12.84356481 cubic inches.

1/20 of a pint, or the volume of a fluid ounce, would be 1.73388125 cubic inches and that of a chert equivalent, 0.642178241 cubic inches, which gives a side length of a cube of 0.862750451 of an inch. This could, perhaps, have been seen for practical purposes as 0.864, within 0.0027 of an inch. This would equate as 1/24, or a digit of the *Long Egyptian* cubit.

Our Harappan base weight is counted 33.3333333 times in an ounce. Its volume in cubic inches [of chert] is therefore 0.052016438. One side of such a cube would measure 0.373290441 of an inch. The equivalent in volume of water would be 0.140444383 cubic inches with a side length of 0.519798224 inches. In a pint are 20 oz and a Biblical bath contains 22.5 pints. Therefore the weight of a bath of water is the equivalent of that of 15000 Harappan base weights.

The Bisht [our evaluation of 1/34.56 of an ounce] unit treated the same way results in 0.135459437 cubic inches of water with a side length of a cube at 0.51357407of an inch. The chert value is 0.050170175 of a cubic inch giving a side length of a cuboid of chert at

0.36882063 of an inch. The count of Bisht weights in the unit of a bath of water would be 15552. The connecting factor [15552 / 1500] is 10.368 [12^3 x 6 / 1000] which in feet is the long Egyptian Reed as defined by John Michell. Numerically 15552 = 432^2 / 12.

An additional connection factor between the various values is that, 3456 / 27 = 128.

The side length of a cuboid unit in chert equalling the weight of 1/256 [128 x 2] of a pint of water also measures 0.36882063 of an inch, exactly that of a Bisht unit. In a pint of water can be counted 691.2 Bisht base weights and 691.2 / 256 [series value 128 x 2] = 2.7, the chert water relationship.

The above correlates, on stone artefacts thousands of years old, the use of chert as a value for water, verification of the numerical elements of the Bible and connections to the Imperial system that has almost finally been kicked into touch after thousands of years of precision usage. [But not quite, as we still have the pint and after a lengthy running battle between traders, the public and the government, traders are again allowed to deal in lbs and ozs and imperial volumes provided metric measures are also displayed.But for how long?] Referring to the figures above, additional correlation of the ancient measurement system as a whole can be seen in the fact that 69.12 miles equals a degree of the Earth's circumference and that prior to 1824 two pints or one quart of water measured 69.12 cubic inches at $56^1/_2$ degrees Fahrenheit in the Imperial system.

However, we obviously cannot have fractions of weights. The key here is 2.7. A half pint of water weighs 10 ounces. This reveals 345.6 base weights. But the weights are of chert and not water and hence it is necessary to divide our 345.6 by 2.7 to arrive at the number of chert base weights at the Bisht standard equal to a half pint of water. The number is 128. This is the top number in the series of a count of 7 doublings of the previous value, the standard method of the Indus valley.

So we now have a relationship between a pint weight and an Indian weight in a numerical format coherent with the Indian concept. This is further borne out by the fact that 128 x 2.7 = 345.6 where a unit which weighs 1/ 34.56 of an ounce of water accords exactly in volume to 1/256 of a pint weight formed in chert. What has been revealed is reiterated in Table 16.3.

Table 16.3 Indian Base Weights

Harrapan base weight	0.03 of an ounce	33.333333 to the ounce
Bisht base weight	0.028935185 of an ounce	34.56 to the ounce
Lothal base weight	0.972 of an ounce	1.028806584 to the ounce

There is further correlating evidence to the values seen here from *The Institutes Of Vishnu,* a famous Indian work.

1. The (very small mote of) dust which may be discerned in a sun-beam passing through a lattice is called trasarenu (trembling dust).

2. Eight of these (trasarenus) are equal to a nit.

3. Three of the latter are equal to a black mustard-seed.

4. Three of these last are equal to a white mustard-seed.

5. Six of these are equal to a barley-corn.

6. Three of these equal a Krishnala.

[6. Krishnala (literally, 'seed, of the Guñgâ creeper') is another name for Raktikâ or Ratî, the lowest denomination in general use. According to Prinsep (Useful Tables, p. 97) it equals 1.875 grains = 0.122 grammes of the metrical system. According to Thomas (see Colebrooke's Essays, ed. by Cowell, I, p. 529, note) it equals 1.75 grains.]

7. Five of these equal a Mâsha.

8. Twelve of these are equal to half an Aksha.

9. The weight of half an Aksha, with four Mâshas added to it, is called a Suvarna.

10. Four Suvarnas make a Nishka.

11. Two Krishnalas of equal weight are equal to one Mâshaka of silver.

12. Sixteen of these are equal to a Dharana (of silver).[7]

The import of this extract cannot be overstated. Below is an evaluation that complies with other Indian weights and the Imperial system along with counts of numbers seen repeatedly in the ancient world.

1. trasarenu (trembling dust).	= 0.0000033333oz
2. nit or eight trasarenu	= 0.00002666roz
3. Three nits or black mustard-seed.	= 0.00008oz
4. Three black mustard-seed equal to one white mustard-seed.	= 0.00024oz
5. Six white mustard-seed equal to a barley-corn.	= 0.00144oz
6. Three barleycorns equal a Krishnala. = *1/225 Lothal weight*	= 0.00432 oz
7. Five Krishnala equal a Mâsha.	= 0.0216oz
8. Twelve Mâsha equal half an Aksha	= 0.2592 oz
9. The weight of half an Aksha, with four Mâshas added to it, is called a Suvarna.	
Therefore Suvarna	= 0.3456 oz [*oz /34.56 = Bisht weight*]
10. Four Suvarnas make a Nishka.	= 1.3824 oz
11. Two Krishnalas of equal weight are equal to one Mâshaka of silver.	= 0.00864oz
12. Sixteen of these are equal to a Dharana (of silver).	= 0.13824 oz

The numerical conections here will be apparent, there are 216, 864 and 2592 along with 24 and 144. We also see the conections of a metricated element in that the Nishka is ten times the value of the Dharana, the Krishnala and Masha connect by the multiple of five. Perhaps more interestingly however is the value 10.8 which numerically would indicate half a Masha, or 2.5 Krishnala. At the end of the scale we find a Mashaka and the Dharana of Silver. The specific gravity of silver is 10.8. Both the Nishka and Dharana exhibit the numerical value 13824 and 1382.4 / 10.8 = 128 which is the top value in the series of weights in these calculations. The Krishnala which is intimately connected with the silver weights is itself a very distinct fraction of the Lothal base weight, it is 1/225 of that weight of 0.972 of an ounce and we should note the connection with the Biblical 'bath' because that specific unit was 22.5 Imperial pints. Here we find confirmation that the calculations are indeed correct, that the ancient Indian weights have been correctly defined and indeed that specific gravity was well understood at around 3000BC. The weights are now examined in a little more depth and some tables are constructed from the units involved. This shall be extended, as suggested earlier, to indicate correlations between other values and numerical counts and will clarify the situation.

Bisht Values

Key Feature: 128 of these units are 3.7037037037 ounces [formed in chert].
[1/34.56 oz = 0.028935185 and 0.028935185 x 128 = 3.7037037037]

This weight, multiplied by 2.7 [specific gravity of chert] results in the value applied to water. This would form, as it is the top of the scale at 128, the base of the next count. It is this following count that is demonstrated here. 3.7037037037 ounces x 2.7 [to revert to water from chert] = 10 ounces. This is *exactly* ½ of an imperial pint of water in weight. Hence the base unit of this series is equal to the chert value in weight of a volume in water that we recognise as half an imperial pint. The units double in increments up to eight times to give 128 units, which here has here been classified as a series, commencing at a count of 128 base weights [see Table 16.4].

Table 16.4 Bisht Values

Units	Weight of chert	Weight of water	Weight of water	Volume of water
	oz.	oz.	lb.	
1	3.7037037037	10		0.5 pint
2	7.4074074074	20	1.25	1 pint
4	14.8148148148	40	2.5	2 pints
8	29.6296296296	80	5	4 pints
16	59.259259259	160	10	1gallon
32	118.5185185	320	20	2 gallons
64	237.037037	640	40	4 gallons
128	474.074074	1280	80	8 gallons

Hence a neat correlation can be observed between the count of units and count of ounces. As stated earlier this sequence can be extended. By again utilising the top weight as the base for the next series, the following becomes apparent. As it appears that the object was to define the weight of a volume of water and we have seen that the actual chert weight corresponds, we shall this time leave out the weight of the chert for clarity [see Table 16.5].

Table 16.5 Bisht Values Simplified

Units	Weight of Water		Volume of Water	
1	1280oz	80 lb	8 gallons	64 pints
2	2560 oz	160 lb	16 gallons	128 pints
4	5120 oz	320 lb	32 gallons	256 pints
8	10240 oz	640 lb	64 gallons	512 pints
16	20480 oz	1280 lb	128 gallons	1024 pints
32	40960oz	2560 lb	256 gallons	2048 pints
64	81920 oz	5120 lb	512 gallons	4096 pints
128	163840 oz	10240 lb	1024 gallons	

According to Bisht, 8 of the base units of 1/34.56 oz made the *ratti*, which then increased by the usual increments. 32 of the same base units formed the *karsha,* the lowest unit of another scale[8]. This new base, the *karsha*, has a weight equivalent of 2.5 fluid ozs, which is 1/8 of a pint. There are 180 of these units in a bath and 8,100,000 in the *Molten Sea* noted earlier. The Bisht base unit in a weight context can be counted 11,520,000 times in the *Molten Sea.* The full sphere, a purely hypothetical situation, would therefore be occupied by 23,040,000 of these units. As a further numerical alignment, 1.152 British feet is the *Long Egyptian* foot.

Harappan Units

Key Values: Harappan base weight = 0.48 dram [0.03 or 1/33.333333r oz]

Here is seen a further relationship to the *bath* of 22.5 pints, which, as detailed above, is derived from the *Molten Sea* of Solomon's Temple. In effect, this scenario, a correlation of the *bath* measurement units and the Indian units, relates the reciprocity of the dimensions in this work, not to mention the early use of 22/7. This π factor was utilised to evaluate the volume of a *bath* and here we see the unit correlating *exactly* with our other values. The relationship between this and the Bisht value is 1.0368 and as earlier mentioned 10.368 feet is the *Long Egyptian* reed measure, related to the cubit of 1.728 and foot of 1.152 [British feet].

Table 16.6 Harappan units

Units	Drams	Ozs	Pounds
1	0.48	0.03	
2	0.96	0.06	
4	1.92	0.12	
8	3.84	0.24	
16	7.68	0.48	
32	15.36	0.96	
64		1.92	0.12
128		3.84	0.24

This series is fine within itself and the relationships can be easily seen. There does not appear to be anything other than an increase in numerical value to be gained by following the series as it stands. However, when we attempt to relate this base value of the Harappan series to the *bath,* another picture emerges, a vision of coherence with other cultures as indeed we have seen with numerous linear measures.

At 33.33333333 to the ounce, [666.666r to a pint of water] there are 15,000 to the bath. A *bath* equates with 2.8125 gallons [22.5 pints]. Table 16.7 reveals a series constructed along these lines.

Table 16.7 Volumetric Relationships

Units	Count	Galls	Pints	Baths
1	15,000	2.8125	22.5	1
2	30,000	5.625	45	2
4	60,000	11.25	90	4
8	120,000	22.5	180	8
16	240,000	45	360	16
32	480,000	90	720	32
64	960,000	180	1,440	64
128	1,920,000	360	2,880	128

Note that in the ancient world the value 360 was seen to indicate completion. Here we have the completion in the context of 360 Imperial gallons and that of a count of 128, which indicates completion following the tradition with these Indian weight systems. It is worth extending the sequence to observe the emergence of some familiar numerical values from the lesser count with small weights. In reality this probably did not happen given that 360 gallons and 128 baths coincide. It does, nonetheless, indicate the coherence of the numerical systems at work.

Table 16.8 shows that the same count, albeit it in many thousands, is retained. The numbers 192, 384 and 768 for example are seen as a count of drams in the lesser count. The count of gallons reveals the 1.152 of the *Long Egyptian* foot, 2.88 feet make the Egyptian step, the 5,760 of the Egyptian mile and the 23.04 count of ounces, which is a weight from Babylonia. 4.608 miles is the Indian 'short yojana' length. There are, as has been stated, numerous numerical repetitions and therefore connections. Such poetry cannot be found in the bland metric system.

Table 16.8 Larger Measurement Unit Values

Units	Count	Gallons	Baths
1	1,920,000	360	128
2	3,840,000	720	256
4	7,680,000	1,440	512
8	15,360,000	2,880	1,024
16	30,720,000	5,760	2,048
32	614,400,000	11,520	4,096
64	122,880,000	23,040	8,192
128	245,760,000	46,080	16,354

The *Molten Sea* contains 2,000 *baths*. This equates as 30,000,000 Harappan base weights. This is for a hemisphere. The hypothetically complete sphere would therefore contain a sexagesimal 60,000,000 of the same units. The implication of such a large, whole number in the *sexagesimal* count, is that this evaluation is correct.

The Lothal Weights

From Lothal is derived a different series of weights. The count here is also different and does not follow the 128 sequence. As noted earlier, the count for these specific values is in multiples following the pattern of 1/2/5/10/20/50 and the base weight is 0.972 of an ounce. Table 16.9 demonstrates the sequence with fractions of that weight.

Table 16.9 Lothal Weight Sequence

	Weight			Baths
	Drams	Ozs	Lbs	
0.05	0.7776	0.0486		0.000108
0.1	1.5552	0.0972		0.000216
0.2	3.1104	0.1944		0.000432
0.5	7.776	0.486		0.00108
1	15.552	0.972		0.00216
2	31.104	1.944		0.00432
5		4.86		0.0108
10		9.72		0.0216
20		19.44	1.215	0.0432
50		48.6	3.0375	0.108
100		97.2	6.075	0.216
200		194.4	12.15	0.432
500		486	30.375	1.08

Once more we can observe the canonical numeration in conjunction with count of *baths*. By utilising the 500 units as a baseline for a further series, it can be seen that when one reaches the new 50 units, a volume of 54 *baths* has been reached. 100 units then give 108 *baths* or 2,430 pints. This is a count in weight of 48600 ounces or 1,620,000 Harappan base weights.

16.4 Ancient Weights in Egypt and Mesopotamia

Egypt

One of the Egyptian base weights was known as a *kite*. It apparently varied in value by the proportion 24/25 or 0.96. Britannica relates a unit value of 0.16 of an ounce or a very convenient 1/100 of a pound of our familiar British weight system.

A larger version is said to be about 1.05 ounces[9] or alternatively, as this investigation has revealed, 35 Harappan base units.

Another possible connection relates to a granite ball found within the Great Pyramid. As *Charles Piazzi Smythe* related in his work of 1880 The *Great Pyramid,*

...a little bronze grapnel hook; a portion of cedar-like wood, which might have been its handle; and a green-granite, or green-stone ball, which, from its weight, 8,325 grains, as weighed by me [Piazzi Smythe] in November, 1872, must evidently have been one of the profane Egyptian mina weight balls, long since valued by Sir Gardner Wilkinson at 8,304 grains…[10]

The granite weight was probably original weighed at 8400 grains [it would likely have lost weight in use and not gained] which is equivalent to 544.310844 grams or 19.2 ozs. This then complies with 120 of the small '*kites*' mentioned above, 640 Harrapan base weights or 320 of the Kot Dijan weights [see below]. Further calculation would reveal additional connections such as the fact that this weight is 0.96 [24/25] of that of a pint of water. 19.2 ozs is 1.08 x the Ur Mina [see below] Again, we see connectivity between ancient Egyptian and Indic measurement systems, here seen to extend to accommodate the Mesopotamian systems.

These units will bear further investigation. There are more connections here that emerge from a study of the unit values as described by Petrie in his 1926 work *Ancient Weights and Measures.* [11]

Petrie denoted his weight research in grains. The weight of 8400 grains or 19.2 ounces, as seen above has a direct association with the weight of water in that via division by the familiar 0.96 or effectively an increase via 25/24 it increases to 8750 grains. This is the exact weight of a pint of water. We now examine some of Petrie's results and within extremely fine tolerances we find correlations to the findings already revealed.

In *Ancient Weights and Measures* Petrie recorded a number of series of weights. The page numbers noted here refer to that book. There were quite a large number and with quite a lot of variation which he noted appeared to date from different ages of Egyptian history. Nonetheless there were constants.

One of Petrie's conclusions was for a weight that endured as a standard across the whole of Egyptian history and that was claimed to be 145grains.[p14] Even then Petrie claimed that here were local variations up to 150grains. In India there were cuboid weights of chert, all the same shape and material increasing via constant multiples. This was a perfectly logical and effective system. Egypt, however, created weights in a wide variety of materials and in many shapes from cubes, to discs to cones and in animal shapes. There was little consistency in shape, material and hence size and this effectively made it even more difficult to maintain fixed weights. This variety caused inaccuracies.

So to return to the 145 grain weight and its connections; firstly this was meant to be 145.83333 grains which is 1/60 of a pint of water in weight. 1350 of these made the 'bath'. 145.83333 is 11.52 Bisht weights where 1.152 feet British is the length of the long Egyptian foot. Hence 15552Bisht weights equate with the weight of a 'bath' of water.

145.83333 is 5/4 of 116.666r.and this particular value is another of the weights that Petrie [recording it at 166.5 grains] deemed to have been constant throughout the Egyptian period.[p10]It is classed as one of the Peyem series of weights and equates with 9.216 Bisht weights. There are 75 of these to the pint of water weight of 20 ounces or 8750 grains. Hence in terms of Bisht weights we see 691.2 which again is interesting in that 69.12 miles is one degree of Earth circumference as accepted before more recent evaluations. Again we see correlation of numerical values.

A first dynasty basalt weight is described by Petrie as being found in the tomb of Queen Sma-nebui and weighed 438.9 grains. Here we look to the weight of an ounce. This is 437.5 grains and here we have a weight at 438.9 grains, within 0.0032 of an ounce of being that ounce. Given the variations in recorded weights in Petrie's lists and similar variable results in

the derived measures from cubit rods we can quite safely take this to be a weight of one ounce. So far the remainder of the system conforms to the imperial so why should this not do so?

In relation to this Petrie recalls that the Maccabean Shekel was 220 grains, again with extremely small margins this would be a half ounce of 218.75 grains or within 0.0028 of an ounce of the recorded 220 grains. The weights are close but not accurate and as stated above, given the variety of materials and shapes this is not surprising. But again this mention of the shekel weight is further evidence for the widespread use of the same basic units and all are related to the weight of water as was described in the analysis of the Indian weights. However, what also emerges is that it appears, from the accuracy and consistency that the Indian weights predate the Egyptian, these weights defined the weight of water and Egypt copied the standards.

On page 28 of Ancient Weights and Measures Petrie informs us of a series of 'shekel' weights which 17 are listed and these involve various multiples of lesser values between 35 and 38.3 grammes or 540.1325424 grains to 591.0593249 grains or put another way, 1.234588668 to1.350992743ounces. The mean of the final calculation for Petrie was 578.7 grains +/- 1.7 grains.

The calculation here is for 577.5 grains which is 1.3 grains less than Petries figure but within his tolerance. We arrived this via comparison to Indian weights when it was revealed that 44 Harrapan weights = 1.32 ounces which is exactly 577.5 grains. Once more within the finest of margins we reveal the intention of the weight manufacturer of those far off times from comparison to what we have already discovered. Weight systems have to correlate each other as do linear measures and we are seeing via this methodology how well these work together. Petrie claims that the intention here was for other unit measures, Indian, Etruscan, Babylonian and indeed Chinese correspond to this standard. We have proved the Indian connection.

Under the title *Measures of Capacity* in *Ancient Weights and Measures* and found on page 35 there is another neat correlation.

Among a list of volume measures of approximately 29 cubic inches there were 10 made of bronze which showed a consistency of 29 cubic inches +/- 0.3. The minimum here therefore is 28.7 and at 28.89802083 cubic inches we find the volume coincides with 1/27 of the Biblical bath unit for volume. Bath = 22.5 pints where a pint of water equates with 34.677625 cubic inches hence the bath equates with 780.2465625 cubic inches. When we divide this by the 28.89802083 cubic inches the results is exactly 27. Hence 27 of these weights results in the weight of water designated as a bath of which there were 2000 in the Brazen Sea, the large hemispherical bowl used for handwashing by the priests at Solomon's Temple.
To further enhance the connectivity this volume of water weights exactly 576 of the Indian Bisht weights.

There are many more weights in Petrie's narratives that could be further analysed and recorded here, but in these few examples we see as sufficient to confirm the evaluations seen in this work, of both weights and linear measures. The results atre not approximations but by carefully evaluating what were approximations we have revealed the fixed units that were utilised across nations and millennia.

Mesopotamia

Babylonia also has a tale to tell along somewhat similar lines. A value known as the *mina* is the unit involved this time. Britannica gives us two *approximations* of 34 ounces and 23 ounces[12]. Britannica clearly indicates the approximate element so we have scope to experiment. Commencing with the lesser weight it is seen that a familiar numerical value, that of 23.04, [2,304 = 36 x 64] we find an interesting alignment to the Harappan system. 23.04 ounces = 768 Harappan base weights. [768 = 6 x 128] 23.04 ounces are additionally 144 of the lesser version of the Egyptian *kite* of 0.16 of an *ounce. Its weight is equal to 1.152 pints of water where 1.152 British feet is the long Egyptian foot*.

The values given in Britannica were approximations and therefore we need not worry when we find 23.04 x 1.5 is 34.56 and not 34 ounces. 34.56 is the value we seek. This is 216 x 0.16. It is 2.16 pounds or as Petrie may have described it, 15120 grains. Another numerical 'coincidence' occurs because the short Greek cubit is 1.512 British feet with a foot value of 1.008 British feet.

There are 1.728 pints of water in weight to this value of 34.56 ounces. 34.56 / 2.7 = 12.8 where 128 is the top of the weight series in India.

Again looking to Petries evaluations we find that among the weights classed as 'Sela' there is one of 220.5 grains which he records as 220.6 grains. A multiple of four of these gives 882[Petrie at 882.4] and a further multiple of ten increases the value to 8820. This value of 8820 is 7/8 of 10080 [see value of short Greek foot above] and 10080 grains is 23.04 ounces.

This is further confirmed by a relationship to another weight with the value of 0.06 of an ounce discovered at Kot Dijan in India. The cuboid weight is stated as being 1.7 grams [1.7 grams = 0.059966352 ounces]. This is virtually exactly 0.06 of an ounce. In itself, this is a direct correlation with our evaluation of these units. Our interpretation of the Harappan weights began at 0.03 of an ounce. This is the second weight in the series. These weights appear to be twice the weight of the Harrapan weights. Further, it is no coincidence that 0.06 of an ounce multiplied by 384 [128 x 3] = 23.04 [see above]. To further enhance this correlation of values, 34.56 ounces is 1,152 Harappan base weights where the cubit of 1.728 has a foot value of 1.152.

[*Authors Note*: There have been occasions where there are direct correlations between specific measurement units of, for example, the *talent* seen below but the regions using this unit have then divided the unit in proportions to suit their own needs. This is seen again later in a reference to China. Where such correlations occur, the value in use appears to have been a trading unit. The important element however is the constant standards that reappear across wide regions and over the millennia.]

There is a reported Babylonian unit of the *ka.* It is said to contain the volume of a *Great Mina* of water and to be the cube of a specific handbreadth of between 3.9 and 4 inches. According to Britannica, 300 x this volume, the *gur*, is "almost" 303 litres[13].

At 302.9829545 litres or 533.25 pints, there are 23.7 *baths*. This gives a handbreadth, or a side value of cube for the *ka* of 3.950013569 inches. As it is not used in multiple in length, we can term this at 3.95 inches. It is probably merely coincidental that this handbreadth value gives a cubit of 23.7 inches, the number associated with the count of *baths* in the larger volume

of the *gur*. As it does not align itself to the more commonly utilised values, this was either a special unit devised for a specific purpose, or the indicated volume is incorrect. If the latter were the case then a strong contender would be a handbreadth of 3.96 inches with a resultant cubit value of 1.98 feet or 23.76 inches. Alternatively, by the exceptional action of a multiple of five handbreadths being utilised, the cubit value becomes 1.65 feet. This gives a volume for the *gur* of 305.2848738 litres. It evidently appears probable that the volumes have been miscalculated. However, we can content ourselves here in the following evaluation, which is accurate.

Geoffrey Bibby in *Looking for Dilmun* [14] relates some values that were part of a trade agreement between Ur and 'Dilmun' which he analysed as being in the region of Bahrain. What he termed the Ur '*mina*' was, according to his information, the equivalent of 504 grams.[15] The Ur *talent* is 60 Ur *minas.* At 503.9915222r [within 0.00847r of a gram, an infinitely small value] we find connections to another set of values with which we are already familiar, those discovered and written of by Bisht, which we have analysed earlier.

The weight of 503.99152222r gms is 17.7777r ozs or 614.4 Bisht weights. Of course we cannot have fractions of a weight but when this is multiplied by 60 for the *talent* we find that 614.4 x 60 = 36,864 = 128 [series value] x 288 [where 2.88 feet = Egyptian step measure]. Hence at the larger value this complies. It is here that we find the connections with India are refined and the Mesopotamians afterwards subdivided the weight by the sexagesimal value 60 as opposed to the series value in India of 128. But note that the value that was translated and copied was one that was at the head of a series in India, 128 with a count of 128 in the total count, albeit here allied to a greater count of 288. Nevertheless, the Ur *talent* has a direct and precise correspondence to the weights uncovered by Bisht.

Bisht also mentioned other values including the *karsha* which was a larger unit comprising 32 of the base weights. This gives another result, 19.2 for the *mina* and a more practical, to enhance the transference of the equivalent of the *talent* as against the *mina*, 1,152 *karshas* for the *talent*. Here we see yet another reference to a familiar value from Egypt, the foot value in British feet of 1.152, further enhancing the use of the British units as a valuable measurement commodity in ancient times.

However, this evaluation does not stop with the *karsha* because there was yet another related value from Bisht, the *ratti* that comprised eight base units. Hence if we divide the original evaluation of 614.4 Bisht base weights by eight we find 76.8, which for the *mina* is once more unsatisfactory. Again, however, the *talent* has another story to tell for here we find, when multiplying 76.8 by 60 for the *talent*, there are 4,608 rattis *to* the talent and 4,608 / 128 [the Indian series value] = 36.

Once more, to emphasise the complete numerical integration of the system, readers are reminded that 4.608 miles is the length of the short yojana in India and 4.608 miles / 128 = 1200 x 1.584 feet.

Hence it would appear that ultimately, given the inclusion here of both 128 and 36, it was the *ratti* of eight Bisht base weights that formed the basis of the Ur *talent*.

Bibby relates a trade account where 36,666.66666 Ur minas are involved.[16] We can divide this for talents by 60 and arrive at 611.1111r, which amounts to 2,816,000 *rattis*,

704,000 *karsha*. This is equivalent to 22,528,000 Bisht base weights which fits our numerical system extremely well because 22,528,000 = 128 x 176,000.

Hence although for everyday practical reasons these values were probably exchanged via the talent, underlying the whole numerical value system is a coherence not seen in the metric system, a coherence which would make these exchanges, which on the face of it would seem illogical and not consistent, very precise and easy to understand.

There are, of course, other connecting factors here to the weights and volumes of water. 128 base Bisht weights in chert is the equivalent of a half pint of water. Therefore the total value of 36666.666r Ur *minas* is the equivalent weight of 88,000 pints of water [176,000 / 2] = 11,000 gallons.

Bibby was also a little perplexed in the evaluation of the 'Dilmun' *mina*. Unfortunately some of the text with which he was working was incomplete and he did not have the complete list of figures. However, not a great deal was missing and he evaluated the 'Dilmun' *mina* to between 1,329 and 1,411 grams.[17] This leaves a wide window for error but we should be able to discover what was happening with these values.

Dilmun was seen as being a seaport in the region of Bahrain and was definitely in contact with India, almost certainly, therefore with the port of Lothal. It would consequently appear logical to attempt an evaluation utilising the Lothal weights of 0.972 of an ounce. The mean of the values evaluated by Bibby was 1370 gms, which is 48.3253278703 ounces. At 48.6 ounces we have exactly 50 Lothal base weights. This is entirely in keeping with the series value of these weights where we saw that the multiples following the pattern of 1/2/5/10/20/50 instead of the usual 128.

There is a tolerance window here of 2.89246488 ounces [the difference between Bibby's 1411 and 1329 grams] and at 48.6 ounces we are neatly within this window at 1377.786824 grams. Additionally the value 486 is seen in the tables of values above from India.

However, we do not get a direct correlation to the Bisht weights here. What we do have is 1620 Harappan base weights and once more in the number 1620, we see a correlation with the tables of weights in India.

Converting the Harappan base weight to Bisht weights or vice versa is accomplished via the value 1.0368 or its reciprocal of 0.964506173. The change from Bisht to Lothal weights is accomplished via the factor 31.25. To convert from Harappan weight to Lothal or vice versa the value 32.4 is used. As the Bisht base weights at 1/34.56 of an ounce are slightly smaller than the Harappan base weights we divide the 1,620 Harappan base weights by 0.964506173 for a count of 1679.616 Bisht base weights. Self evidently this is unacceptable as a fraction of a weight is implied; hence we once more search for the *talent* of 60 *minas*.

1620 x 60 = 97200 Harappan base weights of 1/33.33333 ounce [2,916 ounces] and thus : 97200 / 0.964506173
= 100776.96 Bisht base weights of 1/34.56 ounce [2,916 ounces]
= 3000 Lothal base weights of 0.972 of an ounce [2,916 ounces]
= 60 Dilmun *minas* = 1 Dilmun *talent* = 48.6 ounces x 60. [2,916 ounces]

The conversion factor between the Ur measures and those at Dilmun therefore is 2.73375 or the reciprocal of 0.365797897. In all probability this was seen as 0.365, being a replication of the count of days in the year.

16.5 Classical Greek and Roman Weights

Britannica gives a volume for the *metretes* of 39.4 litres[18]. This equates as 69.344 pints. Yet, within 0.127127 of a litre of this relatively large volume, we find a value of 69.12 pints. This numerical value is 34.56 x 2; hence it is aligned to previously seen systems. This, given the previous evidence, is surely correct. It is, in weight, 86.4 pounds, or 1,382.4 ounces. The Harappan base unit of 0.03 of an ounce can be counted 46,080 times in this Greek weight.

The value 1,382.4 ounces / 2.7 [assuming that perhaps it stems from an earlier period and chert was in vogue] is 512 and 512 = 128 x 4. Hence there are direct connections to the ancient Indian world in this Greek volumetric measure.

The Greeks utilised the value of 12 in their counting systems. Hence the weight in pounds of 86.4 / 120 = 0.72 pound = 11.52 of our ounces. But 11.52 / 12 = 0.96. This, in reality was the Greek ounce, 32 of the Harrapan base weights of 0.03 of an ounce. [32 x 16 for the pound = 512 which is 4 x 128.] So we can see that our base unit of an ounce is derived not specifically from the Romans, as is usually stated, but from the ancient Indians, leading eventually to the Greeks and to the Romans. To increase from this ounce to the British version, simply divide by 24 and multiply by 25, the same method as is used for linear measure increase from Greek to British and a reversal of that used to reduce from Greek to Roman.

The Roman system was built upon that of the Greeks with influence from other regions. According to a number of sources the Roman *uncia* or ounce weighed 27.264 grams. This equates as 0.9617 ounces. It would therefore appear that the Romans utilised the same ounce value as the Greeks, 0.96 of our British ounces or a count of 32 Harrapan base weights. The *drachma* was 1/8th of the *uncia* or 4 Harrapan base weights [0.12 of an ounce] and served as the basic value. Once more we find the top weight in the series, the *mina*, being a count of 128, this time of *drachmas* [*mina* =15.36 ounces].

Volume was based upon the *sextarius.* This is stated in *Britannica* [19]as being 0.53 litres which equates with 0.9328 pints. The Dent Dictionary of Measure puts it at 0.935 of a pint or 0.53125 litres. Paul Tyers at Internet Archaeology Magazine[20] claims the volume was 0.5471 of a litre, which is 0.962896 of a pint. Others tend to round the value at 0.54 of a litre. None of these values appears to be connected to the Roman weight system in general or any other measure in particular. However, at 1/24 of a *bath*, we find a close correlation for this volumetric measure of 0.9375 of a pint or 18.75 ounces or 625 Harappan base weights.

Table 16.10 Roman and Indian Weights

Roman Weights	Roman Weights		Bisht Weights	Harappan Weights	
Sextarius x 6	= Congius	= 112.5 oz	3,888	3,750	1/4 bath
Sextarius x16	= Modius	= 300 oz	10,368	10,000	2/3 bath
Congius x 4	= Urna	= 450 oz	15,552	15,000	1 bath
Urna x 2	= Amphora	= 900 oz	31,104	30,000	2 baths

This also equates as 648 Bisht measures and as a further indicator of the probability of this being valid, 648 / 2.7 [the chert factor] = 240. There would have been 48000 of these units contained within the Brazen Sea. Further weights/ volumes in the series were as seen in Table 16.9.

16.6 Hebrew Values

These are generally seen as problematic as no hard and fast values appear to be ascertained. According to Britannica,[21] the *bat* "may" have contained "about" 37 litres. "If so," then the *log* had a value of slightly more than 0.5 litre. This is all very unsubstantiated but amazingly accurate when compared with other units that are given firm, but in reality, erroneous evaluations. 37 litres is 65.12 pints or 1302.4 ounces. However, our evaluations in other directions come again to the fore. The volume of a *bath* of 22.5 pints is related to the *log* and the *bat.* 22.5 pints x 2.88 = 64.8 pints or in weight, 1,296 oz. 1,296 x 33.33333 [Harappan base weights] = 43200. This evaluates as a *bat* of 36.818181818 litres, against the Britannica approximation of 37 litres.

The *log* is said to be "slightly more" than half a litre.[22] At a half litre we have 0.88 pints and therefore, to be "slightly larger" we shall opt for 0.9. This is 1/25 of a *bath* at 18 ounces, [1/ 50,000th of the volume of the *Molten Sea*], 1/72th of a bat and a count in base Harappan weights of 600 at 0.03 of an ounce. A larger weight of the *hin* is 12 times the *log.* This puts it at 0.48 of a bath or 10.8 pints, or 13.5 pounds or 216 ounces. In terms of Harappan weights this is 7,200.

16.7 Chinese Weights

According to Encyclopaedia Britannica, a *shi* or *tan* was a weight that was set at 132 lbs under Shi huang-ti in around 221BC. This is interesting because not only do we have 132 [132 x 12 = 1584], but a weight of 132 lbs = 2,112 ozs. In association with our weight measurement units the shi or tan was the equivalent of 105.6 pints of water [at 20 ozs per pint] in weight and 70,400 Harappan chert base weights [33.333333 to the ounce].

It appears that with this Chinese weight system, the little that we know about it, there is a series of connections to linear measure and to the Indian weight systems.

The Dent dictionary of measure relates that from the 19th century onward, conformity to modern standards throughout the world began taking place in China and there were a series

of weights demonstrating this. There is the *liang* at 1.333r ounces and 16 *liang* to the *chin* or *catty* which therefore weighed 1.333r pounds.[23] This equates as being equal in weight to 0.324 of a pint of water. A further weight known as a *tan* equalled 100 chin or the equivalent of 1.44 baths.

According to the Dent Dictionary of Measure was all based upon the *liang.* An ounce is 0.75 of a *liang*. Bisht base weights in *liang* = 46.08 which although being fractional does indicate a connection with the earlier numerical system as 100 *liang* or would equal 4608 Bisht weights. Furthermore, as seen with the Harappan weights, the value 4608 was in use in conjunction with volumes of water and 460.8 / 360 = 128. This is further confirmation of the validity of the evaluations seen in this chapter although not giving a clear cut definition in this specific case.

In relation to numismatics in China a different set of values has emerged. We learn that 1 *jin* = 16 *liang* [as with *chin* or *catty* above] and 24 *Zhu* = 1 *liang*. Therefore the *Zhu* could be counted 18 to the ounce.

It appears that meaningful values are seen here in British measurement units. The values are the mean of a number of approximations and probably the approximations were caused not by wear and tear but by poor manufacture to keep costs down, although the relevant value was stamped on the coins, coins which should have been manufactured in specific metals and hence have an intrinsic value.

We look at three quoted weight values. One from Western Han with an average value of 250 grams or 8.8 ounces, one from Qin at 275 grams or 9.7 [9.68?] ounces and one from Eastern Han at 220 grams or 7.76 ounces.

However, these are all approximation with no apparent connecting valuation factors, which for coinage, above all else, should be a consideration. It therefore appears, after much evaluation, that there was a theoretical connecting factor of 1.1 between these same values from different regions, which would mean that there appears to be a series here that runs as follows: 8 ounces, 8.8 ounces and 9.68 ounces. [These were heavy bell shaped exchange units].

16.8 Confirmations

To put these evaluations in some sort of perspective, we next examine a very recent [15th November 2009] front page inclusion in the Indian journal, *The Hindu*. Here we have a report on the findings of Dr. Wells, A Harvard Phd who is a researcher for the Institute of Mathematical Sciences at Taramani, India. Dr. Wells has been examining three pots with specific indicative markings on their sides. The markings indicate proportion in the volume of the pots. We are in complete agreement with this evaluation, however, the stated volumes of the containers are very approximate and the three units are given as containing volumes of 27.3 litres, 55.64 litres and 65.89 litres. The base unit indicated by the markings is 27.3 /3 or 9.1 litres which is calculated to be 9.24 litres. In the larger volumes there are said to be 6 and 7 times this base volume which evaluates to [using the quoted 9.24] 55.44 and 64.68 litres. Hence Dr. Wells' statement of approximations which extend to the 9.24 being additionally termed 10 litres.

If we allow for the base unit to be 9.205134548 litres, well within the approximate parameters, we have a volume of 16.2 pints and this surely is the correct evaluation as seen in the numerous connections below.

16.2 pints = 324 ozs.[of water]

This is the equivalent of:-

- 10800 Harrapan base weights
- 333.333333 Lothal base weights
- 1/9 Dilmun Talent
- 6.66666 Dilmun Minas[x 50 = 333.33333 Lothal base weights.]
- 0.72 of a Bath
- ½ Chinese Tan
- 5400 Kot Dijan base weights [x 2 = 10800 Harrapan base weights.]
- 18 Hebrew Logs [1 Log = 300 Kot Dijan base weights = 600 Harrapan base weights; 36 Logs = 1 Chinese Tan; 162 Logs = Dilmun Talent]
- 1.5 Hebrew Hins
- 4 Hebrew Bats
- Roman Modulus / 1.08

Multiplying by three and then doubling for the six multiple gives further obvious connections.

16.2 pints x 7 = 113.4 pints = 2268 ozs

This is the equivalent of:-

- 75600 Harrapan base weights.
- 2333.33333 Lothal base weights.
- 7/9 Dilmun Talent
- 46.6666666 Dilmun Minas[x 50 = 2333.33333 Lothal base weights.]
- 5.04 Baths
- 37800 Kot Dijan Base weights
- 3.5 Chinese Tans
- 2160 large Egyptian Kites at 1.05 ozs
- 126 Hebrew Logs
- 10.5 Hebrew Hins
- 28 Hebrew Bats
- 7.56 Roman Modius

Again further calculation will reveal more

Hence once more, hard won knowledge of the ancient systems reveals what has escaped the experts.

16.9 Ancient weights: A General comment

At the time of the assembling the multifarious calculations and pieces of evidence into this singular chapter, its author, Harry Sivertsen, was unaware of archaeological evidence for any vessel's *precise* liquid capacity. Naturally, one is not about to pour water into a very fragile urn many thousands of years old. Hence, direct physical correlation for the above evaluations is doubtful although with modern computer equipment accurate assessments can now be achieved and such simulations will undoubtedly eventually show these evaluations to be accurate.

Such a close correlation of values over a very wide area and time span must surely be seen as conclusive evidence for the systems as described. The "Egyptian" units, found in India, now evaluate very well in what is generally thought to be a Hebrew construction, the *Molten Sea* of Solomon's Temple. The generally accepted Greek, Hebrew, Egyptian and Mesopotamian systems subscribed to the same units and numerical counts over time spans of thousands of years and, as is implied, great distances.

As regards lengthy numbers, specifically with long strings of noughts, both ancient Egypt and India are well known for using such constructions. These pose no problem. But as outlined at the very end of this chapter, further evidence has come to light revealing a commonality in volume that is very accurate and most revealing.

16.10 The pi Factor

Another important element to consider here is the use of 22/7. This was used to evaluate the *Molten Sea* and the value of the *bath.* The evaluation of the *bath* has clearly been verified but in itself this raises questions regarding the early use of 22/7.

Many 'authorities' [for one example see below] blindly claim that because the circumference of the *Molten Sea* is given as 30 cubits and the diameter 10 then 3 was utilised for a pi value. One may legitimately query that if this was the type of thinking prevalent at the time of the construction of Solomon's Temple, how on Earth was it built anyway? How could this 'bath' have been devised utilising such notions? It simply would not work.

When we examine what is written regarding the Egyptian *Rhind Papyrus*, which is dated to about 1650BC, although evidence indicates was a copy from an earlier source, there is good evidence for 4[8/9] 2 = 3.16 as a value for pi[24].

If this much was known at that period, why accept that tradesmen of a later period, who by nature of their work had to be efficient in geometry, would be far less knowledgeable?

The first theoretical calculation of pi is said to have been accomplished by Archimedes of Syracuse (287-212 BC). He obtained the value of: - 223/71 or 3.14084507, which is said to be an approximation of 3.142857142 or 22/7 [25]. This calculation was recorded as being achieved by the use of a 96-sided polygon. Perhaps an earlier scribe, for some as yet unfathomable reason added 1/7 to 223 making the figure 223.142857142. Dividing this value

by 71 gives the correct value e.g. 223.14285714285 / 71 = 3.142857142 etc. Ptolemy in circa 150 AD is said to have evaluated the formula to 3.1416 by extending the same type of calculation. Yet the academics who wrote the web page referenced above from which the history was derived also state the following:

'A little known verse of the Bible reads:-

And he made a molten sea, ten cubits from the one brim to the other: it was round all about, and his height was five cubits: and a line of thirty cubits did compass it about. (I Kings 7, 23)

The same verse can be found in II Chronicles 4, 2. It occurs in a list of specifications for the great temple of Solomon, built around 950 BC and its interest here is that it gives pi = 3. Not a very accurate value of course and not even very accurate in its day, for the Egyptian and Mesopotamian values of 25/8 = 3.125 and pi = 3.162 have been traced to much earlier dates.' [26]

Earlier in this work, comment was made upon the lack of knowledge of the numerical abilities of our forbears. Given that here we have comment from one the leading British institutions of the day, this earlier comment appears to be justified. It is ironic that the authors of the commentary have an excellent website that has been utilised to a large extent in the research for this work.

Yet to further confuse the conventionally accepted history of the evaluation of π, we have revealed evidence for numerical values associated with, and correlating *precisely* with the unit of the *bath* dating to between 2500 and around 3000BC and almost certainly earlier. The bath was calculated by the utilisation of 22/7. Assuming, as all the evidence indicates, that the unit of the *bath* was in use as a standard, from where and when did the 22/7 value emerge to be utilised at the time of Solomon, [assuming he was not a later fiction] circa 1000BC? However we examine this, even if we allow that Solomon and his temple along with the Brazen Sea were later inventions, the 22/7 value had to have been known far, far earlier than modern historians generally accept or quite simply, the unit measures that we find would not have existed.

Some may hypothesise that the tale of the construction of the temple and the *Molten Sea* was an elaboration from a later date, to a time when the formula of 22/7 was historically known to be in use. Yet, even if this is the case, it does not obviate the problem of its precise correlation via the volume of the *bath* to units then seen *over two thousand years earlier* in India and in any case the 22/7 value was utilised at the Great Pyramid. The dimensions associated with the volumetric and weight measurement units have been seen to be a part of the overall integrated numerical system. This system was ultimately based upon what we have, following Michell, called a 'Greek' dimension set, this being self evidently derived from an accurate assessment of the circumference of Earth. Many of these units are also directly related to the diameter of the Earth. Given that this is the case, it appears to be inescapable that at a point much earlier than 3000 BC the value for pi, seen on other pages as 3.1418181818, had been developed. Again, given that the measuring of the Earth's circumference involves angles, it is a certainty that this development of splitting a circle into degrees came at roughly the same time as the ability to accurately draw and calculate the diameter of the same circle and evaluate

the distance around its circumference. Hence historical research has still not answered the question of from what was the unit of π developed in the first place, and when and where was that first place?

For practical purposes a length of cord could be placed around the perimeter of a circle scribed onto the ground, its ends marked and the distance measured. Such exercises could be repeated and refined until a definitive value emerged. However, given the thought that led up to the measuring of the Earth, for which geometry had to have been known, it is almost a certainty that pi in some accurate format was understood before this happened. And just where and when was the Earth measured? That is a subject dealt with in a the following two chapters.

At this point it is desirable to return to the bricks of Merhgarh, the supremely accurate building blocks dating to over 9,000 years ago. Here there is a further amazing correlation of values to be seen. The brick dimensions were: -

1.082677165 feet or 12.99212598 inches evaluated at….	12.96 inches
0.475721784 feet or 5.708661408 inches	5.7024 inches
0.229658792 feet or 2.755905504 inches	2.75 inches

This is further confirmation of the validity of the hypothesis forwarded in this book, of the knowledge of π and of specific gravity and that mathematical ability stems from a very early age because…

…the volume of one of these bricks is exactly 15.84 times the volume of a chert weight that is the equivalent of the weight of a pint of water.

Not only linear measure is found on the site complying with the system as outlined in this work [this is evident from the brick sizes] *but the volume accords exactly* to one of the principle numerical components allied to the later weights system, a volume that is *directly related* to the specific gravity of the mineral chert…and still…no sign of a learning curve. How far back do we have to investigate to discover the truth of the initial measuring of the Earth and indeed, beyond that momentous event to the dawn of understanding of mathematics?

This ancient historical questioning regarding the measuring of Earth shall be completed later, albeit in part, somewhat speculatively. However, answers are forthcoming. There is an additional piece of information that requires revealing, a facet of the results of numerical investigation which relates to more modern times. It *may* be merely mathematical coincidence, but without proofs for such argument, given what has been revealed in this work, it is rather difficult to accept that there is an accidental direct correlation between the ancient systems we have been examining in this work and the modern apparently faceless metric notion of measure representation. Yes, we have seen the ancient use of decimals; yes we have been utilising a decimal count throughout the work but no, we have not used metres. The metre and litre, as has been clearly demonstrated, have no place in these matters. To correlate the weight system into units that made any sense, we had to translate from metric to imperial measure.

It is here we begin to see a correlation between the old and the new, ancient and modern, or at least, what seems to be an attempt at a continuity. This was also seen at the George Washington Monument where we had time represented in ancient linear measure… in a structure that was completed as recently as 1884. As seen in Chapter 3 the NASA interpretation of the Polar circumference of Earth is 24859.49307 miles. In reality Earth is far from as stable as we like to think and this dimension varies…just a little…not enough to worry about and it is a sound figure to accept. When the French were conducting their surveys to ascertain the Polar circumference they were not quite as accurate as this, satellites and infra red measuring systems had not been invented in those days. Nonetheless, they were very close; this is apparent because the metre and the litre are intimately linked, being parts of a system that interlocked, as indeed did the ancient systems. Currently the litre, after various slight alterations over the past 200 or so years, equates to 1.759753986 pints, almost exactly 1.76 pints, in fact *within 0.00492028 of a fluid oz. Indeed, the Dent Dictionary of Measure defines the litre as 1.76 pints*[27] and for most practical purposes this is near enough. But is it not strange that while originally the British measures were intimately related to the ancient units that were understood across the world, they were moved from that alliance via metrication and scientific definition and yet now appear to be edging back to an association with the old values?

If the equation of a litre being 1.76 pints was precise then the metre would have a length of 3.280998953 feet [and only a few years ago some publications quoted its value at 3.281 feet, within 0.000012564 of an inch] whereas in reality it currently stands at 3.280839895 feet, within 0.001908696 inches or $^{1}/_{20.6}$ of a millimetre, little more than a hairs breadth. If we hypothetically link the metre to the volume of water and not as currently recognised, the speed of light, we would have a variable and at some specific temperature and air pressure, [noting the small change made to the weights by the change in temperature and barometer specification in 1824 detailed in Chapter 3 and mentioned early in this chapter], we would find that there indeed were precisely 1.76 pints to the litre. But in any case, for most means and purposes we can accept that the correlations exists, that the ancient marries with the modern and that indeed, there are 1.76 pints per litre and therefore 10.56 pints to six litres.

Let us close this chapter with the comment that if any of the calculations or theories seen in this work to date were incorrect, then the evaluations seen here could not feasibly have been constructed. The weights prove that the linear measures as denoted in the book are indeed correct.

CHAPTER 17

The Source of the Measures of the World

…writing and the other necessities of civilisation have only just developed when the periodic scourge of the deluge descends, and spares none but the unlettered and uncultured, so that you have to begin again like children…

Plato Timaeus 23 D.Lee Trans.1965

17.1 Introduction

Having traced the measurement system of antiquity to Mehrgarh in North West India, and followed its usage through the ages since, the investigation will now turn to the location where the early development appears to have taken place.

The Sumerian culture was very briefly examined earlier and as in other regions, there was found no apparent source for the units of measure in use. They seemingly appeared in a fully formed structure with no apparent learning curve. In Europe, as in India and the South of Egypt, are found what are generally known as dolmens along with other megalithic structures such as stone circles dating to approximately the same period as the rise of the Sumerians in Mesopotamia. While there is little availability of accurate measurement of dolmens, this is not the case when stone circles are examined.

Stone circles, at least in Western Europe, dating to 2,000 BC and beyond are known to have been set out utilising what Alexander Thom termed a megalithic yard. This was a unit of 2.72 feet, which has been refined to 2.727272727feet with the correct term of *step* [2.5 feet] instead of megalithic yard to describe the unit. Research in South East Wales has shown connectivity across the landscape to Bronze Age burial mounds, Cairns and other structures via this and other measurement units. As was seen earlier, even the world famous Stonehenge has a circumference measured through the centres of the lintels of 316.8 feet which is a microcosm of the square containing the circle of the Earth seen in circular format in British feet whereas at the pyramid of Khufu it appeared in Egyptian inches in the square ground plan. The units, which all interrelate whether directly or indirectly, appear across the ages and nations; yet while the same units of measure in Europe as in India and Egypt are found, there once more is no semblance of a source of those measures.

But not all this transference of knowledge happened at once, as is apparent from the later emergence of the use of the units in Europe. This was far, far later than Mehrgarh and as a *generality* later than Sumeria or Egypt. In all cases, however, it appears that the use of these measures historically appeared 'out of the blue', but of course this was not the case. While a period of a hundred or two hundred years can be lost in the archaeological ladder of time, at Mehrgarh we have a case virtually identical to that of Sumeria, a sudden appearance of refined

measures on brickwork. Mehrgarh was also the source of the commencement of agriculture in India, at around the same time. It appears that the people of Mehrgarh kick-started the region into urbanised life, although this once more appears unreal, at least if the people at Mehrgarh were indigenous to the area. But what if they were immigrants? Could the people of Mehrgarh have brought the basic essentials of knowledge of the measurement system and its associated values into India from another source?

It was realised a few chapters ago that the investigation had appeared to have accomplished as much as was possible by examining ancient structures. It was seen to be necessary to look elsewhere for inspiration and the direction chosen was upwards, to the skies. As it happened, the object of the search was precisely that which was discovered via modern computer programs showing the ancient [and modern] skies. Now the research looks once more to modern science to assist in finding a source, but here we are searching for the source of people. The writing [and illustrations] of Professor Stephen Oppenheimer and the subject of genetics are examined.

Oppenheimer, a member of Green College Oxford and Honorary Fellow of Liverpool School of Tropical Medicine specialises in genetics and their contribution in the protection against tropical diseases. He has spent numerous years in the region of South Malaysia and it was while there that he became fascinated by the genetic variations of the people of the area and of their connections to other parts of the world. While studying such transference of the basic human code, he also noticed linguistic connections and a similarity of what we term 'flood myths', all apparently stemming from the same region, a region which since the end of the last Ice Age has been under water.

To summarise the findings of Oppenheimer relayed in his fascinating work *Eden in the East*, there is a commonality of genetic markers that extend from South Malaysia to Europe and the Middle East, specifically Sumeria. This genetic spread also applies to the Eastern regions of Japan, China and to a lesser extent Russia, all having a source in South Malaysia. The greatest influx, however, was into India.

This work will not get bound up with the technicalities of genetics, of which neither of the authors has any specialist knowledge, but suffice to say, Oppenheimer has traced, across the regions mentioned, genes of various marker denominations, flood myths and to a lesser extent, languages. *Eden in the East* is a book that is highly recommended, it is a very important contribution to anthropology, and this chapter draws heavily on its contents.

The source of this genetic material in terms of location is that region which is now under the sea, that which is known generally as Sundaland. It is to here that this investigation has journeyed in the search for the source of the ancient measurement system.

Looking back to Egypt, however, there is found no genetic link to the source region of Sundaland; it seems that the Egyptians were of African descent and did not interbreed with other races. Nonetheless, there certainly is evidence of Malaysian DNA in the Sumerians and as these people were established and involved with major building projects about 300 years or more before the Egyptians commenced their principle building campaigns, it is highly probable that the Egyptians learnt from the Sumerians. Additionally both countries traded with India, albeit predominantly for Egypt, via Sumeria, and knowledge would have been additionally derived from this region. The Middle East was a veritable melting pot of learning at that

period. Certainly, the 'long Egyptian' measures, which this research has not discovered in Mesopotamian records but almost certainly were in use there, were utilised in India and both Sumeria and India began to develop before Egypt. As previously seen there was a correlation of weight values across the whole region.

In common with the Sumerians are the remainder of the regions of North India and to a lesser extent, parts of Europe. These all embraced migrations *out of Sundaland*, as is seen in the migration maps from Oppenheimer below. There is no specific dating for these migrations out of Sundaland, nor for the appearance of these related peoples elsewhere, but given the appearance of the Sumerians and measure, the sudden up springing of Mehrgarh and shortly before 3000 BC the expansion of India…all associated with the use of the ancient measurement system, the dating may eventually be traced approximately via the use of these units.

It would appear that the Sumerians appeared around 3,500 BC along with, in India, a number of other migrant peoples. We do not know when the influence and genes of the Sundaland people arrived in Europe, but certainly their knowledge is in evidence. Anyone looking for a guide in this direction of measure should look to the setting out of the Sarsen Circle of Stonehenge and other such monuments at around 2,500 BC. The builders of this edifice, which was erected in various stages, remain elusive; there is no clue to their origination, whether they were Britons or immigrants. Hence, if this could be correlated with other dated monuments where the all important measures are discovered, perhaps a pattern will emerge. If earlier use of the measurement system is eventually revealed then it will be confirmation of an older spread of specialist knowledge and contact with either emigrants from Sundaland or others who have learnt from them. This is similar to the use of a pottery style as an archaeological tool.

It is only at Mehrgarh, however, that a very early appearance has apparently occurred, although there are other places in Japan that have yet to be analysed in this fashion. The evidence indicates that these people, the emigrants from a flooded Sundaland carried a known system with them on their travels away from the region that had nurtured them.

The first clue to this origination of the source of the measures came from a surprising source, teeth, dental remains that were in the region of 9,000 years old.

17.2 Sudadont

Dentistry is not a subject that most people [including the authors!] find appealing, but it is a key element of archaeological research, as the teeth survive better than any other part of the human body. Specific tooth types can identify race and source the location of their owner. It is this facet of archaeological investigation that has been of very great interest regarding the inhabitants of ancient Mehrgarh. At Mehrgarh has been found the earliest evidence of dentistry with 11 drilled molars in 9 individuals, the earliest dated to 7000BC. Dentistry in fact is the key to solving a puzzle here.

The people of Mehrgarh of 9,000 years ago were of a specific dental type. The type of tooth to which we refer is a shovel shaped incisor known as *Sudadont.* This tooth is more usually found in East and South East Asia, specifically in Sundaland. [Although not all of the people from the region would necessarily have had the same identical racial features.] Yet the

remains recovered from Mehrgarh Period 1, the earliest sites excavated and dated to 9,000 years ago boast the same tooth type. This is specific to Mehrgarh I.

An extract from a statement by John Luckacs, a dental morphologist, regarding this anomaly reads thus:

…contrast strongly with the European dental complex generally found in India and in the neighbourhood of Mehrgarh from antiquity and share several dental features common with the Sudadont pattern…[1]

In referring to the high frequency of shovel-shaped incisors among the inhabitants of Mehrgarh Period 1, Luckacs also states that;

This is a distinctive feature of populations of eastern and southeastern Asia.[2]

Reinforcing this argument is a statement from Jonathon Kennoyer:

They (the ancient people of Mehrgarh) *do not have strong morphological relationships to known Neolithic populations of West Asia. On the contrary, their dental morphology associates them with a distinctly Asian gene pool.*[3]

This certainly appears to be race specific evidence of the movement of people and consequently of their culture and knowledge. Evidently, from this, it seems doubtful whether people from this same specific group ultimately came to Britain. Hence the knowledge that is apparent in these islands appears to have been passed on from others. However, it now appears that the people at the ancient town of Mehrgarh, to where the measures have been ultimately traced, were not natives of India but immigrants, immigrants apparently with specific highly developed knowledge; immigrants escaping the flooding of Sundaland. Consequently, the next priority is to examine the source of these people, the region from where they emigrated, the area known as Sundaland.

17.3 Sundaland

This is the region of South Asia, which can be seen to include Borneo, Indonesia, Malaysia and adjacent regions, although the name is generally applied to the region which is now under the sea between Borneo and Indonesia, and the land to the north. The area of sea which is virtually enclosed by the land, marked on this map as Malaysia, and the surrounding areas in fact were all dry land not so very long ago…

Fig.17.1 The General Region of Sundaland

At the end of the last Ice Age, there was a series of disastrous floods. Here we find not only the source of many of the flood legends, taken with the emigrants from the region, but also the reason for the displacement of people and those flood stories. The immigrants to Mehrgarh were displaced by floods as were many others including the Sumerians, many groups in coastal India, Polynesians and indeed, the Jomon [named after a specific pottery style] peoples of Japan. This disastrous situation in Sundaland caused inestimable trouble for many diverse peoples.

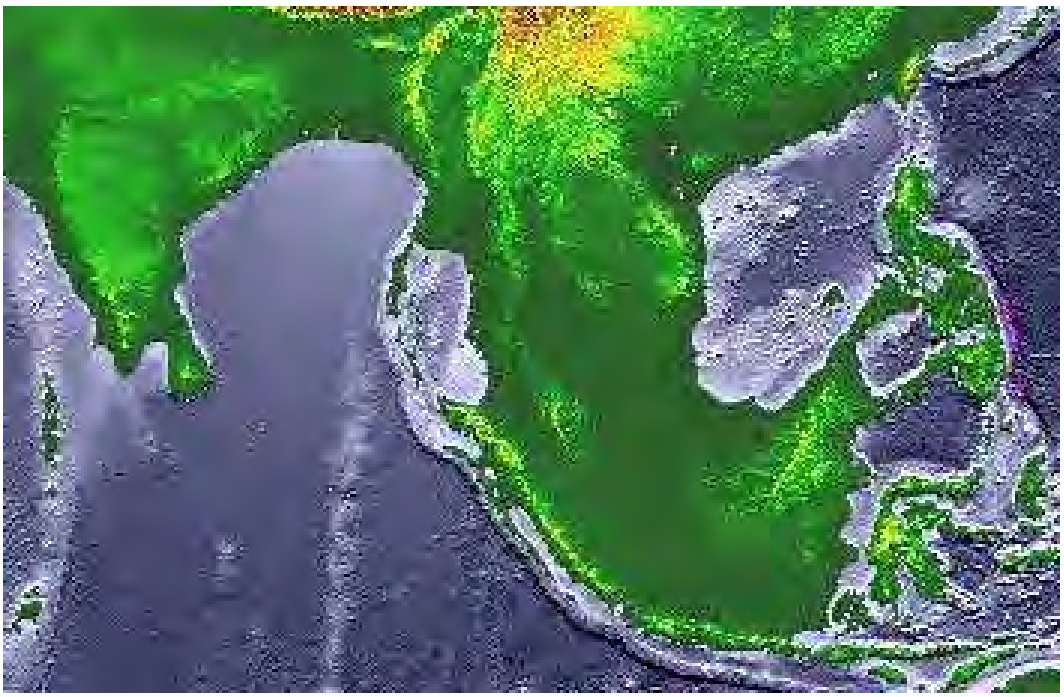


Fig.17.2 India and Sundaland 18,000 years ago

The post Ice Age floods commenced around 12,000 BC and continued in some places until around 3,000 BC. It was around 7,600 years ago that the rising waters passed the level that we see today.[4] In general after 3,000BC the sea level began to drop once more to that which is evident today. This is not to state that a continual rise of sea level to its peak occurred, as over the extended period there were great climatic fluctuations, for example the Younger Dryas cold period mentioned in an earlier chapter. However, in some regions as seen on the chart below, the incremental water rise, specifically during the third episode of deluge conditions, was virtually continual. To show the extent of this disaster the description of the period commences with a series of maps [from Oppenheimer] showing the flooding.

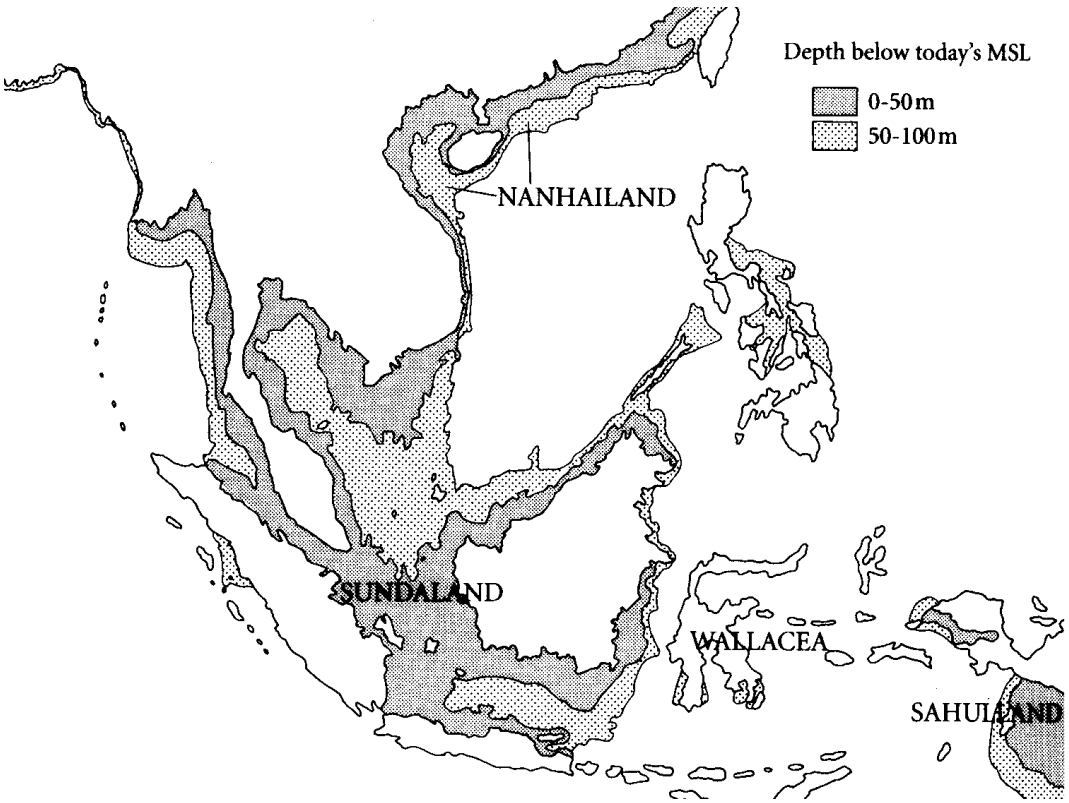


Fig. 17.3 Initial flooding of Sundaland

Initially, as seen in Fig 17.2, this was all land but by 12,000 BC, the sea level had reached the position marked on Fig.17.3 as 50-100 metres. By 9,000 BC the level crept up to the darker shaded regions, indicated here as 0-50 metres. These levels are, of course, approximations, but certainly, the sea level rise was very dramatic.

In reality there was, after this period, another 20 metres sea level rise to come to reach that with which we are familiar today. However, before settling at the modern level in circa 1,000 BC the water had risen to around 5 metres above the current level at about between 6 and 4,000 years ago, dependent upon one's location, as Fig.17.5 indicates.

In the chart Fig.17.5, is seen a comparison between beach lines at similar dates but at various locations around the world. The difference in levels and rates of change can be seen clearly. In fact here in Britain, in South East Wales at about 4,000BC, a whole series of inundations of the Severn Estuary was experienced which only tailed off after 1,000 BC.[5] The whole of the meltdown at the end of the Ice Age has effectively been in a series of jumps not generally levelling off until around 2,500 – 3,000 years ago. Some of these problems were caused by isostatic uplift where glacier weight loading had been lost and the land had risen, but

occasionally this had the effect of lowering coastal regions. Hence the apparent sea level was far from static.

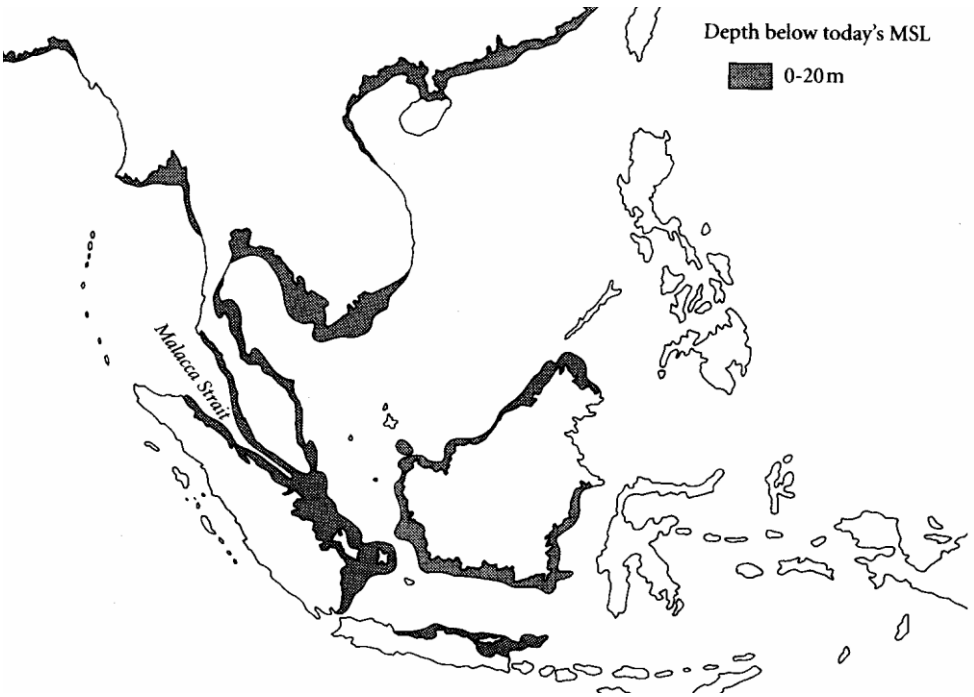


Fig. 17.4 The final flooding of Sundaland: 20 metres below, to present level and above

At Sundaland, seen on the chart [Fig 17.5] represented by the line indicated as Mallaca in South East Asia, the third flood did not pause until around 6,000 BC. After a slowdown of only approximately 200 hundred years however, it then gathered strength and continued rising until about 4,000 BC reaching a culminate level of some 5 metres above today's levels. It has taken since then to fall back to the level familiar on modern shores.

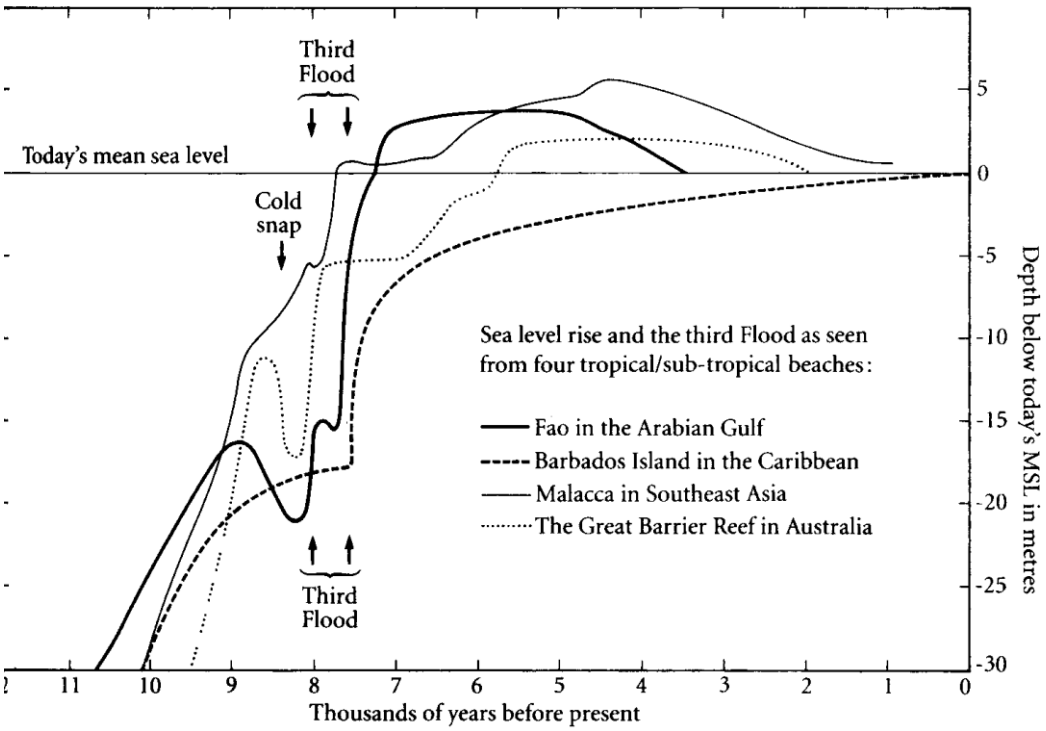


Fig.17.5 Four Different Flood Levels from Different Beaches

The other line on this chart, which is of specific interest to us here, is that which indicates the Arabian Gulf and the beach line at Fao. Here is clearly seen that 9,000 years ago the sea level took a drastic tumble from a rapidly rising situation and began to climb once more a thousand years later. After a couple of hundred years there was another small blip before a steady climb culminating around 7,000 years ago in a level about four metres higher modern levels. This was held at a plateau for some 2,500 years and taking another 1,500 years to descend to modern levels at about
3,500 years ago. During the peak of high water here, when the levels were still rising at Sundaland, the Sumerians arrived in Mesopotamia.

Hence there has been considerable fluctuation in sea levels since the end of the last Ice Age. Climatic change has been the primary cause with temperatures and water expansion reaching a climax around 8,000 years ago, and hence further, albeit slower increase in levels, following suit shortly afterwards. As the temperature eventually fell off, then the water itself contracted and glaciers reformed on high mountains, bringing levels down from their previous high.

The rising sea levels of ancient times have had an effect on people far greater than has previously been imagined. Effectively, it is possible to trace the emergence of the enigmatic

measures in a variety of regions, areas with populations carrying genes from South Asia. Oppenheimer's work has effectively opened up a completely new means of investigation and provides answers for much that was previously a great puzzle.

17.4 Migration routes

Here it is only necessary to replicate two maps from Oppenheimer to explain the routes to all the places that have created such a puzzle…except perhaps America, which is a different and as yet unsolved mystery and as such, not included in this volume although as mentioned elsewhere, recent research in genetics shows that the Polynesians originated here in South East Asia.

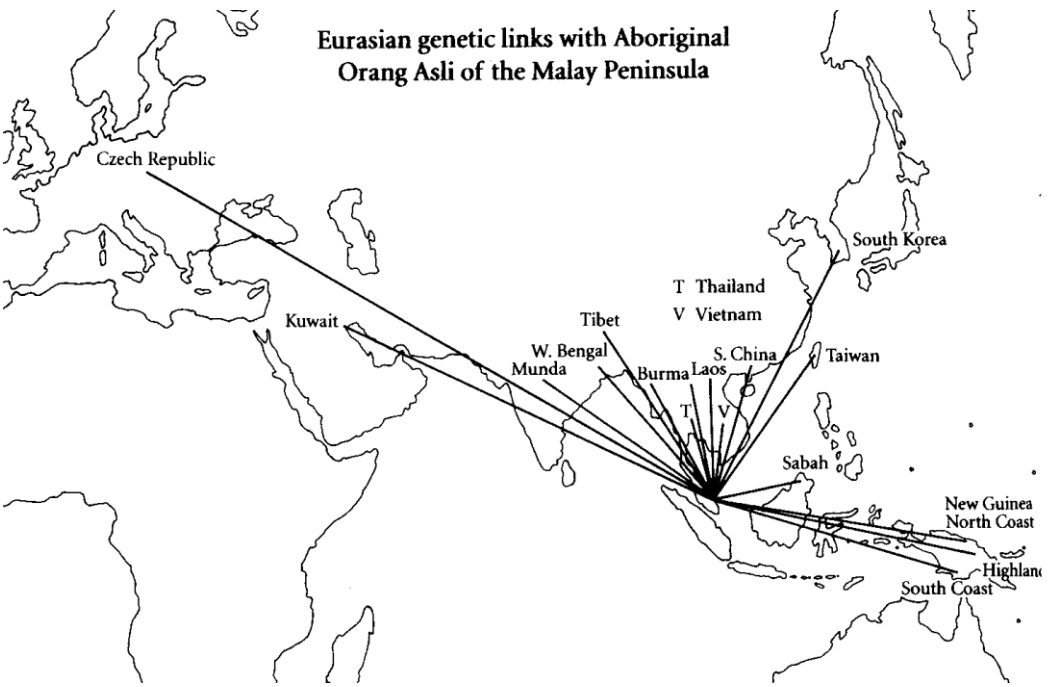


Fig.17.6 Migration Routes A

Here we see multiple lines of emigration from Sunderland. Not all would have been at the same time and some of this evidence would be spread over millennia. What is noticeable is that the measurement units described in this work are seen at their earliest at Merhgarh, now in Pakistan. From this it appears that the small section of Sundaland population that arrived at Merhgarh was that which had developed math and measure. If this were not the case then the same units would have appeared at an early period elsewhere and extensive research has failed

to reveal any evidence of this. Hence it would appear that in Merhgarh we see the last vestiges of a population that for its time were world leaders in human development, the last of what may possibly be termed a 'lost civilisation'.

The investigation will not delve further into myth or language, Oppenheimer's work does that effectively, and his genetic revelations are reinforcing the theory being forwarded in this work. The same routes as he has discovered cover the regions where the measurement system in its various formats is to be found. Mehrgarh is the earliest of these migrations to continental regions that has been discovered and in that respect the odd one of the collection, and as has been revealed, the measures were to be found there, utilised by these immigrants to the region even at the early time of 9,000 years ago.

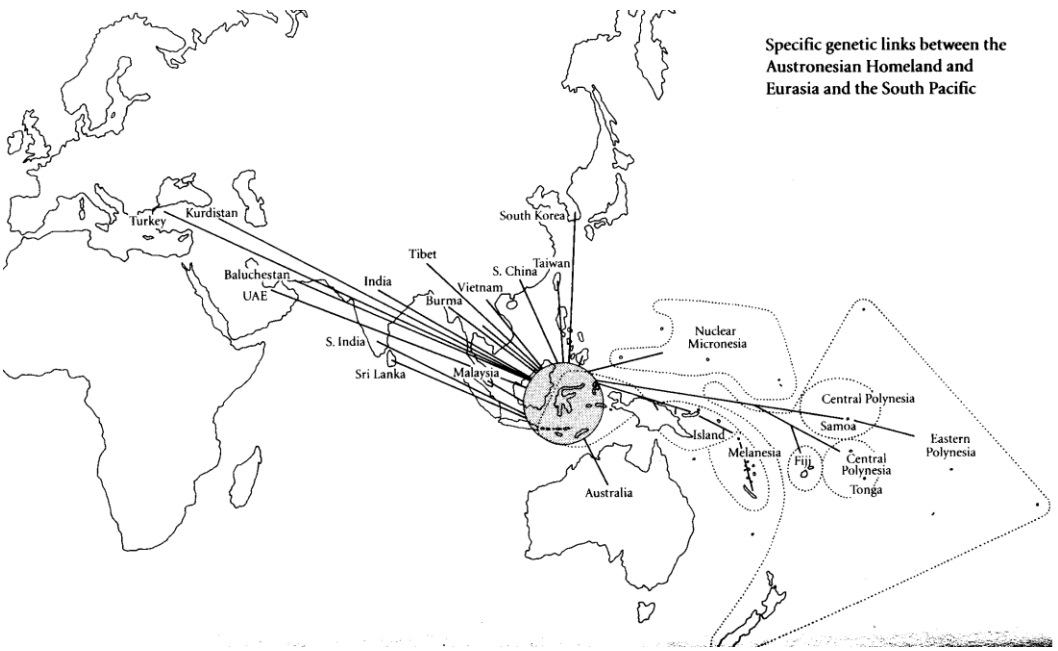


Fig.17.7 Migration Routes B

To date there is no evidence for the use of the measurement units in the Pacific or in Australia, and even later corresponding Chinese measures were almost certainly the result of earlier contact with India. It therefrore appears that, as has been implied in this work, the connected measures with which the whole world eventually became familiar were developed

from the intial learning that emerged at Merhgarh, that was initially derived from developments in Sundaland duringthe last Ice Age.

17.5 The Topography and Vegetation of pre-flood Sundaland

As can be ascertained by the first map in this chapter, the region was not short of rivers. Those seen on this map [Fig 17.1] are but the major flows and numerous smaller streams run across the region feeding the larger rivers or falling directly into the sea. But at the time in question this was not covered by the sea as it was at the time of Mehrgarh and later, hence once more it is essential to look to the results of scientific analysis of the region to discover what is known about the region pre-flood.

A number of researchers have been examining this region via cores drilled, for example into the seabed. Pollen and soil samples have been examined and a reasonable picture has been built up of the region before it was covered by the sea at various times up to and since the final inundation.

For the information here, we have to thank numerous scientists from England, America, Russia, China and Taiwan. The work is part of an international effort the results of which are available on the internet.[6]

So we shall travel back to the beginning, to the last glacial maximum, before the floods commenced and to the central equatorial area of Sundaland.

17.5~1 Central Sundaland pre flood

The maximum drop in sea levels at the Last Glacial Maximum (LGM) is currently accepted to be in the region of 125 metres although the figure of 150 metres is frequently utilised. This latter depth is apparently utilised for cartographic convenience and not accuracy. As seen in the map above, the Malaysian Peninsula was, at that time, linked to the islands of Borneo, Java and Sumatra, and to the Philippines. Looking further north, the islands of Japan were linked together into a peninsula, but probably remained separated from the Asian mainland by the Korean channel. The Sea of Japan was almost entirely enclosed as a lake, its only outlet being the Korean channel. Hence, there was an abundance of available land, land which covered a wide region and which had a variety of vegetation and cover. The climate in the centre of this region was comparatively arid.

A deep-sea core [Core 35-5], which was taken at 7N, 112E shows a much higher terrigenous [dust from the land] sedimentation rate during the LGM, correlated by oxygen isotopes than the Holocene. It has been suggested that this [which from the description is implied to be the interior] is due to sparser vegetation and drier conditions to the west [southern Indo-China and Malaysia]. As such, it would have allowed greater riverine erosion and deposition.[7] However, this is countered in a further argument that the drop in sea levels merely exposed a greater land area and consequently placed the river mouths closer to sea[8]. Probably an element of both applies.

The above description, however, does link to increased salinity after 20,000 years ago in Thailand. A pollen core from Bandung Basin in West Java shows that a scrubland-grassland

cover, similar to that of Southern New Guinea, replaced the former vegetation cover. The implication here is for a reduction in annual rainfall of about 30% and a lowering of mean annual temperature of somewhere in the region of 4-7 degrees centigrade.

This suggests a net loss of lowland rainforests in Southeast Asia, and that there was possibly an even more arid climate and sparser vegetation over most of the exposed central Sundaland mass than previously thought. It certainly complies with the sedimentation mentioned above. It appears also that there may have been areas of peat bogs in the region of the central plains of Sundaland during the LGM, although the evidence is sparse and inconclusive. In reality, the singular sample discovered could easily have been from the borderlines of a wet region adjacent to a river or spring.

Hence, central Sundaland was an area of dry scrubland with little forest cover. There would have been forest at the fringes however, and while the West Java forests may have disappeared, central Borneo was much then as it is today, merely a little cooler.

17.6 So Who Came From Where?

The next question is can this help in identifying which group of measure carrying individuals came from where, and when? The Sumerians look a good contender for the central region as where they eventually settled was of a similar climatic and topographical nature, and they stopped off on route to Mesopotamia, in the process picking up some lingual traits, which resemble Dravidian. [Their initial language however, would possibly have been related to Dravidian.] The Sumerians arrived in Mesopotamia between 3,500 and 4,000 BC, but almost certainly closer to 3,500 than 4,000. Hence, we can hazard a guess that they left Sundaland perhaps around 4,500- 4,000 BC having been driven out of the last remaining fringes of scrubland on the edge of the sea when the sea had risen to above today's levels. These people appeared to like the open plains of Mesopotamia and even recorded that it was a fine land. There is a commonality here to the open plains of Ice Age Sundaland.

However, the climate had turned moister by that time and the forests spread, hence perhaps they had to adapt more then they would have desired. We can only speculate on this aspect of the matter. But again, as they emphasised the quality of land at Mesopotamia and the implication as seen previously was that they had been somewhere where they were not happy and were known as the 'black headed ones' it would appear that this geographical surmise may be close to the mark. Their short stature would also be fitting with this type of environment and fits the descriptions of many people from this region.

Given the rise to prominence of megaliths in Europe and the use of the measurement system to set them out [see previous evidence in this work] around 2,500 BC, we can additionally see that other groups may have left around 4,500 BC, just before the peak of sea level rise when it appeared that all was to be lost. It would take quite a period of wandering before settling as far from Sundaland as Western Turkey. However, the origin of the people of Catal Hoyuk is unknown and they also were builders in brick, albeit not of the accuracy of

those of Mehrgarh. Certainly, the trail of genetic information leads from Sundaland to Turkey and so this is another possibility that cannot be discounted.

There are many groups and destinations from a relatively small initial region. As Oppenheimer points out, this is an area where there are a multitude of racial types and languages, many of which are region specific.

Numerous of these people were familiar with the sea and were sailors and navigators. Oppenheimer shows that there was communication between the islands of the region and far out into the Pacific. The Aborigines of Australia had earlier originated from this region and again they must have had vessels capable of crossing to the continent. Thor Heyerdahl was correct in his ascertains of the abilities of the ancient peoples in sea faring and navigation.

But from where did the earlier movers into India, as far as we currently can tell, the first escapees from the flood, the people of Mehrgarh derive? According to the dentistry, we would expect this to be the South East of the region. Certainly, they vacated the area before the floods completely overtook them; perhaps from a fear that the whole area was to be inundated, seeing what was happening to the flatlands in the region.

From wherever they came, they appear to be the people who were first with the measures, perhaps the developers of the system. It was earlier stated that the measuring of the Earth had taken place in the region of the equator and we now find ourselves at just that location.

17.7 The Probable Location of the First Measuring Of Earth.

Given the evidence of the dentistry which shows the inhabitants of Mehrgarh having links with *eastern and south-eastern Asia* it would be appropriate to look, as suggested above, at that region specifically, the eastern section of what we are loosely terming Sundaland.

It is noted here that if the people who developed the system were from the centre of a plain region and were growing crops then perhaps they would be familiar with irrigation. This would involve creating lines across the landscape, an important part of the process of measurement. The Sumerians were well versed in irrigation techniques before their arrival in Mesopotamia as indeed they were in farming, and brick production; perhaps bricks were originally the result of clay deposits excavated for irrigation? Clods of the material sun baked into a hardness that was seen to be useful? The people at Mehrgarh were also farmers… and producers of bricks… But we do not have evidence of any irrigation of the central plain of Sundaland because it is well and truly underwater. Additionally we have evidence that the peoples on the peripheries of the area knew about irrigation.

Kuk Swamp indicates that there have been several periods up to 9000 years ago during which drainage systems were employed for cultivation.[9]

Kuk Swamp is in New Guinea, the South East of the Sundaland region. The dentistry of the people of Mehrgarh derives from the South East of the Sundaland region. Around the same time, rice was grown in paddy fields in China and this has controversially been dated to

even a thousand years earlier. In India rice growing is also an ancient art. Rice requires much water and hence irrigation, drainage and flooding systems. Perhaps these techniques were more widespread, stemmed from an earlier period and were better understood than is currently thought?

However, the work of Oppenheimer is suggestive of movement from central Sundaland *to* New Guinea; hence it would appear that perhaps the region now underwater was well developed long prior to the time that the agricultural evidence of Kuk Swamp would indicate; that it was maybe *imported* from the central region. The peak of the second flood was at 9,000 years ago and people would have been looking for escape routes, higher land where they were safe. By this time most of the region would have been under the sea hence as irrigation was found at New Guinea, it would be likely to have been developed in the plains area where it was more likely to be utilized and which by that time was flooded.

So at this point there is massive flooding, vast areas of plains over which people and animals had previously moved were now a part of the sea bed. Navigation was of prime concern to the people of those times and in those places where their means of transport between places was a boat on the open sea, this was second nature. As the floodwaters rose it became ever more crucial and as the waters continued to rise after a break of the Younger Dryas cold snap which was preceded by inundations after the Older Dryas which stopped the first major flood in its tracks. People were getting desperate, not only looking for survival measures but answers. The moon controlled the tides, and so there was but one place to look, to the skies, the only stable element in life…the abode of the Gods.

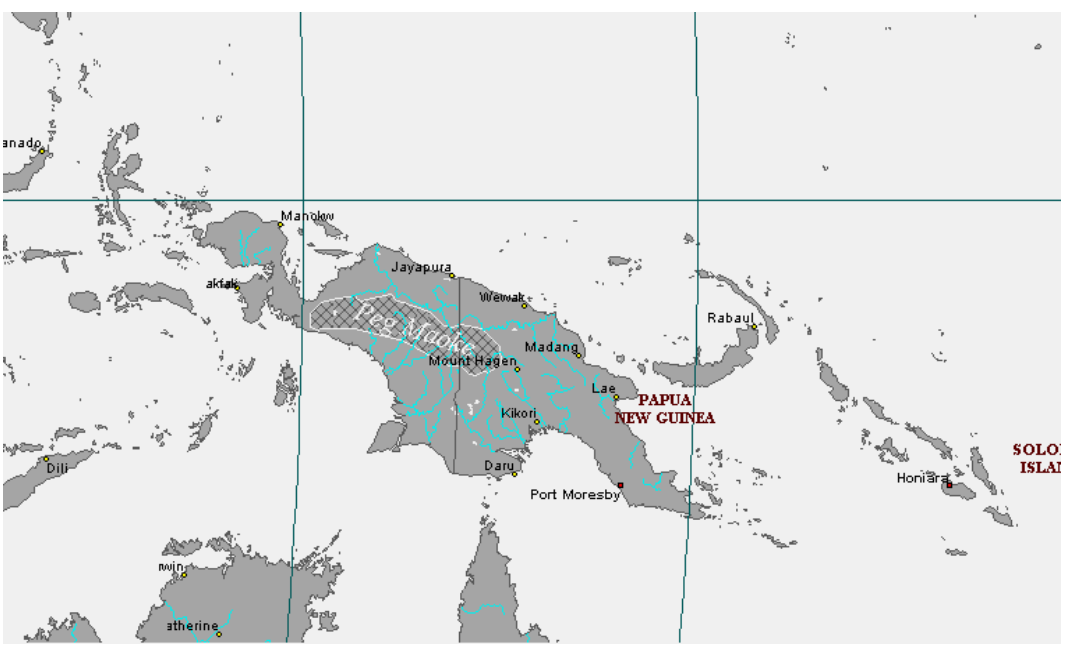


Fig.17.8 New Guinea region

Among the gods in the sky at that time, the lights which gave the only stability in an ever destabilizing world with its lessening of land area due to flooding there was one specific light that would have been seen as auspicious. There was a particular god, a specific astronomical feature of 8,800 BC – 9,800 BC which was unusual. This light in the sky would have been perfect for the purpose of measuring the earth, an exercise which took place almost certainly at that period, probably during the short lull between floods two and three.

This one specific star would have been seen as not only rather unusual but as extremely important. There was only one primary means of navigation and that was via the stars. Currents and other factors, smells and swell depth and type would also be of great value but primarily the stars and the planets were the means by which one knew where one was. This applied on land as much as sea, except for the gain of landmarks and loss of ocean swells.

It is ironic that today in this highly technological age we are doing exactly the same thing in a more sophisticated manner. We are once more navigating via the stars …using our GPS equipment and *man made* stars, the satellites sent up for this purpose.

So effectively the same principles that governed mans abilities to move around safely and to know where he was on planet Earth are still in use today, on both fronts…the modern navigator uses the hi tech while his poor counterpart in his outrigger canoe or sailing boat, island hopping, still utilizes the stars his forbears used. However the mathematical principle is the same. One takes sightings of the positions in the sky, whether with an instrument or by a mark on the vessel one is sailing. The result, if care is taken, is essentially the same, except for the accuracy factor.

On land, where there is not a rolling sea with which to contend, this operation is made much simpler and sighting of the stars would have been easy to people familiar with the skies and finding their way around the seas by their use of the skies. As noted above, there was one specific star that was vitally important. Its name is Capella and it is one of the brightest stars in the sky, residing in the constellation Auriga.

It was around the era of 12500 BC that the sea began to invade the land in earnest. Prior to that the conditions as described above which were discovered by core drillings prevailed at Sundaland. The same conditions had prevailed for a considerable time, thousands of years, and people would have been settled. To make achievements such as the development of mathematics after its initial discovery one either requires a peaceful era with time to spare or be driven by something. Here we see an element of both, an initial discovery and time to ponder then a rapid onset of flooding when handed down information would be utilized.

During the peaceful era the initial discoveries and development would have taken place, there was time to sit and contemplate, to wonder what made the sky revolve in the way that it apparently did, to contemplate man's place in the grand scheme of things. Mathematical systems developed, based upon stellar observations. Perhaps the Indian concept of Brahma as creator of the universe stems from Sunderland. There seems to be an inbuilt need, an instinct almost, for humans to believe in something larger than themselves, and hence we have religion. Modern science has determined that this is related to the temporal lobes of the brain. Dr. Michael Persinger dealt with this matter quite effectively on a BBC Horizon documentary broadcast on 17th April 2003.[10]

Contrary to the prejudiced view of some modern historians, early man was no fool, he was an inquisitive creature, he had to be, initially to survive, and then he proved himself via his own ingenuity. He made beautifully crafted stone tools, had an artistic ability which we see in cave paintings, he built boats, and when we examine the cures for various illnesses the natives of the Amazon use we are simply amazed at how they could have been developed as some the ingredients are highly poisonous, yet when combined with others they make very effective remedies.

Early man was not the backward creature he is so often portrayed to be. If there are any fools they are more likely to be found in modern society where we utterly depend upon electricity arriving down a wire and if it does not arrive then all comes to a halt, and in a very short period that also includes the water supply. If we have a problem we cannot solve it ourselves but have to buy a part for whatever has gone wrong or pay an expert to sort it out or simply throw away the item. We have lost all our sense of independence in modern society. One is paid for services rendered but what happens when those services are no longer required? The financial 'bottom line' of organizations dictates whether individuals are allowed to work to sustain themselves and utilize their skills or not. Their willingness and ability plays little part in the matter. One cannot be independent in a modern state, the self-employed are only one very small step above those who are not.

Early man was an independent being who did live in collectives, who did care for his neighbours, [this had to be the case or the collectives would not have evolved] but also developed his own ideas, and put them to use.

But then the floods arrived…

An overall approximate picture can be seen in the following table, which has been adapted from that seen in an earlier chapter.

12,500 BC. - rapid warming and moistening of climates. Rapid deglaciation begins.

11,500 BC. - Climates at least as warm and moist as today's

11,000 BC. 'Older Dryas' cold phase (lasting about 200 years) before a partial return to warmer conditions.

10,800 BC. Rapid stepwise onset of the cold, dry Younger Dryas.

9,500 BC. Younger Dryas ends suddenly over a few decades, back to warmth and moist climates (Holocene, or Isotope Stage 1)

8,200 - 7,000 BC. Climates warmer and often moister than today's

About 6,200 BC. - sudden cool and dry phase lasting about 200 years, about halfway as severe as the Younger Dryas.[Correlated in Indian texts-see *Deluge*.]

6,000-2,500 BC. - climates generally slightly warmer and moister than today's.

But even then in many places as seen in the chart above from Oppenheimer, the waters continued to rise.

Basic mathematics and geometry were understood as will become clear in the next chapter, but answers were needed for the disaster that was occurring. Hence what was a development derived from curiosity which itself was conceived from a basic knowledge of the skies, developed naturally over millennia, became an essential science, perhaps coupled to a religious belief, in a desperate need to understand what was happening on Earth.

Probably the most obvious star in the sky for a period of 1,000 years, apart from the sun and the moon was Capella. This very bright star appeared exactly in the east five hours before dawn at the spring equinox, rose to an overhead position and then descended exactly to the west. The most precise year for this display was in 9,071 BC but the position was seen within a degree or so either side of east between 9,800 and 8,800 BC. This vision had to have been very auspicious. Here was the only star in the sky to behave in quite such a fashion. Even the sun and moon and planets deviated along the ecliptic but Capella would always, as observed from the equator which runs through the center of Sundaland, every day of every year, rise to overhead then sink directly to the west. Other stellar lights such as Regulus in Leo were close, but around three degrees away, Cappella was aligned precisely East-overhead - West. This was the navigational marvel of all time. At the summer solstice, the sun would set in the west and 50 minutes later this bright star Capella would rise exactly in the east, the province of the equinoctial sun. Capella would continue to rise to directly overhead, a very bright light dominating the positions of all else in the sky and it accomplished this every single day without fail although during the winter the time would be wrong for viewing as it would then be in the sky during the day. This was a summer star but what an unusual star, it was the only one that behaved in such a manner, and this was not only noted, as we shall see, it was acted upon.

While the moon was utilized for time counts, given its association with natural cycles specifically with tidal influence, this star was almost certainly seen to be of even greater, albeit not understood eminence. It had to be closely observed and studied. This did occur and it was observed that as seen with all the other stars and recorded earlier, during 72 years it had slipped backwards in comparison with sunrise. The skies were slipping away and the water was rising. What was happening? Was there a connection? Even the pole star Vega which used to revolve around the North point was totally out of place and even more, its counterpart in the south, Canopus, moved out of its allotted position in tandem with the loss of Vega…the whole axis of the cosmos was thrown out of kilter and as this happened, the vast area of Sundaland began to be inundated with the seas. The floods, as seen and detailed clearly in our work *Deluge* were evidently associated with the loss of the Pole Star or stars.

Here we have one of the reasons for an in depth study of the sky, for a very powerful reason to desire to understand and to be able, if possible, to predict the future. As the moon dominated the tides, and was clearly associated with happenings on Earth, then logically this is a feasible idea. Hence Capella was taken as the most auspicious sign in the sky and mathematics, which had previously developed sufficiently for the seers of the day to be able to chart its progress, was used to divide up the sky into tiny segments. These segments were

based upon an approximation of the days in the year, 360; hence we now had our familiar 360 degrees to a circle. The sky was seen as a dome hence the visible part was half a circle, 180 degrees. It would not have been long before arithmetic developed further and other astronomical factors came into play such as the 20 year conjunctions of Jupiter and Saturn, a count of three of which would reinforce the use of the original bases six and ten. Possibly, indeed probably long before this time, this had already occurred. Coincidentally perhaps, Capella also seemed to appear with the onset of the third major flood. While the moon was known to be associated with the tides here we have a star that is seen to be associated with the onset of flooding, a star which is very accurate in its apparent movement, so we have the moon, associated with tides on Earth, and the Earth itself which was being flooded concurrent with the loss of pole stars Vega and Canopus. Mathematics, given the emergence of the measures shortly afterwards at Mehrgarh, had developed to the stage where use could be made of it in an attempt to understand what was happening, and it would appear that this is what occurred.

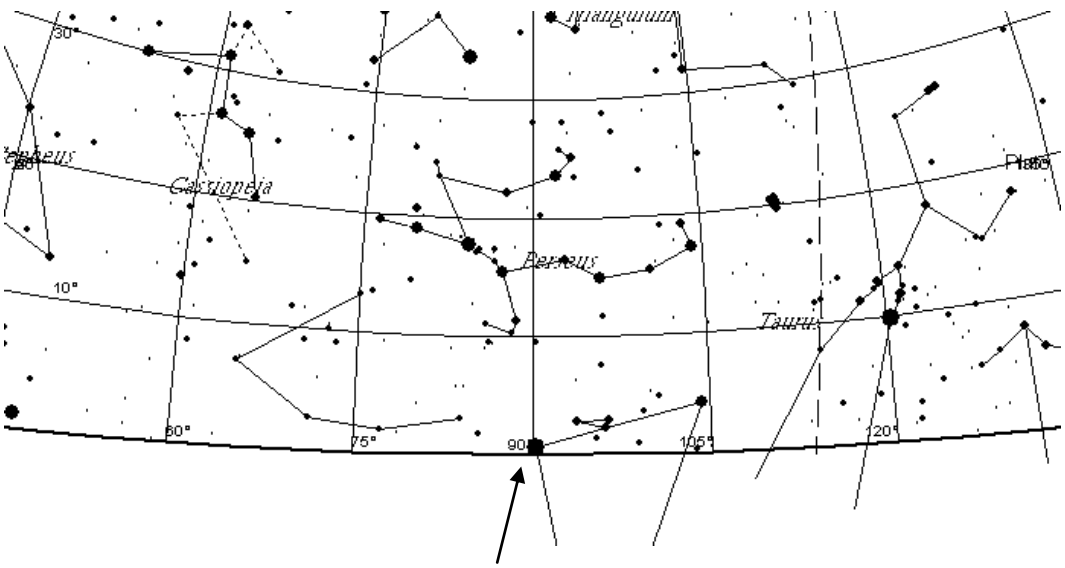


Fig.17.9 Capella Rising in East 9,071 BC at Sundaland

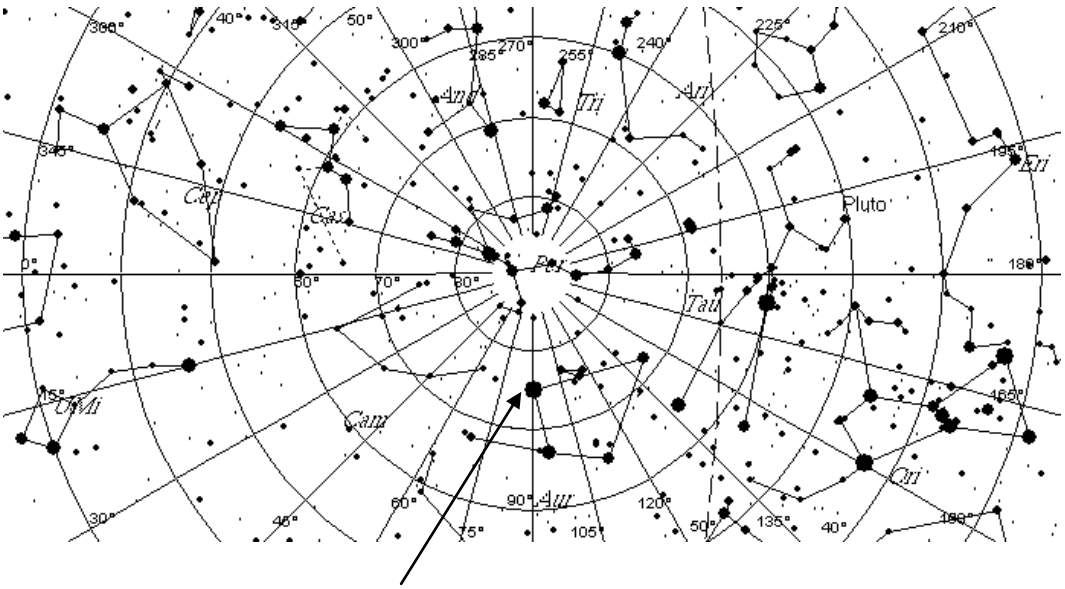


Fig.17.10 Position of Capella at Spring Equinox 9,071 BC Capella rises due east, travels to an overhead position and then falls to due west. This was not the only star to be close to this position but was most accurate. This movement was not confined to the equinox but continued throughout the year for around 1,000 years.

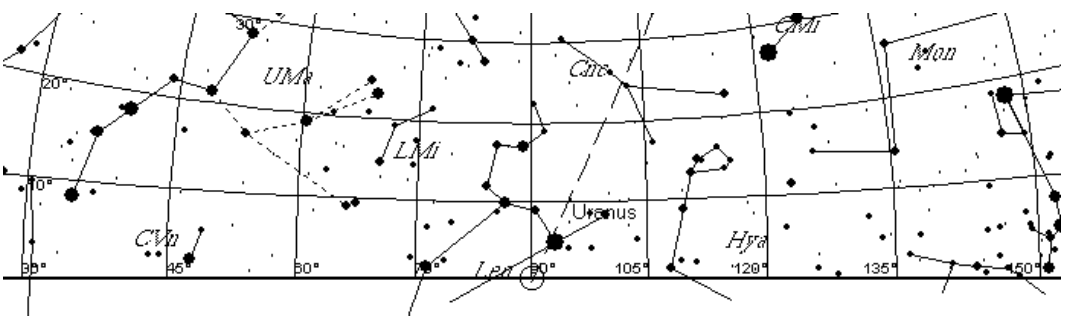


Fig.17.11 Sunrise Spring Equinox 9,071 BC at Sundaland

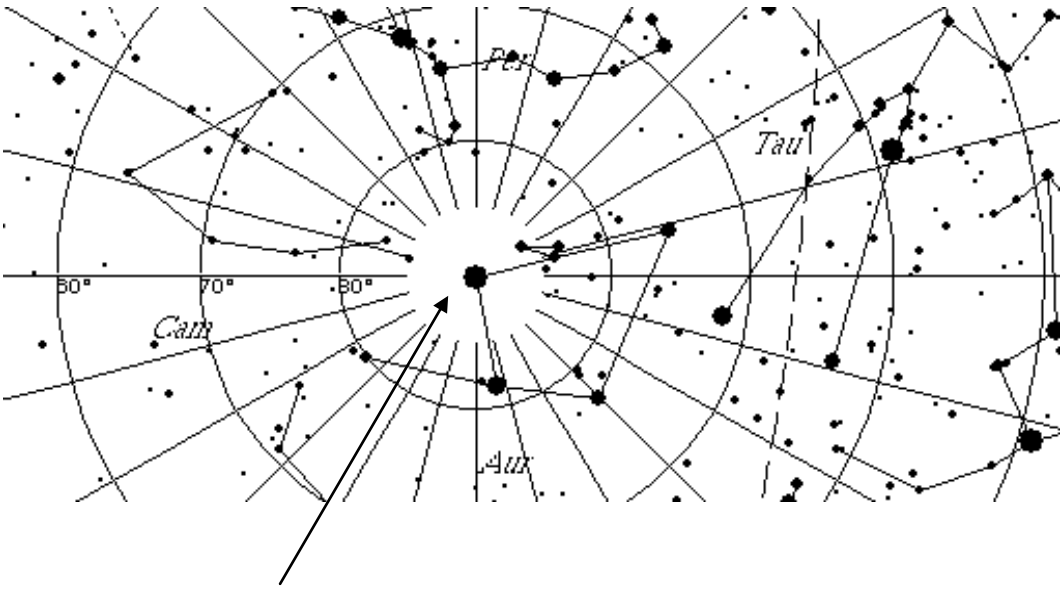


Fig 17.12 Capella directly overhead viewed at 4 hours before sunrise, summer, equator at Sundaland 9071 BC

Capella was carefully monitored. It was decided to measure the Earth; the mathematical knowledge was sufficient and it was thought that just maybe some answers might come out of the investigation. The result was the circumference measure of the Earth that stood the test of time, that seen throughout this work, that which was in use right up to the decision to devise a new count of units, the metric system. *But the measuring of Earth at Sundaland was the ultimate source of all the world's units of measure until the onset of the Metric System.*

Hence after all the investigation into the source of the ancient measures, which commenced via a curiosity about the background of the British Imperial System, we have arrived at the end of the second and beginning of the third of the major floods at the end of the last Ice Age. It appears virtually certain that mathematics had begun to very rapidly develop, after its initial discovery at some point prior to this epoch. The history of mathematics, and indeed astronomy, will eventually have to be rewritten to accommodate the early use of astronomy and measures, whether or not the hypothetical situation described above proves to be correct. For the measures to exist at Mehrgarh then something along the lines of the theory outlined here must have happened. The use of the measures at an early period is proof of the early development of mathematics and astronomy.

It is difficult, on the basis of current mainstream thinking to imagine people setting out to measure the Earth at that distant time, and yet at some point it was achieved and it was achieved prior to the development of the measurement system seen across the world. We have traced that system initially to circa 5,000-5,500 years ago and the findings at Mehrgarh extended this to 9,000 years ago or probably at least 2,000 years after the period at which the first elements of the mathematical system upon which it is based were probably developed.

To what extent and when the initial calculations expanded we cannot begin to guess. All that can be said is that the rudiments of mathematics and geometry had to exist before the measuring of Earth so we are looking at a period prior to 9000 BC. With Capella being such a beautifully positioned star, perfect for position taking, elevation readings, and additionally being bright, it simply must have been used.

Certainly, it would have taken a considerable period for the basic knowledge derived from the sighting of Capella to evolve into the system evident at Mehrgarh. The Bible in fact gives a description for this [see following chapter] that complies very well with a compilation of dating from this work and our companion volume *Deluge From Genesis to Atlantis*. The division apparently happened at Merhgarh; there is much more to the Biblical account than most believers would believe. There are other considerations here as well. The 22/7 value for π we noted earlier was almost certainly derived from a practicality, it would not have been a difficult operation as these were practical people. Given the phases of the moon they probably were also familiar with counts of seven and hence would have readily accepted such a calculation.

At Mehrgarh, one of the brick measures was of two handbreadths associated with the 1.584 feet cubit and this implies that the value 1056 was understood *by the time of Mehrgarh.* The implication here is clear, the factors utilised by Michell were already in place, the diameter of Earth at 7920 of the miles we term British was known by the time of Mehrgarh and the secondary value of π had been evaluated; the new symbolic circumference of Earth was developed, one that embodied the symbolic month of 30 days and the value 1056. We would place this development at around 7,600 BC…*at the very latest.*

While the reconstruction in this chapter is basically a hypothesis, it cannot be denied that the ancient measurement system must have had a reliable astronomical source. It existed at Mehrgarh in a fully formed system as was evident from the three different measures on the bricks and the conformity of volume to the weight system.

The period under discussion here is not long before that of Mehrgarh, the people of Mehrgarh were imports from Sundaland, Mehrgarh is the only place that the measurement system has been discovered at such an early date. In addition, the evaluations seen in this work fit the Indian material very well, material and myth, astronomy and measure. If the hypothesis is incorrect then another source of around the same period, which utilised an identical system and developed exactly the same dimensions for Earth has to be found…now that would cause someone a few headaches!

Archaeologists and historians handle the evidence for the system portrayed in this work every day. The birth of that system was at the end of the last Ice Age, long before man was supposed, according to conventional thinking, to be able to devise such a system. The evidence has been misread…it indicates otherwise.

CHAPTER 18

How the Earth was Measured

Math cannot take the mystery out of life without doing away with life itself, for it is life's mystery.

(Source unknown)

18.1 Observation and ability

The previous chapter has clearly shown that mathematics was being developed long prior to a time than that for which current mainstream thinking would allow. Observational astronomy is an ancient art and effectively the movements of the 'lights in the sky' provided the only predictable, stable elements in anyone's life in early antiquity, specifically during the time of the floods. Being predictable, their movements could be seen to alter over varying periods, be those periods days, months or years. But for such an understanding the ability to count was essential. It was apparent that the lunar phases correlated with the menstrual cycle and for those living at the coast, the tides. So here was an initial understanding of what is above is of great relevance to that below.

As mentioned in Chapter 2, humans are far from being the only creature with the ability to count, although we have obviously developed further than others. There does, however, seem to be an inbred numerical 'hardwiring' into a number of creatures, much as the migratory knowledge with which many birds are born. Over the many millennia, this mathematical ability appears to have developed well in humans resulting in a calculating creature with a great deal of imagination and ingenuity.

For a star, or constellation of which it is part, to slip backwards one degree in its precessional cycle a short period of 72 years is required. It therefore would not require a lengthy record of events to be noticed; as the horizon was the predominant sighting line of the early antiquity and as stars rose or set at different times in relation to sunrise or sunset then this would be noticed. Given that over the lesser period of 36 years the difference would be the equivalent of the lunar diameter it is difficult to understand how it could have been missed.

The change in seasons in conjunction with the various constellations of the zodiac [or possibly patterns of stars in the sky] would have been known by all and sundry in antiquity. This statement is probably a truism dating to long before the first cave paintings and lunar calendars etched on bones were produced, millennia before the period that is of interest to this study. These were all natural events and people survived via their ability and knowledge gained by observation coupled with hard learned skills, a vastly different situation to the modern developed world, but one where people were in tune with their world and the experienced universe.

Given that there is a 'hard wired' mathematical aptitude in the species, this undoubtedly was coupled with the sizes of the various body parts such as forearm [cubit] hand

width [span] etc. A step was just that, a step. Over the years this developed into a coherent system, but one that almost certainly lacked a basic standard. Eventually such a standard was developed.

We have earlier shown the origins of the 360 day year [as seen specifically in India]. This may also have been utilised as an approximation and that round value applied to a circle [which as the Sun appears circular as does the full Moon has been a familiar geometrical figure since the dawn of mankind]. Remains of huts of circular format have been found in abundance around the world hence this was *a commonly utilised practical shape*.

There are commonly understood to be 12 constellations in the zodiac and this was utilised in India long before its recorded adoption by the Babylonians or Greeks. This specific count, of course, is an inherent part of the sexagesimal system, a count in sixes that formed, along with a decimal count of 10, the base of the ancient system of mathematics and measurement.

The previous chapter indicated that mathematics, by the time of the period in question had developed to a stage where basic geometry was understood and a circle had been divided into 360 degrees. On a flat plain it would have been realised that from horizon to horizon, passing through a location directly overhead, would be 180 degrees with that spot above the head being a rise of 90 degrees. It is this knowledge that eventually allowed a measuring of the Earth to take place.

Continual observations of the skies and relevant calculations revealed, via the 72 years it took a star to move backwards a single degree, of the 25920 years of the precession of equinoxes. As the circle had previously been divided into its 360 constituent parts, it was an easy matter to multiply 72 years by 360 and arrive at 25920.

However, this means that not only had the circle been divided geometrically, but instrumentation had been devised to measure the angles of the stars above the horizon. Conventional thinking would have us believe that this could not be the case. Yet conventional thinking would also claim that the bricks at Mehrgarh bear no relationship to the measurement values in use in the later 'ancient' world. Indeed, conventional thinking has not even allowed that measurement of an accurate nature could have existed at this period. It has been shown in earlier chapters that indeed, this relationship does exist with the circumference of Earth being divided by the 25920 years of the precessional period and that at Mehrgarh there is no apparent learning curve. Here, the bricks were in use at the stated accurate sizes from the beginning of the build up of the region, the build up that involved the people with the 'Sudadont' dental remains. These were the people who are derived from Sundaland, from where the name for the tooth type is derived.

We have now arrived at a time when instrumentation had been developed and the angles to the various stars could be measured, that a star which was declining in its precessional progress toward the eastern horizon could be monitored and its rate of movement over a period could be calculated. This was when it was realised that all that moved forward east to west during the course of year, moved backward over a period of 25920 years. [In modern times known as 25,826.73307 years which in reality is a variable period frequently erroneously rounded to 26000 years.] This period, as is the year, had 12 zodiacal divisions. These have become known as 'ages' as with the forthcoming age of Aquarius. Of course, a value of 2160

years emerged from this as 25920 / 12, which as the Moon travels around the Earth in a month, was also later applied to its diameter in a symbolic manner in British miles. As it happened, this evaluation was virtually exactly correct and was accepted until recent times as the lunar diameter.

While we have seen the measurement system of antiquity in use throughout the ancient world including Mehrgarh, we have yet to date it. That is in part the purpose of this chapter. However, the system is dependent up the measuring of Earth and hence here we also reveal how we believe this exercise must have been conducted. As it was also dependent upon the stars we can additionally utilise astronomy to ascertain, within very narrow limits, when this Earth measuring exercise was almost certainly accomplished.

18.2 Measuring the Earth: Instrumentation

In discussing this chapter the authors and colleagues came up with many ideas on how the Earth was first measured in antiquity. For example the use of widely separated mirrors and sand clocks to catch the rays of the equatorial Sun at the equinoxes was pondered and rejected as there is no direct evidence that these 'technologies' could have been employed in the 9th-10th millenniums BC. It seemed however, that it would be most sensible to use a technology that was employed much later in the Asiatic continent, *but before the advent of the telescope;* in other words, a simpler and perhaps portable version of something seen much later. This is because it is likely that the extant evidence of such usage would have been predated by simpler version of a similar methodology.

Here we stress that much of what follows is conjecture, but conjecture based upon all the previous evidence and practical experience [the principle researcher and author is a carpenter of extended experience]. We have traced the units of measurement to Mehrgarh and the people at Mehrgarh to Sundaland. Given that the Earth was measured at a location at or adjacent to the equator, Sundaland appears to be a logical place to investigate and the following seems to be a logical answer to the question of these measurement units' origination.

So what type of tool was devised for this exercise of star monitoring and how did this enable the Earth to be measured? Firstly we should examine some instrumentation from India albeit from much more recent mediaeval times to show how observations have been carried out in times nearer to our own [See Figures 17.1 -17.3]. Incidentally, such instrumentation as is seen here is not unique to India and similar principles have been utilised in many locations.

The primary point to note is the format of the instruments. These are large structures, which could equally well be scaled downwards and then constructed in lightweight materials, making them portable. It would appear that these are a development from an earlier concept, a pattern that changed but little over the millennia and indeed, except for the advent of powerful telescopes would still be in regular use today.

Fig. 18.1 Selection of instruments at Jantar Mantar

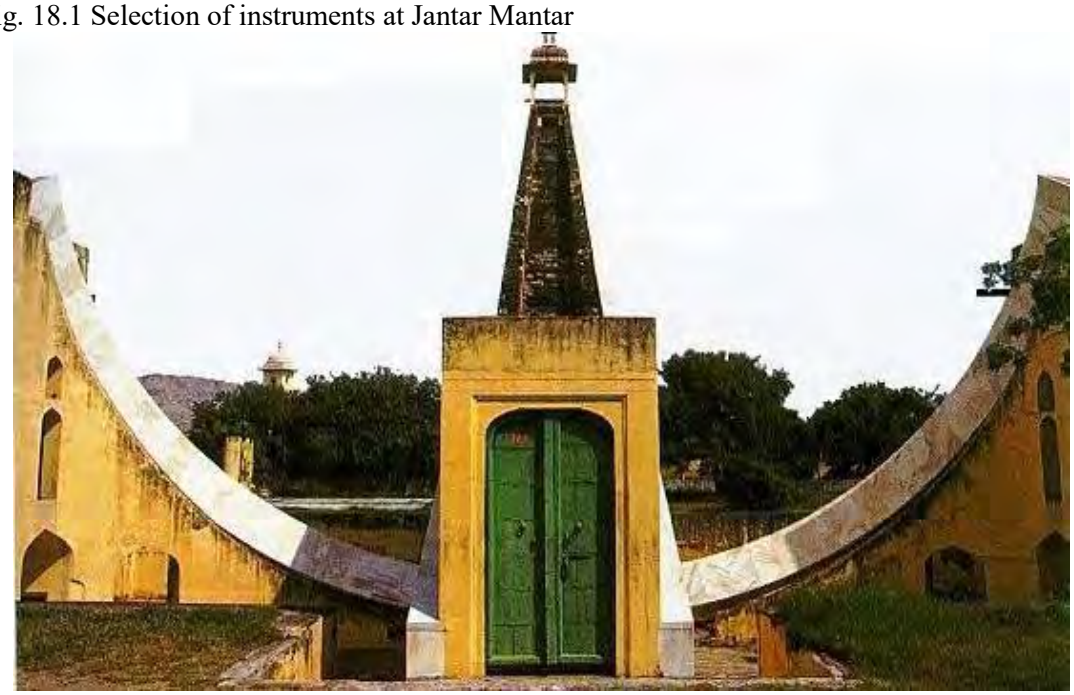


Fig. 18.2 Sundial at Jantar Mantar in Jaipur

What can be seen in Figure 18.1 is a selection of step like structures set at different angles, aligned to different altitude locations but simultaneously all having the same general direction of alignment. The site as whole contains numerous large scale very accurate instruments.

Figure 18.2 shows a singular instrument which is a large sundial. It is this structure that is eye-catching because if it were possible to pivot this tool and it had a pendulum like pointer that could swing from the high point of the centre section, then any star could be followed with this one instrument.

It appears that all of these tools/ instruments/ structures are a development from some early version of the same that in appearance must have had a great similarity to the sundial seen above. Ability and the means to measure the skies in terms of degrees, is an essential prerequisite to measuring the circumference of the Earth.

With the proposed type of instrument we find that these skills and abilities would have been available to people who had mastered geometry and arithmetic [that they were already accomplished in the field of observational astronomy is a foregone conclusion]. What we need to do now is explain how and with what, it was accomplished.

As noted in the previous chapter, at around the time of 9070BC the star Capella was rising in the East, travelling to a point directly overhead and setting in the West. It is this star that we believe was traced through the skies with an instrument uncannily akin to the sundial seen above. Here we see a line drawing of an instrument that has been devised for the purpose of being a mobile astronomy observation device although more permanent tools would almost certainly have been in existence.

The idea was for the operator to lay directly beneath the instrument and sight the chosen star through the tube in the centre.

[A bamboo is easily split, hollowed out and bound and sealed back together making a perfect sighting tube. This is a process has been used for water pipes and in recent times, until the advent of more modern materials, for fishing rods.] The tool had the advantage of being portable which in exploratory work was essential, as in the later surveying instruments such as the theodolite.

While the drawing may depict a rather odd looking contraption it is in reality quite an accurate instrument and when set up correctly should give surprisingly precise results of measurements…to within a degree at least. It is a well braced timber structure with an arc following the same as that on the Indian sundial but with the suggested 'pendulum' in the centre. Here, however, the pendulum is hollow and pivoted hence it can be set to any angle on the scale marked off on the curved section. Alternatively, the operator can call out to an assistant when the object of the viewing appears in the eyepiece and the assistant would then read the angle off the curved scale.

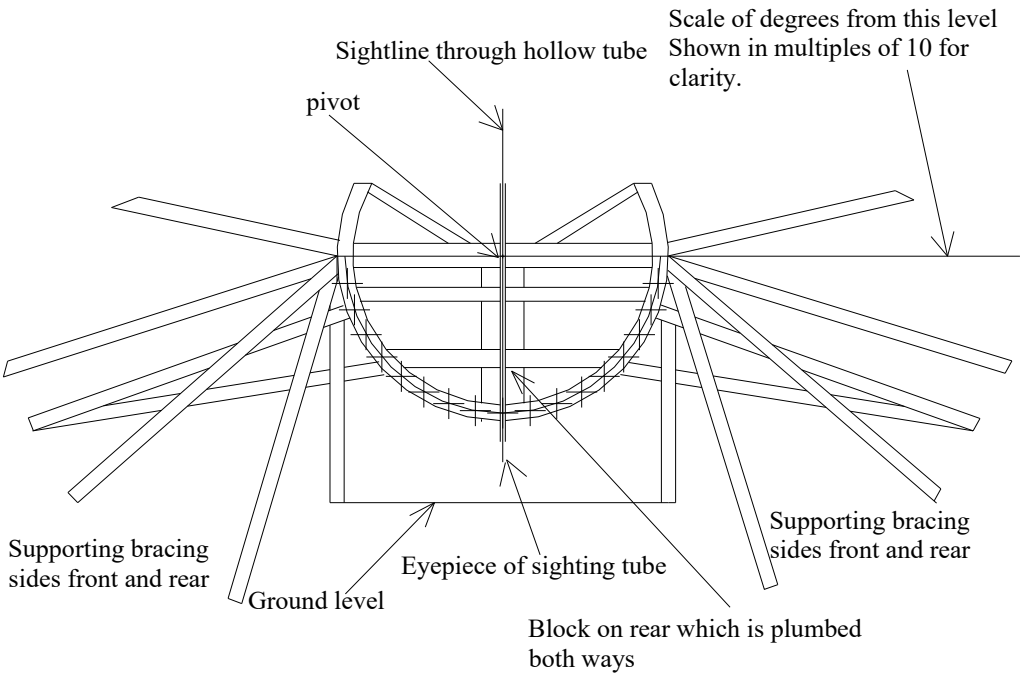


Fig 18.3 Demountable instrument showing sighting position for 90 degrees elevation

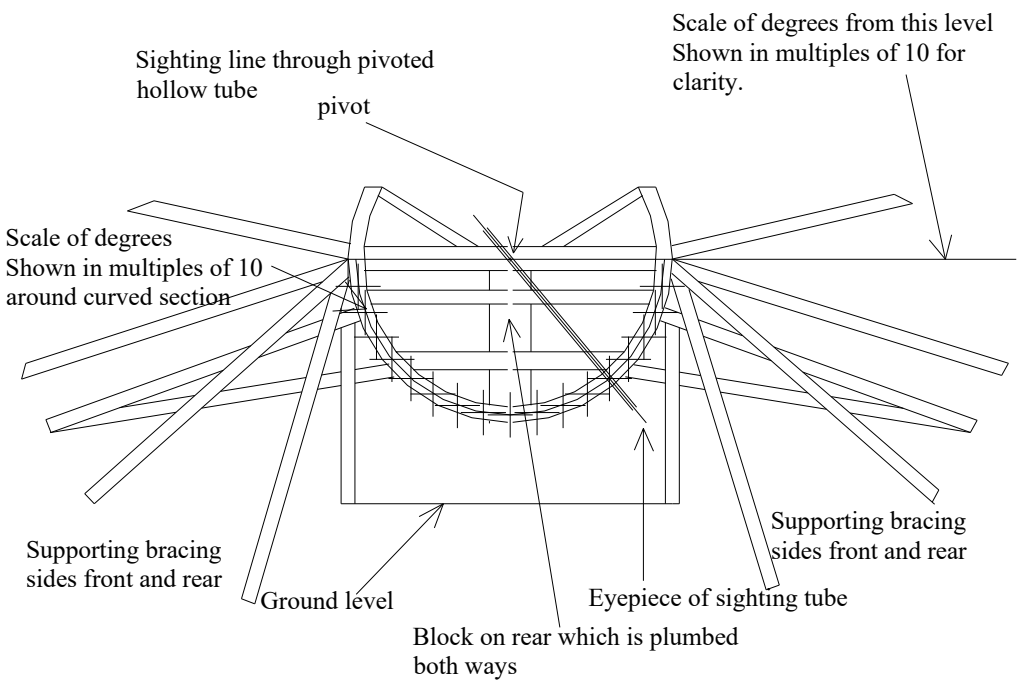


Fig. 18.4 Instrument showing sighting position for 50 degrees elevation

Hence an operator laying on his back sighting a star at various times in its traverse [when it travels in a straight line] coupled with his partner observing the degree scale should be able to give accurate notation of the relevant stars elevation virtually from horizon to horizon.

It is thought that such an instrument would have been the precursor to more solid and permanent structures such as those seen in the earlier figures.

If this instrument is carefully constructed in the fashion indicated then it would be an accurate astronomical observational tool albeit limited in scope due to the pivot being in only a singular direction. The commonality between this and the later large fixed structures is obvious and while here we see the invention of a portable version it is highly likely that other more permanent versions with fixed angles for the observation of stars, for example those with heliacal risings [making the notice of the 36 years per half degree or visually the lunar diameter of precessional movement even more simple], were built.

So in this historical reconstruction we now have a situation where Capella is moving to an overhead position and we have an instrument capable of accurate observation that is both accurate and portable. Capella could have been tracked in terms of degrees of elevation East /West through the night sky.

The seas were generally increasing and flooding from the South at Sundaland, although whether this had any bearing on the following is unknown. It is apparent that readings were taken and clearly showed Capella to within a degree of being overhead at the equator. But as this was unusual and risings of Sun, Moon and stars moved in general from North to South and South to North, a reading to the North was desirable. Hence the team of observers moved northwards until by a trial and error process they could see that Capella was now at the 90 degree elevation when it was a degree to the South and not directly overhead. It was realised that by simply moving north, a degree difference in a stellar observation had become apparent. This was a case of as above so below and hence if the star was now seen a degree to the South then the observers must, by definition, have moved a degree to the North.

So effectively these astronomers had travelled a single degree of the Earth's circumference. Now all that was required was to measure the distance travelled and multiply it by 360 to find the circumference. Undoubtedly this was not the prime mover of the exercise, a fascination with Capella [among numerous other astronomical matters] was probably the initial motivating factor but when realisation of the implications set in, no time would be wasted in the measuring and calculating element. The exercise would certainly have been repeated many times for confirmation. Of the nature of the original measurement units we have no idea but what we do know is that when this distance was finally confirmed and it was multiplied out to find the circumference of Earth, the value that emerged is that calculated by John Michell.

It is ironic that we also find that this was in a meridian direction, although the world was considered globular. There can be no doubt of this simply because of the divisions that were applied to the result of the exercise.

The principle divisions were of 25920 and 27000 representing the precession of equinoxes and the 27 days of the sidereal month. These, divided into the calculated circumference result in the Greek and Roman miles which as we have seen, themselves are interconnected via the factor 0.96 or 24:25. However, virtue of the fact that a circumference

calculated in a meridian direction is divided by elements that are seen in an East-West direction [and vice versa for the precession] it is clear that the planet was believed to be spherical *and definitely not* the flattened globe as Michell and others, without any firm foundation other than numerical coincidence, have assumed.

However, as noted in the previous chapter, these divisions seemingly were not immediately applied. According to Genesis it was during the days of Peleg that the 'Earth was divided' and Peleg was Noah's great great grandson. Hence if we take the flood[no pole star period] immediately after the loss of pole star Vega as our commencing point and move on to the onset of Tau Hercules as pole star, we have a date of 8100 BC when Noah's sons starting multiplying. Given that we have a traditional ten generations during a creation period [the varied dating in Gensis gives additional information] then multiply 1/10 of 1000 years by 2.5 to arrive at this fictional character's midlife point, so we now have a date of 7850 BC which seems as if itmay concur with the dating for the measurement development seen a while later at Merhgarh. As the flood tale came from India, is cyclic and stems from this early period we can rightly dispense with Noah and call the main character Manu. This particular Manu would be the one *before* the earlier of the two indicated [two floods in Genesis] in the Bible. So while an imaginative suggestion, there does seem to be the possibility of a connection to the statement in Genesis.

John Michell, in his book *New View Over Atlantis* claimed that the Earth's dimensions were understood in antiquity and that the circumference of Earth was understood to be 24883.2 British miles. In one respect, he followed the work of both Stechini and Greaves in his claim that this was the meridian circumference. As repeatedly stated in this work, we disagree. The meridian or polar circumference was not measured until quite recent times, shortly before the metric system was envisaged and surveys conducted to ascertain this measure. The first measuring of Earth, conducted many thousands of years ago we agree was in a meridian direction, but it was conducted at or adjacent to the equator. The assumption taken was that the earth was a globe. While the Greeks made attempts to measure in a N/S direction, it is strange that using a multitude of stade values and therefore different counts of stadia, *they all arrived at the same dimension,* that which had long been accepted, that around which the ancient measurement system was developed. The Greeks may have suspected that the circumference through the poles was different to the equatorial measure but did not have the capacity to evaluate the figure and in any case, it would have involved travelling far away in both Northerly and Southerly directions from Greece. It appears that they were totally unaware of the true shape of Earth.

Michell's circumference of 24,883.2 miles, which is mathematically coincidentally a count of 1.2 x 12 x 12 x 12 x 12, and which he and others claim to be the meridian circumference, is within less than 24 miles, or 0.1% of today's NASA estimates of both Earth's polar and its equatorial circumference, so take your pick! What this does nevertheless undoubtedly prove is the ability of those who first made these calculations thousands of years ago. The differing values of units were seen by Michell to be associated with a mean degree value of the meridian circumference of Earth which coincidentally is to be found at the latitude of Southern Britain. John Neal [All Done with Mirrors] has extended this theory to associate various measures with regions around the meridian quadrant. Coincidentally the factors work

as Neal describes but they were not initially derived in this fashion, as we have repeatedly stated, the prime element in all the initial numerical manipulations was that strange ephemeral entity, time.

18.3 The Source Found

So it now seems that we have discovered the most probable source of not only the ancient measurement system in general but the 'British' measurement units in particular. In essence, all is derived from observations of the 'lights in the sky', of astronomy, a subject in which our forbears, with their limited technology, excelled.

At Mehrgarh the measurement system appears in a mature state and the people involved are derived from South-east Asia only a short period earlier in archaeological timescales, so it is to Sundaland that we have had to look for evidence.

It is here, just over 11,000 years ago that is found the method, the motivation and the people who were the first to devise the measurement system that gave us, very shortly afterwards, the basics of the Imperial System, that which is still in use in the U.S. in 2007 AD. The history of the Imperial system has effectively been rewritten. However, what is even more important than this is that it shows the history of civilisation itself and the intellectual development of humankind needs to be reconsidered.

There has been considerable interest in some qwuarters regardingeth possibility, indeed the virtual certainty of the existence of a 'lost civilisation'. While there is abundant evidence of mans ability to work in stone and indeed to move heavy stones this does not imply a great deal of knowledge as much of this will be derived from experimentation and practice. To develop a 'skill' requires much practise but skill is not knowledge, it is the practical application of knowledge.

Math has been the mainstay of the development of human civilisation and hence it certainly appears that in this work we have seen the location of what must be seen as the 'lost' civilisation that laid the foundations of all modern math based development. The civilisation passed on its learning to Indian people and then it became 'lost' and buried in India among the ruins of Merhgarh. But while this is the case, and whether there are any descendents of these folk still alive inIndia, the germ of learning that was passed on at that early time spread and evolved into a great mathematical language, a language that eventually allowed the development of the computers that enabled this research to uncover the origination of this 'lost civilisation'.

CHAPTER 19

An Open Secret

Because it is sometimes so unbelievable the truth sometimes escapes becoming known.

Heracleitus

The first key to wisdom is constant and frequent questioning…for by doubting we are led to question and by questioning we arrive at the truth.

Peter Abelard

If one accepts the currently taught history of humanity, then the truth, as Heracleitus put it, will escape becoming known, because it is, to those who have been indoctrinated with entrenched theories, simply unbelievable. To arrive at the truth, Abelard says, one must doubt, one must continually question, implying that we should not blindly accept because 'it is written'. This implies that one must be prepared to change one's ideas as evidence reveals that the currently held theory is invalid. One, must of necessity then, have an open mind, a mind that will accept information from far and wide, a mind that will dissect and analyse this information, question 'until there is nothing left to ask'. Of course there are always questions and in the context of this work, it is to be found that questions remain, but most of them will be new questions, questions that have been thrown up by the research undertaken during its preparation.

The spur to the research that underpinned this work related to the history of the British Imperial system, a history that offered no evidence to support the academic assertion that the British measurement system stemmed only from the system used in Roman times. As the study developed from its infancy in the early 1980s, the history of measurement became only one facet of the research, and since the late 1990s the scope of the investigation widened into many fields, especially into ancient astronomy and the numerical aspects of myths and religion, as we have touched upon here and detailed in our companion work *Deluge.* Although the scope of the research broadened, the ultimate goal was achieved and here has been revealed the source of the measurement system that eventually made the industrial revolution that led to modern machinery and electronics possible.

A great effort has been made to give a historical and archaeological background to what in itself, the history of measurement, might have only been seen as a dry, esoteric study. In reality it is a fascinating subject that has bearing upon all facets of modern life.

It is to the detriment of many scholars that academics tend to ask their questions in their own speciality, therefore science or perhaps more importantly, knowledge itself, becomes compartmentalised and the academic benefits of the cross fertilisation of learning are lost. Numerous essential questions are simply not raised within academia for this reason. Luckily

this rarely applies to the sciences and two famed examples are naturally from the field of science, Jacob Bronowski and Carl Sagan. However, in the field of study covered here, what previous work that has been accomplished has tended to focus on one aspect of what is a much wider and inter-linked subject. Questions have then had to be asked in wide range of academic fields which have eventually revealed evidence which has, for the most part, *been in the open all the time*, unrecognised for what it was, in effect an *Open Secret*.

As we note above, questions still remain as this study is brought to an end. However, it is hoped that fellow researchers will agree with us that much basic ground work has been undertaken in understanding how the measurements used in the ancient world were based on an understanding of that world itself, and its relationship with other celestial bodies.

For the reader who has found this work instructive and would like to know more, in our companion work *Deluge* we reveal how the knowledge relayed in this book was related to a memory of a Great Flood, a memory that mainly relived the experience of the rising of the waters and the associated astronomy after the last Ice Age, the same era and in fact the same location as this investigation unexpectedly found to be its ultimate destination.

Measurements of the Gods
Notes and References

About the Notes and References

The Web

If this investigation had been accomplished ten or more years earlier, it would have been done differently and probably not as well, the vast resources of the Internet and World Wide Web would not have been available. As one of the authors earns his living from the Internet it is to be expected that there will be a number of references to web – based resources, particularly from university websites around the world.

The authors recognise the impermanence of websites and webpages, which is reflected in the use of fairly stable university resources wherever possible. We have endeavoured [as far as possible] throughout this book that non-educational sites are for general reference and research only – if a reader wishes to explore some of the more esoteric references in cyberspace, he/she will able to find many similar sites to the one he/she is interested in, if a so–called broken link is found. The problem of broken links is however, offset by the fact that web references make these sources available to everyone, and if the reader wants to look into some aspect in more depth, it is easily done, in many instances obviating the need to try and locate texts, that in some cases are hard or impossible to find. Numerous classical and religious texts and scholarly commentaries upon them are now available on the internet.

We must particularly thank Henry Davies Consulting for their wonderful collection of maps and monograms and the mathematics department of the University of St Andrews for the information in some of the chapters. Without their input the history as told in this book could not have been assembled.

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A Connecting Factor

2.0454545 is the connecting factor between a number of important values. It unites time factors to measurement units.

(precessional month)	2160/ 2.0454545 = 1,056
(precessional year)	25920/ 2.0454545 = 12,672 (inches in 1056 feet)
(days in sacred year)	360/ 2.0454545 = 176 (1.76 = cubit of 10.56 foot reed)
(years per precessional degree)	72/ 2.0454545 = 35.2 (inches in relative pace of 2.9333r)
(years in Indian yugas)	432/ 2.0454545 = 211.2 (21.12 = inches in 1.76 feet)

(months in year) 12/ 2.0454545 = 5.8666r (mile relative to 1.76 foot cubit =5866.666r feet)

In addition to these connections, there is yet another. The long Greek mile of 5068.8 British feet multiplied by 12,672 equates with the circumference of earth divided by 2.0454545**.** i.e.(5,068.8 x 12,672) x 2.045454545 = 131,383,296.

Also, 2.04545454545 x 5280 = 10800 = 21600 / 2 and 5280 x 2 = 10560 (see precessional month evaluation above)

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See also Dr. S. Kalyanaraman October 1997 *Sarasvati River (circa 3000 to 1500 B.C.)* http://www.hindunet.org/hindu_history/sarasvati/sartxt.PDF and http://www.hindunet.org/hindu_history/sarasvati/html/civilizationdates.htm
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Chapter 17 The Source of the Measures of the World

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All illustrations and photographs by Gillian and Harry Sivertsen.
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All illustrations by Gillian and Harry Sivertsen except:-
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For the astronomical studies in this work great use was made of the Skymap programs:- Skymap 3.1, Skymap Pro 4 and Skymap Pro 11 (written by Chris Marriott) plus Redshift 4, Starry Night Pro and the ever popular Skyglobe. Google Earth also played a role here.

For non specialist information the Wikipedia pages have proved invaluable and these often do lead to the specialist knowledge which is required.

Harry Sivertsen and Stephen Redman Newport, South Wales, February 2008.

Updated by Harry Sivertsen

June 2010, October 2010, February 2011, September 2011, May 2012, September 2012, March 2014, May 2015, October 2015.August 2016, March 2017, Dec 2017 February 2018.

The End.