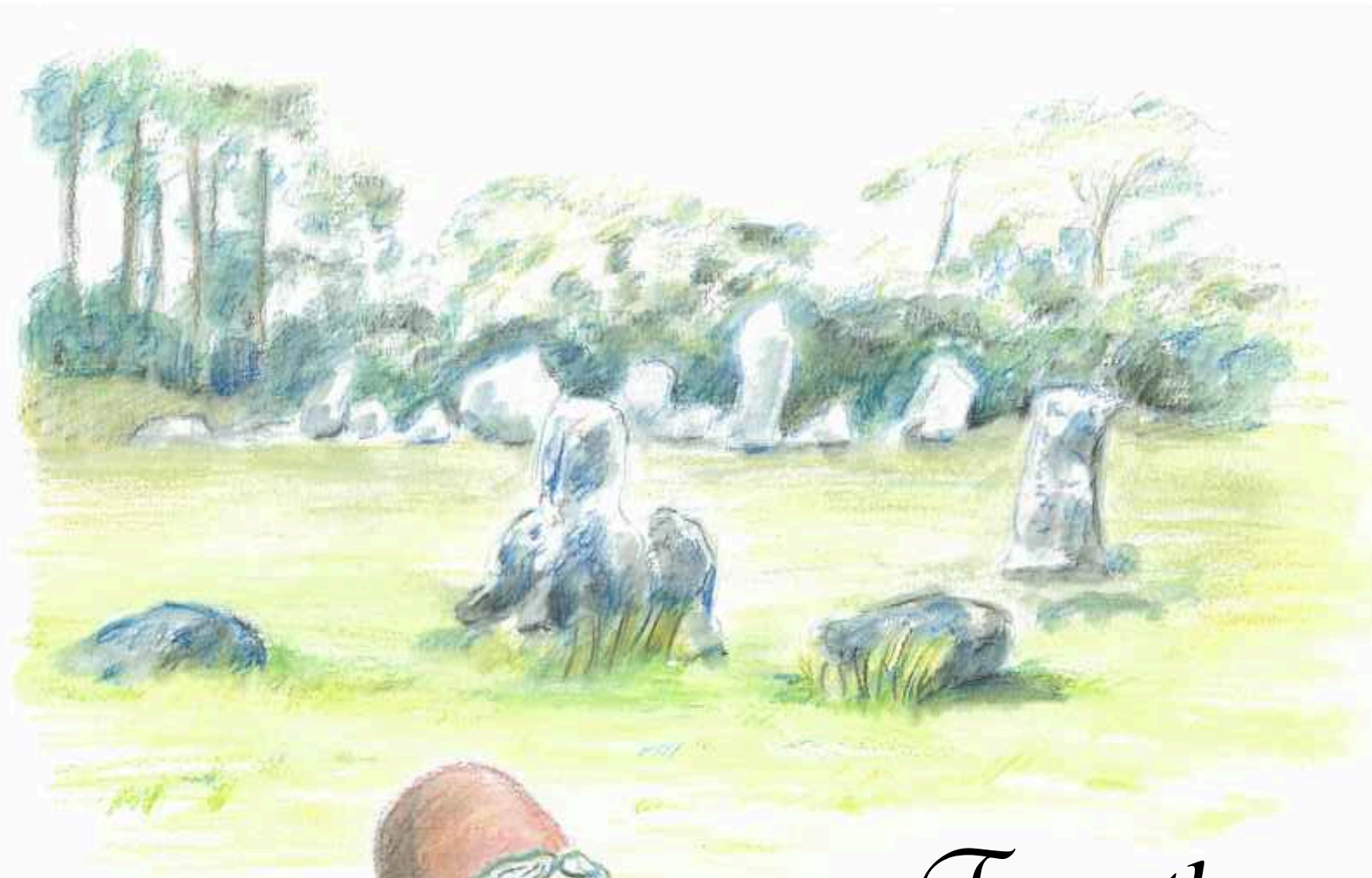

From the Rollrights to Stonehenge a measure

From the Rollrights to Stonehenge—a measure

A pint's a pound
All the world round.

This is an ancient rhyme and lasted many centuries. A change occurred during the reign of George IV and the old measures were finally done away with.

A pint of pure water
Weighs a pound and a quarter.

In this essay, I will introduce the reader to an ancient British measure called the Saxon foot or Drusian foot (13.2 imperial inches). I will show its potential use in the design of at least some of the great stone circles in Britain. I propose the architects of these circles used 13.2 imperial inches as a standard measure.

The measure has an ancient origin that can be traced through Egypt, India and the Middle East to Britain and parts of Germany, France and northern Italy. It is the mother of the imperial system of measures. This system is a wonderful system of measures, because it includes a metric system that is nearly the same as the present metric system, but it also manages to incorporate both the metric and imperial systems magnificently.

This story begins with my son, Jonathan

It was the end of the June school holidays in 1994. A cold day, and one of the very few that rained that winter, but just the sort of day to lie down and have a good read.

I chose an article on the Indus Valley civilisation from a *Time Life* series. In a discussion on Harappa, the article stated that the basic unit of measurement throughout the civilisation was a foot of 13.2 inches and a cubit of about 52 centimetres. I was thinking about this, because the length of 13.2 inches sounded familiar.

Then in walked my nine-year old son, Jonathan.

He said, 'How tall are you, Dad?'

‘Well, I’m not sure. About two metres, I think.’ Australia changed to metric many years ago and being an ‘oldie’, I am afraid I have not caught up yet.

‘No, Dad, how tall are you in feet?’

This was great. At least I knew the answer. ‘Six feet and half an inch, but why do you ask?’

I saw the answer in his hand—a basketball card—and of course there was a basketball game on television at the time.

‘Thanks Dad—you’re not as tall as Shaquille O’Neal, but you’re taller than some.’

Americans use feet and inches on their cards and Jonathan was using me as a datum point. Anyway, like any good father, I decided to educate my three children on the history of weights and measures. I went straight to a Child Craft book, *Mathmagic*, waited until the basketball game finished, and then gathered them together for a quick lesson.

The imperial system of measures consists of a foot of 12 inches; 3 feet equals one yard; 16½ feet equals one rod; and there are 5280 feet in a mile.

The imperial system

Foot	Yard	Rod	Furlong	Mile
1	3	16.5	660	5280

Ever since I was a young boy at school, I could never see why anyone would design a system that had 16½ feet in a rod, or 5280 feet in a mile. I knew that the world was crazy, but I assumed the people who designed these things were smart.

So why the odd numbers?

Child Craft told the children and me that over the centuries, Romans, Saxons and other groups conquered England.

The Romans had a unit called a ‘pes’, or ‘foot’, which was a little shorter than a modern foot. They divided the pes into 12 parts. Each part was called

an ‘uncia’, a word that means one-twelfth. It is from the word uncia that we get the word ‘inch’. The Romans also had a unit called a ‘milia passuum’, meaning ‘a thousand paces’. Our word ‘mile’ comes from milia.

The Saxon invaders had a unit called a ‘fot’, which was a little longer than a modern foot. The Saxons also had a rod, which measured 15 Saxon feet; this equaled the modern rod of 16.5 imperial feet. This meant that if 15 Saxon feet equaled 16.5 imperial feet, then a Saxon foot or fot was equal to 13.2 inches—a little longer than a modern foot. The fot was divided into 12 equal parts called ‘thumas’, or thumbs.

I stopped reading and picked up the *Time Life* article on the Indus Valley civilisation. The length of the foot for the Indus Valley people and the Saxon invaders of England were the same: 13.2 inches. What an interesting coincidence.

Coincidentally, at that same time in England and Wales, there was a Welsh foot of 9.9 inches, which was three-quarters of the Saxon foot of 13.2 inches (or ‘great span’).

About 700 years ago, King Edward I decided that there should be one standard of length for the entire country. He was the first English king to set out tables of length and area measurement. Under this system, the new foot was a little longer than the Roman pes and a little shorter than the Saxon fot.

This led to a problem. Land was measured in Saxon units. One of these was a rod, equal to 15 Saxon feet. The king did not dare change land measurements, so he made the rod equal to 16.5 new feet, or the same as 15 Saxon feet. This meant that farmers’ fields would be the size they had always been.

Thus the Act of 1305 stated:

> ... it is ordained that three grains of barley, dry and round, make an inch, twelve inches make a foot, three feet make an ulna [Latin word for elbow, later changed to yard], five and a half ulnae make a rod, and forty rods in length and four in breadth make an acre. (In Rush and O’Keeffe 1966 p 60)

About 400 years ago, Elizabeth I changed the number of feet in a mile from 4800 Saxon feet to 5280 imperial feet. This was done to bring the mile in line with the rod, furlong and other land measurements.

The older system of measures (the Saxon system) was structured so that the rod, furlong and mile were the same length as in our present system but the numbers were more even and logical:

Imperial system

Inches	Feet	Yards	Fathoms	Rod	Furlong	Mile
12	1	3	6	16.5	660	5280 feet

Saxon system

13.2	1	3	6	15	600	4800 feet

By this time my children had left, being unimpressed with the lecture.

Over the years, I have written many articles on this measure but had always intended to write something on the stone circles of Britain.

In November 2006, I finally got my hands on a book for which I had been searching in vain for many years. The book, *Stonehenge*, was written by William Matthew Flinders Petrie, who many people consider to be the father of modern archaeology. Flinders Petrie completed his survey of Stonehenge in June and September of 1877. The book was published just before he embarked on his famous survey of the pyramids in 1880.

William Matthew Flinders Petrie was born on 3 June 1853 to William and Anne Petrie. Australians have a connection here: his mother, Anne, was the daughter of Captain Matthew Flinders, the navigator and explorer who charted the coast of Australia.

Flinders Petrie, also known as the father of modern Egyptology, completed his Great Pyramid survey during 1880–82. His survey is still regarded as a great achievement. In Margaret Drower's biography, *Flinders Petrie A life in Archaeology* (1995), she explains how his work in England gave him the skills necessary to carry off this great work:

> Flinders Petrie's plan of Stonehenge was more accurate than any previously drawn, being measured to the nearest one-tenth of an inch ... Flinders Petrie was measuring monuments, old crosses in churchyards, and the dimensions of churches and castles and other ancient buildings: his purpose was two-fold: to gather data for a book which he planned as a study of ancient metrology. (pp 24, 26)

Finders Petrie got the idea from Sir Isaac Newton's *A Dissertation on Cubits* (1737). The royal cubit was in his mind when he wrote:

> The four sides of the King's chamber (which is inside the Great Pyramid) yield a mean value of 20.632 ± 0.004 (British inches), and this is certainly the best determination of the cubit that we can hope for from the Great Pyramid. (p 28)

Flinders Petrie and modern measurers such as Alexander Thom and Gerald Hawkins have left us meticulous measurements that have allowed me to apply the Saxon foot and propose it as the measure used in the construction of some of the great megalithic circles in Britain.

The Rollright Stones

In August 2004, my son, David, and I had a holiday in England. After leaving London, we based ourselves in Bath and from there visited Stonehenge, Avebury, Stanton Drew and the Rollright Stones.

The Rollright Stones form a 'Cambrian' circle with a diameter of 103.5 imperial feet and dating from the late Neolithic. They are located 2.5 miles north northwest of Chipping Norton.

I have a copy of Aubrey Burl's *A Guide to the Stone Circles of Britain, Ireland and Brittany*. Occasionally over the years, I have applied the old Saxon measure to dimensions given in Burl's book. I began to wonder whether the architects had planned the dimensions of the circles so others may notice them; for instance, so that others, perhaps priests, may recognise that the circles' dimensions mirrored the movements of the sun, moon, planets and stars.

For example, there are 29.5306 days in a synodic month, and perhaps the architect planned the diameter or circumference of a circle to correspond with this number: 295.306 feet.

At the Rollright Stones, I began to look for numbers corresponding with lunar events such as a synodic month of 29.5306 days.

Burl determined the diameter of the Rollright Stones circle to be 104 imperial feet; Alexander Thom gave 103.5 imperial feet. Using a calculator, the circumference equals:

> 104 × pi = 326.725 imperial feet

To convert imperial feet into the old Saxon foot, I multiplied by 12 inches and then divided this number by 13.2. Therefore, 326.725 imperial feet equal 297.023 Saxon feet. This number is approaching the number of days in a synodic month: 29.5306 days.

Burl's method of measuring a ring is to the centre of the stone circle. Therefore, there is some room to move with dimensions. Flinders Petrie favoured the inner edge but also took into consideration a neutral point and the outer edge of the circle.

Burl's diameter of 104 imperial feet equalled 94.54 Saxon feet, so I decided to try 94 Saxon feet as a diameter. Therefore, 94 Saxon feet (103.4 imperial feet) × pi = 295.309 Saxon feet. Once again, this number is similar to the number of days in a synodic month. This seems to me a remarkable coincidence; however, a coincidence must repeat in other situations.

Was this a coincidence, or had the architect of the Rollright Stones intended to leave a message that the circle had something to do with the moon?

I wondered whether the architects of these circles intended using a language that future generations would be able to read, simply by studying and gaining some knowledge of astronomy and mathematics.

In astronomy, a very famous cycle of time is known as the Metonic cycle. This is a period of 19 years during which there are 235 lunations (a lunar phase cycle), named after Meton, the Greek astronomer who discovered the cycle in 432 BC. Modern astronomers hold that there are 6939 days and 14.5 hours in 235 lunations.

The old Julian calendar, which dates back to Julius Caesar in 46 BC, had a Julian year of 365.25 days. A Metonic cycle of 19 Julian years comprises 6939 days and 18 hours.

I am taking a little time over this as, incredibly, this number can be observed in the area of the Rollright circle.

A perfect circle, such as the Rollright Stones, may be constructed by hammering a peg into the ground and then someone with a line stretched tight simply walks around measuring out the circumference.

A circle has a centre and a circumference, and the distance between is the radius. The radius of the Rollright Stones circle is 47 Saxon feet and that fact, to me, is a coincidence, because it produces these remarkable numbers:

- the circumference of the Rollright Stones circle = 295.309 Saxon feet
- the number of days in a synodic month = 29.5306 days
- incredibly, the area of the Rollright Stones = 6939.778 square Saxon feet
- the number of days in a metonic circle 6939.75 days.

I'm not sure whether anyone has looked at this coincidence before as I stumbled on it independently.

The Rollright Stones have been associated with the moon. Burl (1995) states that 'at this latitude with an azimuth of 142.5° and a horizon of 0°.03, the declination is 29°.3, very close to the major rising of the southern moon at midsummer' (p 73).

Figure 1, below, is a diagram of the Rollright Stones circle with the diameter drawn and the circumference noted.

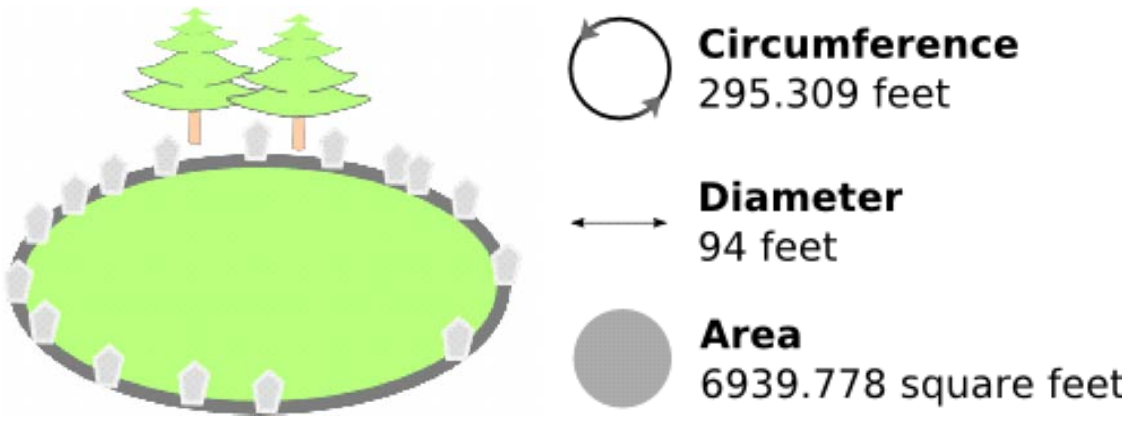

Figure 1 The Rollright Stones circle

The lunar calendar

The origin of the lunar calendar is steeped in antiquity and its development has led to several complex calendars. The lunar calendar has several cycles of time built into it, including a Metonic cycle and a 30-year cycle. The present Muslim calendar has a 30-year cycle. It is composed of 19 years of 354 days and 11 years of 355 days, a total of 10 631 days, or an average of 354.3667 solar days in a lunar year.

A synodic month of 29.5306 days × 12 = a lunar year of 354.3672 days, and in turn a 30-year cycle = 10 631 days.

I wondered whether this cycle of 10631 days could be found in a stone circle, and as my son, David, and I had visited Stanton Drew during our holiday, I decided to find out the dimensions of this ring complex.

Stanton Drew

Stanton Drew is six miles south of Bristol, just off the beaten track but in a wonderful location.

At Stanton Drew, there are three significant circles: the largest, the Great Circle at Stanton Drew, consists of 36 standing stones. Alexander Thom measured the diameter of this circle as 372 feet, 3 inches.

I wondered whether the Rollright Stones were mathematically connected with Stanton Drew. As the architect of Stanton Drew chose to place 36 stones around the circumference of the Great Circle, I decided to use 36 in my calculation. I multiplied it by the circumference of the Rollright Stones: 295.309 Saxon feet by 3.6 and (I could nearly taste the number 360 here) 295.309 × 3.6 = 1063.1124 Saxon feet.

And there it was, just beautifully laid out.

The circumference of the Great Circle at Stanton Drew of 1063.1124 Saxon feet divided by π = 338.399 Saxon feet (372.23 imperial feet). Thom's diameter of 372.25 imperial feet = 338.4 Saxon feet.

The number 10 631 is the same number found in a 30-year lunar cycle.

It was clear to me that, if what I had found was mere coincidence, then it was surely a remarkable coincidence.

The origin of the Saxon measure

Measuring sticks

The *Collins English Dictionary* defines a wand as

> 1. A slender supple stick or twig. 2. A thin rod carried as a symbol authority. 3. A rod used by a magician.

In *Man Learns to Measure,* Keith Gordon Erwin (1962) discusses the wand in detail. Erwin states:

> The standards of the time of Alfred the Great did not match those of today in relation to such measuring units as the quart, gallon, bushel, foot, and yard. The housewife of early England had measures that were far simpler than ours, however, and a measurement system for liquids and grains vastly superior to the one we use at the present time. (pp 28–32).

Erwin went on:

> In the English home of a thousand years ago, the products of the harvest had to be measured carefully, There would be no further supply for a whole year, so the problem of budgeting it was a very real one for the housewife. As the months passed, she would need to know how the supplies were lasting. Knowing that, she could decide, for example, whether to make a cake or use her wheat flour only for rolls. To us, who can go to the grocer's if our flour bin becomes empty, it is hard to understand what a problem it was to keep an almost continual account of what was in stock. Without putting down on paper a single numerical figure, the housewife could take her measuring stick and in a moment report how many more loaves of bread she could bake with the rye flour left in a bin. Stepping into the house where the home made ale was produced from barley and malt, according to a recipe that might have been centuries old, she thrust her measuring stick down into the partially emptied vat and tell, almost instantly, how many days the ale in that vat would last. (p 31)

On first reading Keith Irwin's description of the wand, I stood in awe. He brought it home to me, literally. Irwin writes eloquently of the importance of the wand in the daily life of ordinary people.

I thought of a farmer's wife and mother taking her children with her while she measured the produce in her larder, thrusting the measuring stick down and instantly knowing how long the produce would last. The children must

have wondered how it worked and I imagined her smiling then waving her wand and saying, ‘It’s magic’.

It seems almost uncanny to us today that anyone could make these measurements so easily. But it is all explained by her measuring stick, which Flinders Petrie (1880) called ‘the old equivalent of the metre’ (p 29). It was just half as long as the old arm stretch. Its length, then, was 39.6 modern inches; it was divided decimally, as is the metre. The wand was used, as we will see, to develop in a decimal way the container sizes for liquids and grains; so was the metre. The Angle housewife called her stick a ‘wand’ (see Figure 2).

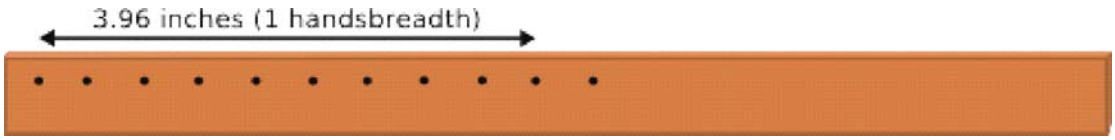

Figure 2 The Anglo-Saxon wand

Erwin also wrote about the container system of early England:

> The entire container plan of early England was built about the wand and its decimal divisions. The result was a simple system, decimal in nature, as easy as counting itself. The main small unit corresponded to the litre of the metric arrangement of today. The unit 1,000 times as large corresponds to the metric *stere*, a cubic metre. The first of these could be used either for liquids or for grains and flour, the second for a liquid, such as ale. In the Angle kitchen the measure was a common object. Made of light wood in box form, open at the top, it’s inside measurements had a width, length, and depth of 1 handbreadth each. Its capacity of a cubic handbreadth was called a measure-full. Recipes for bread making appear to have always used flour by the measure-full. In the special shed where ale was kept the home made liquid was prepared in one or two vats having spigots at the bottom for drawing off the ale. Made of heavy wood in boxlike form, the vat inside was a wand-length wide, a wand-length long, and a wand-length deep. The capacity of a cubic wand was a *tun.* The tun could also be counted as 1000 measure-full, as indicated from the vat’s dimensions. (p 46)

Figure 3 shows the dimensions of a container, similar to that used in an Angle kitchen.

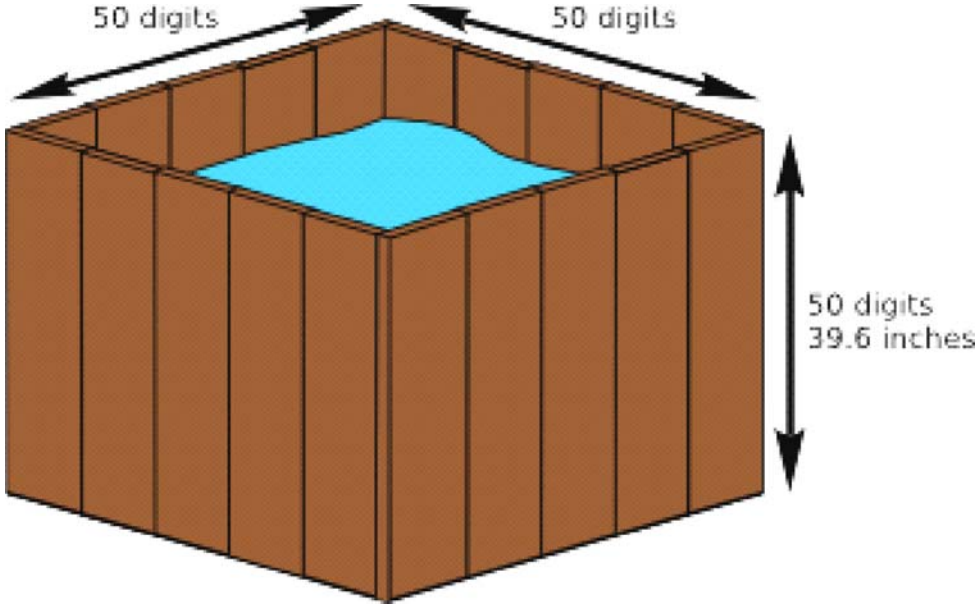

Figure 3 An Angle container

I found the Saxon system of measuring fascinating, and I was interested to see whether there was any evidence of something similar in Egypt. Did the measure of 13.2 imperial inches have any significance?

I wondered whether this measure used in the design of Britain's megalithic sites, as well as the pyramids of Egypt. I then went looking for some evidence.

To demonstrate that the Saxon system could have been used to build Britain's great circles and the three pyramids at Giza, I had to find some evidence of its existence in Egypt. So, I went searching for a foot and a cubit that would fit. I also wanted to find any possible links between eastern Europe and Britain.

Erwin writes:

> In the fourteenth edition of the Encyclopaedia Britannica Petrie summed up the facts he had found about the measures of the ancient world, giving this as a part of the articles on weights and measures. In its enormous amount of detail the article is confusing. Yet certain points stand out. The Egyptians invented the decimal plan for measurement units and used it. Other peoples of the ancient world around the Mediterranean Sea based their length plans upon that of the Egyptians and also kept to the value of basic Egyptian units. But there is a third conclusion, which Petrie only hints at. The plan for early England for distances and farmlands had the same decimal relationship of units as did that of ancient Egypt.

For me, the closeness of the old Saxon yard to the modern metre is a wonderful coincidence. One Saxon yard or
wand = 39.6 inches = 1.00584 metre.

Various measures

The entry on weights and measures in the 1962 *Encyclopaedia Britannica* states:

> 13.3 inches. This widespread measure is first found in Egypt as wooden cubit rods of 26.5–26.7 inches of the twelfth dynasty: later a very accurate standard slab of this unit, divided in 7 palms, reaches 26.80. In Asia Minor it is found as 13.35 in buildings; in Greece 13.36; at Lachis 13.18 (900 BC); and in Syria (AD 620) as 13.22, carried on as the Stambull cubit of 26.6. Hultsh takes it as 13.1 and connects it with the Drusian foot of two digits longer than the Roman foot or 13.10. This was the Belgic foot, which Drusus had to adopt as a northern standard for the border settlements of the Agri Decumates. Hence it connects with the base of English land measure.

Foot	6 = fathom	10 = chain	10 = furlong	10 = old mile
13.2	79.2	792	7920	79 200

> It was the commonest building foot in medieval England (13.2), and its age is seen by its use as a measure for Silbury Hill (13.01). It was also the basis for French architecture, the canne of 78.24, or 6 feet of 13.04.
>
> Unfortunately this old equivalent for the metre has now disappeared. (p488H)

Earlier, the article on weights and measures in the 1910 *Encyclopaedia Britannica* states:

> ‘We now turn to the second great family based on the digit. This has been so usually confounded with the 20.63 family, owing to the juxtaposition of 28 digits with that cubit in Egypt, that it should be observed how the difficulty of their incommensurability has been felt. For instance, Lepsius supposed two primitive cubits of 13.2 and 20.63…..We can restore then the old English system of long measure from the buildings, the statue-prohibition, the surviving chain and furlong, and the old English mile shown by maps and itineraries, thus:

Foot	3 = yard	2 = fathom	10 = furlong	10 = mile
13.22	39.66	79.32	793.2	79 320

> It is remarkable how near this early decimal system of Germany and Britain is the double of the modern decimal metric system. Had it not been unhappily driven out by the 12 inch foot, we should need but small change to place our measures in accord with the metre. (pp 483–484)

In *Weights and Measures*, Phillip Rush and John O’Keefe (1966) state that ‘the northern, or Saxon foot (13.2 inches) coming, as we have seen from northern India, was also used for land measuring’ (p 60).

They continue:

> … two of these ancient measures are particularly important to subsequent British history. Firstly, the northern cubit of 26.6 in. probably of Aryan origin, after 300 B.C. Its use as a standard spread through Mesopotamia, Egypt, Northern India, China, and central and western Europe. It is the basis of existing British land measures. Secondly, the northern foot (13.2in) derived from the early Indus civilization in Northern India and used to build many impressive cities. It spread far afield and was particularly popular in Italy. Southern France and the British Isles. (p 59)

From *The Roots of Ancient India, The Archaeology of Early Indian Civilisation*, second edition, revised by Walter Fairservis Jr (1975):

> … linear measurement was apparently well standardised. Mackay by good fortune found a piece of shell marked in regular fashion and quite clearly intended as a rule. Nine divisions remain, and from circular markings at two places five units apart it would appear that a decimal system was in vogue. Each division is approx 0.264 inches wide, or a five-unit total of 1.32 inches. Thus a foot in the decimal system would be 13.2 inches,

> which fit into a widespread system of the ancient world. Similarly, Vats and Wheeler provided evidence that a cubit was also used. Thus both the smaller and larger units of measurement were used in building and presumably to lay out fields. (p 291)

All this information from diverse sources indicates that the measure of the Saxon foot certainly existed, and it should now be obvious that there is nothing 'special' about a foot and cubit together in one system. The question remains as to whether this foot was used in the construction of these monuments.

What is special about the Saxon system?

I think that the Saxon system originated through the study of astronomy and mathematics, starting with the discovery of the significance of the number 360.

The vernal equinox occurs about 23 September in the southern hemisphere and about 21 March in the northern hemisphere. It is the time of year when the hours of daylight equal those of the night.

There are 360 degrees in a circle, and we know this has an ancient origin. We know the year is about 360 days in length. The remarkable thing is that the number 360 can be measured in a day, and it may be that this was the reason to choose this number above all others as the basis of a system.

The *Encyclopaedia Biblica* (1899–1903) states:

> The division of the day into 12 parts and the further development of the sexagesimal system as a whole had commended itself to the Babylonians from their observation that, at the vernal equinox, the time between the appearance of the first direct ray of the sun and that of visibility of the entire disk above the horizon amounted to $1/360^{th}$ of the time during which the sun was visible in the heavens, or the 720^{th} part of a full day reckoned from one sunrise to another. (p 1037)

This statement seems reasonable, because the diameter of the sun is taken as one-half of a degree and appears to move 15 degrees in an hour, taking about two minutes for the disc to rise.

Vernal equinox

In Figure 4, the diameter of the circle represents a flat surface, perhaps a desert or plane in the Middle East or India. I have tried to represent sunrise at the time of the vernal equinox. The sun begins to rise, first hugging the horizon then the circumference of an imaginary circle. There is the first direct ray of sunlight heralding the sunrise and then the sun climbs above the horizon, appearing more powerful by the second unrelenting in its climb — unstoppable.

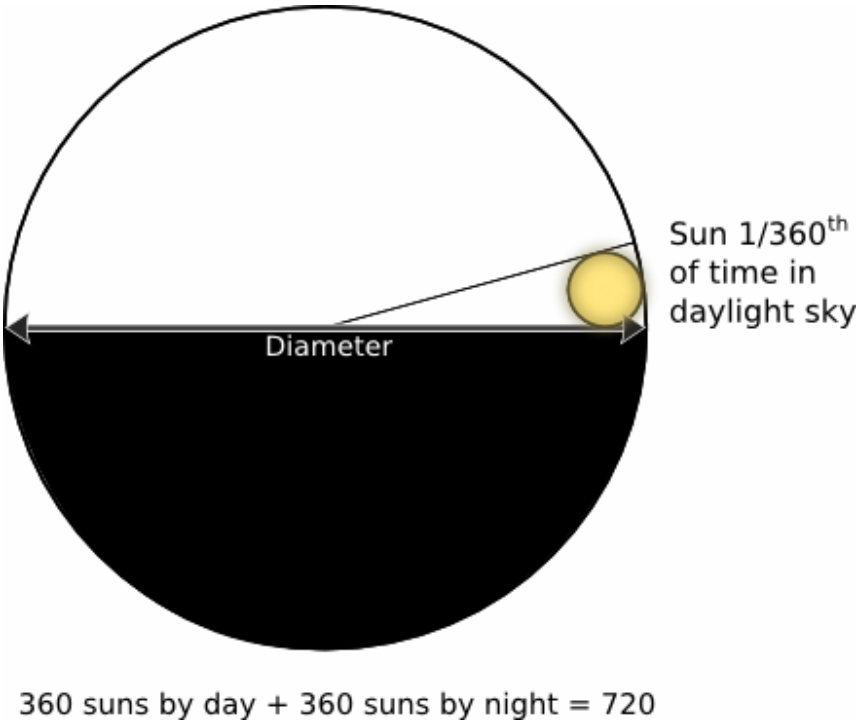

Figure 4 Sunrise at the time of the vernal equinox

In reality the sun does not rise, the sun is stationary, our Earth spins at 900 miles an hour and we roll into it, normally while lying asleep in bed.

I like to imagine the first person watching this sunrise and realising for the first time the importance of the discovery: For if our sun gave us the number 360 then perhaps there is an order and purpose to our universe, one we might even be able to measure.

Imagine an experiment using a water jar with a small hole at the bottom through which a cup was filled during the time the sun rose. You would be left with not just a cup of water but at least three measures:

- a weight of water
- a measure of length (for example, an equal weight of barleycorns laid end-on-end)
- a measure of time (one sun of two minutes).

Could this be the basis for a system?

To find 360 in the Saxon system, we can look at a land measure: the acre.

The acre

The acre is an old measure and its origins have created a great deal of comment. Until now, many people would not believe that an ancient British measure had anything to do with Egypt. Let me demonstrate some coincidences.

An acre in our present system is 40 rods ×4 rods or 660 × 66 imperial feet, giving a total area of 43 560 square feet. There are 16.5 feet in a rod.

Therefore, to calculate how many acres in a square measured in imperial feet, square the length of the base and divide by 43 560. If the base of the Great Pyramid is 755.7 imperial feet, it would contain 13.11025 acres exactly:

$$755.7 \times 755.7 \div 43\ 560 = 13.11025$$

The architects did not have electronic calculators and so calculations took a little time. However, using the Saxon system of measuring makes finding an acre very easy, because there are 36 000 square Saxon feet in an acre. The base of the Great Pyramid measures 687 Saxon feet (755.7 imperial feet).

There are two quick ways to calculate the acreage:

- The first method is to divide the length of the base by 6, square it and divide by 1000:
  - 687 ÷ 6 = 114.5
  - 114.5 × 114.5 = 13110.25
  - 13110.25 ÷ 1000 = 13.11025 acres
- The second method is to square the length of the base and divide by 36 000:
  - 687 × 687= 471 968
  - 471 968 ÷36 000 = 13.11025 acres.

It was clear to me that the measure of 36 000 square Saxon feet in an acre was significant, because it contained the number 360.

More about the Saxon system—the Saxon rule

Imagine a rule with a measure on each side. On one side is a measure with 3 Saxon feet of 39.6 imperial inches, with each foot measuring 13.2 imperial inches and divided into 16 digits with a total of 48 digits for the yard of 3 Saxon feet. This is the old Saxon yard. The other side of the Saxon rule consists of a decimal system in the form of a wand of 50 digits. The Saxon wand and Saxon yard are the same length but are used in different ways, depending on the problem:

- a foot equals 13.2 imperial inches
- a cubit equals 19.8 imperial inches
- a royal cubit equals 20.625 imperial inches
- a Saxon yard equals 39.6 imperial inches.

The Saxon yard is connected in the following way by a digit of 0.825 inches:

- 16 digits equal one Saxon foot (13.2 imperial inches)
- 24 digits equal one cubit (19.8 imperial inches)
- 25 digits equal one royal cubit (20.625 imperial inches)
- 48 digits equal one Saxon yard (39.6 imperial inches).

The cubit and royal cubit are connected by a ratio of 24:25.

Here for reference is a table based on the digit of 0.825 imperial inches:

	Digit	**Inch**	**Span**	**Great span**	**Foot**	**Cubit**	**Royal cubit**	**Yard**
Digit 825 imperial inches	1	1⅓	10⅔	12	16	24	25	48
Inch 1.1		1	8	9	12	18	18¾	36
Span 8.8			1	1⅛	1½	2¼	2.34375	4½
Great span 9.9				1	1⅓	2	2.08333	4
Foot 13.2					1	1½	1.5625	3
Cubit 19.8						1	1.04166	2
Royal cubit 20.625							1	1.92
Yard 39.6								1

The Saxon wand is divided decimally into 50 digits each measuring 0.792 imperial inches:

Digit	Foot	Yard/ wand	Armstretch	Rod	Furlong	Mile
0.825 imperial inches	13.2 inches	39.6 inches	79.2 inches	198	7920	**63360**
	1	3	6	15	600	**4800**
0.792 imperial inches	12.672 inches	39.6 inches	79.2 inches	198	7920	**63360 5000**
	1	3⅛ **(3.125)**	6¼	15⅝	625	

The yard, armstretch (fathom), rod, furlong and mile are the same length in both measures—only the numbers are different—and they are linked with a ratio of 24:25. The numbers for the wand and rod based on the digit 0.792 imperial inches are important because they appear again and again. Importantly, 3⅛ (3.125) is used as an approximate value for pi.

Early Babylon tablets indicated the Sumerian adoption of the value three for an approximation of pi, and subsequent difficulty in determining circular length and area, and difficulty in determining the volume of the frustum of a pyramid.[1] In 1936, a group of mathematical tables were unearthed in Susa, a few hundred miles from Babylon, indicating that the Babylonians had adopted 3.125 as a loose approximation for pi.

The following table is based on the digit of 0.792 imperial inches:

	Digit	Foot	Wand	Mile
Digit 0.792 imperial inches	1	16	50	80 000
Foot 12.672		1	**3.125**	5000
Wand 39.6			1	1600
Mile 63360				1

[1] A frustum of a pyramid is the part between the base and any transecting plane parallel to the base. The American one dollar bill has a nice drawing on one side.

Stonehenge

Together, the Great Pyramid and Stonehenge are completely measured, and measured by the same person: William Matthew Flinders Petrie.

There following sections discuss the four major circle measurements at Stonehenge.

The outer ditch

Flinders Petrie's measures are in imperial inches. He discussed the most likely points to look for when fixing on a measure that the architects may have used when planning the layout of Stonehenge. Flinders Petrie wrote 'the inner edge of the bank, the neutral point between it and the ditch, and the outer edge of the ditch, are the most likely points to be fixed in laying the work on the ground' (Flinders Petrie, 1880, p 22). These distances he gives as 3595, 4045 and 4495 imperial inches diameter. It is obvious from this the ditch is wide and a large number of possible measures may be theorised.

It is also obvious the diameter and therefore the circumference at Stanton Drew will come reasonably close to Flinders Petrie's diameter for the outer edge of the ditch. Alexander Thom's diameter at Stanton Drew of 372 feet, 3 inches (4467 imperial inches) is remarkably close to Flinders Petrie's 4495 imperial inches for the outer edge of the ditch at Stonehenge.

The Sarsen circle

Flinders Petrie measured the Sarsen circle to the inside edge of the each stone:

1167.9 ± 0.7 diameter

He believed this indicated a diameter of 100 Roman feet, because he had found 11.68 imperial inches was a length the Romans had used in Britain. Flinders Petrie did not believe the Romans had constructed Stonehenge but he was of the view the Roman measure was ancient. He wrote 'Not that this shows Stonehenge to be post-Roman, as the unit was the great Etrurian and Cyclopean unit, unit derived from Egypt, and it may have been introduced at any date into Britain' (p23).

There is an interesting coincidence with Flinders Petrie's diameter of 1168 imperial inches. If his diameter of 1168 imperial inches is multiplied by the Babylonian value for pi (3.125), then the circumference of the Sarsen circle equals 3650 imperial inches—an interesting coincidence with the number 365.

Gerald Hawkins (1989) says 'The Sarsen circle diameter is 99 feet, 1 inch, measured at the center of the stones' (p52).

So here is another estimate for the diameter of the Sarsen circle, and a remarkable result:

99 imperial feet = 90 Saxon feet

Here, a 90 Saxon feet diameter gives a circumference of nearly twice the square root of two; that is 1.414213 × 2 = 2.82842, more closely when the approximate for pi of 22/7 is used:

90 Saxon feet × 22/7 = 282.857 Saxon feet

Also interesting is the length of a square constructed about this circle with a diameter of 90 Saxon feet. The perimeter measures 360 Saxon feet.

The Stonehenge–Sarsen circle

Figure 5 represents the Sarsen circle at Stonehenge. I have drawn a square around it to emphasise the coincidence that the length of the perimeter of a square surrounding the Sarsen circle = 360 Saxon feet or the number 360 of degrees in a circle.

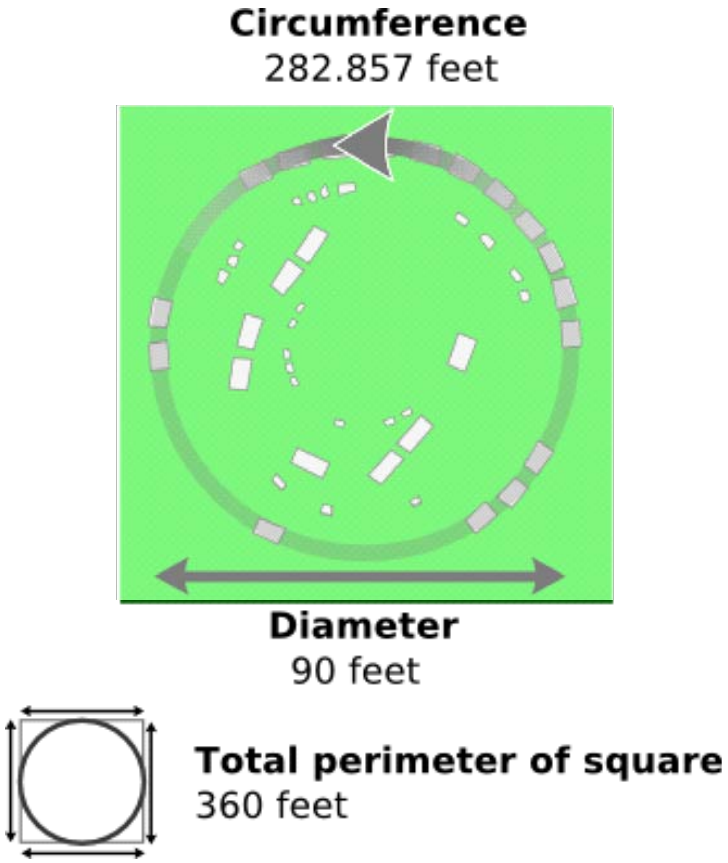

Figure 5 The Sarsen circle at Stonehenge

Another important cycle of time may also be observed within the boundaries of the Sarsen circle. This is the Saros, a cycle of 6585.321 days. This cycle is used to predict eclipses.

The diameter of a circle with an area of 6585.321 square Saxon feet = 91.56 Saxon feet (1208.6 imperial inches). By coincidence, this also falls within the boundaries of the Sarsen circle.

The outer bluestone circle

Flinders Petrie wrote ‘the outer bluestones ... may be anything between 900 and 920 diameter, owing to the curved faces of the stones’ (p 22).

Here I started with the mean of 910 imperial inches and converted to Saxon feet (68.939 Saxon feet) and found the circumference to be 216.579 Saxon feet.

The number 216 is known as a sacred number, because 2160 years is very close to one-twelfth of the time needed to complete the precession of the equinoxes' 25 920 years. The number 2160 is found as a circle inscribed in the base of the Great Pyramid at Giza and therefore the diameter of the outer bluestone circle is one-tenth of the base of the Great Pyramid. There are 687.07 Saxon feet (9069.324 imperial inches, 755.77 imperial feet) in the mean length of the base of the pyramid.

Flinders Petrie wrote that the outer bluestone circle contained 44 stones. This is interesting, because 68.75 Saxon feet = 44 royal cubits. Therefore, the diameter is 44 royal cubits.

The inner bluestone circle

Flinders Petrie gives an accurate measure for the inner bluestone circle: 'The inner bluestones 472.7 ± 0.5 inches diameter' (p23). This measure also appears to be the inner edge of the circle:

> $472.7 \times \pi = 1485.03$ imperial inches, 123.75 imperial feet and 112.502 Saxon feet for the circumference of this circle.

As this is the last circle mentioned in this essay, it may be of interest to study the measure used here and apply it to other circles.

The circumference of the inner bluestone circle is 123.75 imperial feet. The old measure can be converted to digits, feet, royal cubits to start:

> 123.75 imperial feet = 112.5 Saxon feet

In turn, this can be converted to digits by multiplying by 16, because there are 16 digits in a foot. Therefore, 112.5 Saxon feet × 16 = 1800 digits.

Then it can be converted to royal cubits by dividing the digits by 25, because there are 25 digits in a royal cubit: 1800 ÷ 25 = 72 royal cubits.

Moving a little bit further, the architect used an approximate for pi (3.125) to obtain an even number for the diameter of the bluestone circle, and a sacred number at that.

The diameter of 35.808 Saxon feet is almost 36 Saxon feet. If the approximate value for pi (the Babylonian value three and of 3⅛, or 3.125) is used, then 36 Saxon feet × 3.125 = 112.5 Saxon feet. This is the circumference of the inner bluestone circle.

It is in this way the architects were able to reach two or more important numbers. For the readers' interest, 36 Saxon feet can be converted to digits, cubits and royal cubits:

$36 \times 16 = 576$ digits $\div 25 = 23.04$ royal cubits

It is easy to see how difficult it is to rationalise numbers when you do not have the complete system of measures.

If we accept the portability of a measure, then it is possible to connect one circle with the other. Figure 6 shows the inner blue circle highlighted.

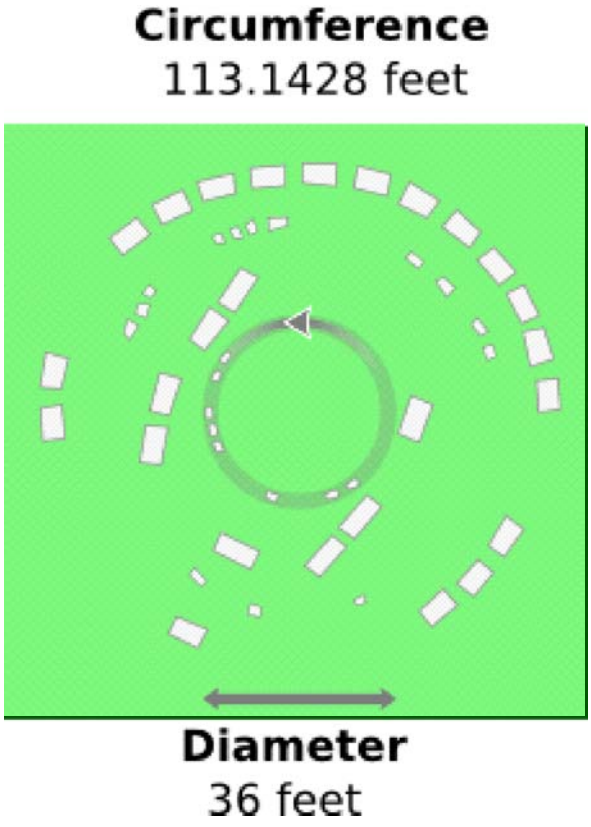

Figure 6 The inner bluestone circle

As with the Sarsen circle, Flinders Petrie measured to the inside edge of the inner bluestone circle, and so there is some room to move with a diameter.

Exactly the same numbers can been seen in the circumference of the inner bluestone circle as in the circumference of the Sarsen circle:

$36 \times 22/7 = 113.1428571$ x $2.5 = 282.857$

It is obvious the architects designed the inner bluestone in a ratio of 4:10 to the Sarsen circle; 36:90 Saxon feet.

The diameter of the Sarsen circle is exactly 2.5 times larger than the inner bluestone circle.

It was all about astronomy, mathematics, geometry and numbers.

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Source

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http://commons.wikimedia.org/wiki/Image:Rollright_Stones_(96100107)jpeg

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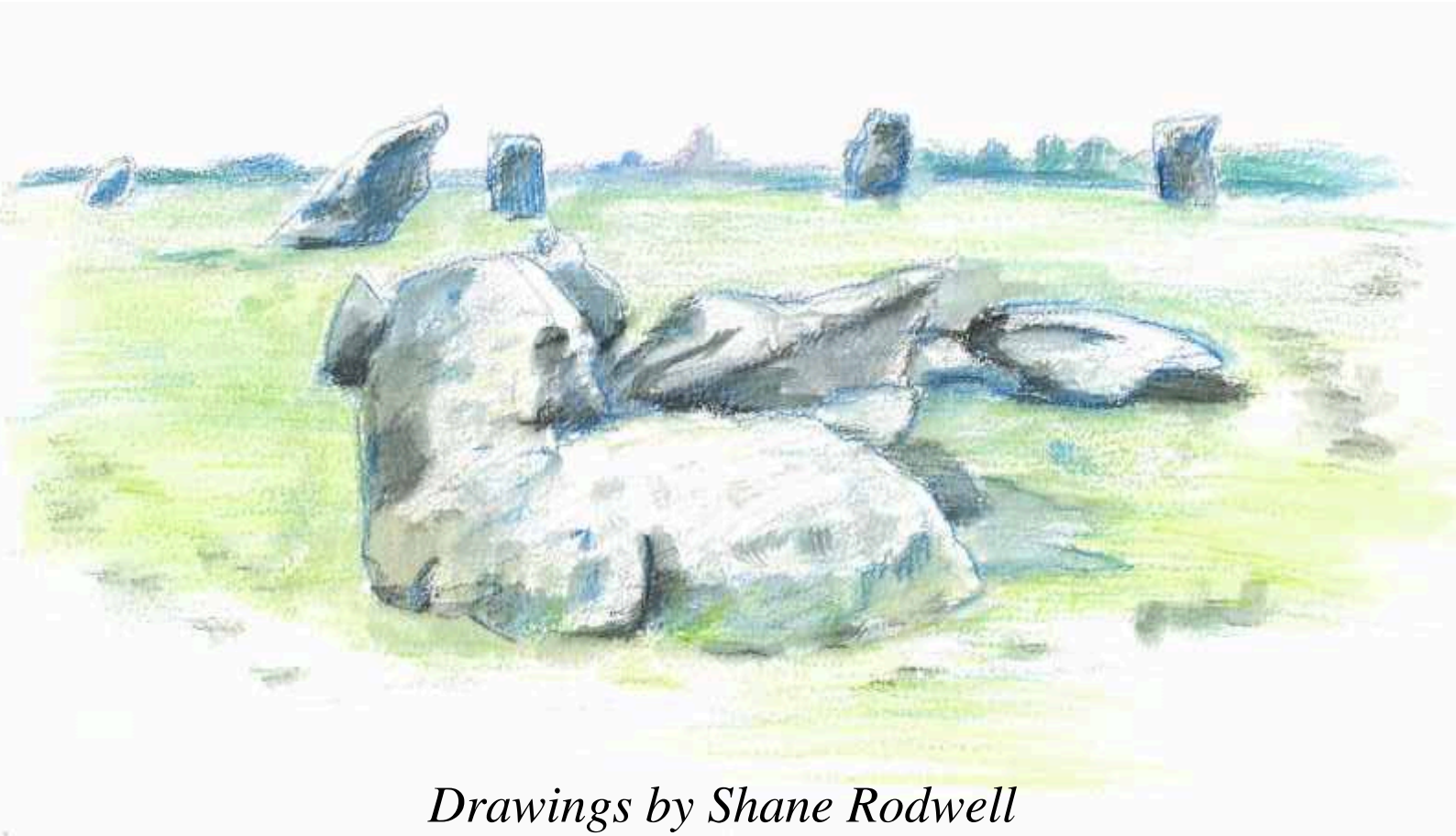

Drawings by Shane Rodwell