Es2 STRABO; DECLARATIONS OF ERATOSTHENES, FACTUAL OR MISQUOTED
An investigation of the river Nile, its measures and then the breadth of the oikoumene

SYNOPSIS

Within *Strabo's 'Geography'*, Book17, chapters 1-4, there is an attempt to portray the river Nile both descriptively and by distance measure, from Meroë to the Aegyptian Sea. This is preceded by the words; '*And here too I must first set forth the declarations of Eratosthenes'*. It is obvious, when reading the text, that in fact they have not been set forth, (as we may expect today), but paraphrased and perhaps misinterpreted. An analysis of the text and measurements enables us to reconstruct the original, cast light upon *Eratosthenes'* world measurement and conclude the argument apropos the length of the *stadion* within the texts of *Eratosthenes'* and *Hipparchus*, as quoted by *Strabo*.

THE METHOD OF ANALYSIS AND BASIC DATA EXPLAINED

The text of *Strabo*[1] (c66BCE – AD21) supposedly contains a record of the text of *Eratosthenes* [2](c275-194BCE), but, as they are some 200 years apart, perhaps that text was subject to the vagaries of miscopying in the intervening period. We know that *Eratosthenes* followed both *Zenodotus* and *Apollonius of Rhodes* as Librarian of the Great Library at Alexandria. It was founded by *Ptolemy II* (309-246BC), around the beginning of the Third century BCE. Thus, with only 75 years of Greek influence upon the writings of Aegypt (spelling as per translation), at the time of *Eratosthenes*, we can assume Aegyptian measures were still paramount, and, in those first years the majority of texts collected included many from the great Temples of Aegypt. When Aegypt became a Macedonian Greek Kingdom by the partitioning of the empire of Alexander the Great following his demise, it would have been impractical for Greek measure to have been imposed upon the populace, let alone change the thoughts and actions of the priests of the great temples. Therefore, we may infer that any measurements would have been founded in the Aegyptian system[3] and comprised of their standards[3], the Amma, Cubit, Derah, Kassaba, Remen, Theb, Terto, and ITRW or ITERU. The ITRW or ITERU is a measure of 20,000 Royal Cubits, and a Royal Cubit has been assessed by archaeologists as 525mm in length. These measurements would, of necessity, and when convenient, have been translated into Greek equivalents, but would have been strictly Aegyptian measures[3].

In Aegypt before *Eratosthenes'* era, the world had already been determined in size and shape[4]. The passage of the Sun across the heavens and through the underworld was assessed as 3708 ITRW, which comprises the twelve sections of the DUAT, and is a metrological calculation thus; 12 x 309 ITRW = 3708; to which must be added the width of Aegypt, 106 ITRW, thus providing us with a total measurement of 3814 ITRW or ITERU.. Therefore we may calculate the Aegyptian world as, 3814 x 20,000 x 525mm = 40,047Km. It is also possible to conclude that this information was part of the historical data which may well have been transmitted to the Great Library of Alexandria and available for use by *Eratosthenes*.

The geographical world is normally expressed as; Equatorial circle = 40,077 Km and the Meridional circle = 40,009 Km, which is the comparative measure used.

But we are analysing the river Nile and its given measures. Thus when we also read that the ancient Aegyptian name for the river Nile is ITRW or ITERU, meaning Great River, and know that the itinerary measure of ancient Aegypt is the ITRW or ITERU[4], it is quite plausible to assume the one begat the other. In other words the necessity to measure the river Nile led to the naming of the measure to be used[5]. (Diagram 1, The Nile, geographical.)

The questions we must ask and resolve are, 1), 'did *Eratosthenes* visit Syene and Meroë to measure the Nile or at least gain knowledge of the river?' If not, 2) 'did he use translated Aegyptian texts to write his geographical notes about the river Nile?' and, 3)' did the data from the river Nile measures provide the base measure for the Syene/Alexandrian solstitial phenomenon to be used later for the

calculation of the Earth's circle?' The solstitial calculation is fully explained, including the world measure calculation, in 2.5.7.

Strabo clearly states in 2.5.12 that; '*At any rate, when (Aelius) Gallus was prefect of Aegypt, I accompanied him and ascended the Nile as far as Syene and the frontiers of Aethiopia'*. Therefore it is incumbent upon us to reflect upon those words as we read the text of *Strabo* and his description of the river Nile.

Having established the parameters of the research we may now analyse the text written by *Strabo, 'The Geography*', Book 17, chapters 1-10 and similar chapters, which equally apply, from Books 1 and 2.

STRABO, THE GEOGRAPHY, BOOK17, CHAPTERS 1-4; ANALYSIS   Diagrams ES2D01 & 2

17.1.1: *"Since, in my description of Arabia,-----; and after this I shall traverse Libya, which is the last remaining subject of my whole geography. And here too I must first set forth the declarations of Eratosthenes."* (Libya = Africa)

But, he does not. Surely, to set forth one person's declarations you actually quote verbatim. However, this may be today's methodology, but possibly was not the method in antiquity. But, it introduces a conflict in that we cannot know how accurately *Strabo* has set forth the declarations. *Strabo* appears to paraphrase, and he uses his own words to describe the text of *Eratosthenes* and to portray a picture of the river Nile, possibly as far from *Eratosthenes* statements, as from the geographical fact. And here we should note that *Strabo* appears to be using only a text, with no accompanying map. It is only when the whole of '*The Geography'* is read, and analysed, that the errors appear and indicate that perhaps *Strabo* concocted his own map from the original text of *Eratosthenes* without understanding the nuances. (Diagram 2, The Nile in *Strabo's* text.)

17.1.2: *"Now according to him the Nile is nine hundred or a thousand stadia distant towards the west from the Arabian Gulf,"*

As a geographer, we can expect *Eratosthenes* to have been a little more precise. Just where is the Nile, 900/1000 *stadia* distant? He has a large choice: from the Khalia es Suweis to the Red Sea at Djibouti. In fact there is only one position the measure is vaguely correct, from Qena north of Luxor, to Bur Safajah on the Red Sea. The basic distance is actually c225 Km or 1425 *stadia* of 157.5m.

17.1.2: *"and is similar in shape to the letter N written reversed;"*

With the classical Greek alphabet *Eratosthenes* was somewhat handicapped in his choice of metaphors. One must wonder if he would have used the English 'S' instead.

17.1.2: *"for after flowing, he says, from Meroë towards the north about two thousand seven hundred stadia, it turns back towards the south and the winter sunset about three thousand seven hundred stadia"*

We now arrive at an enigma- what is MEROË- is it an island, a kingdom or a city, all of which are used later in the text as descriptions? Here it is left unidentified by *Strabo* and thus indicates *Eratosthenes*' text is paraphrased, and, from this text we cannot just assume a singular place for Meroë. But, the bend which forms the winter sunset line is known. And, as confirmation of the new direction, the winter sunset is reasonably described at a bearing of 242 degrees between latitudes 15N and 30N.This accords with the route of the geographical Nile. However, here we also glean our first idea of *Strabo's* descriptive prose; '*towards the north'* and '*towards the south and the winter sunset' (i.e. 242^0*), is in fact only a 28 degree turn from the original north bearing at the bend. Thus when we read towards the north, south or similar directions we should not consider a geographical point as *Strabo's* descriptive prose is too vague.

17.1.2: *"and after almost reaching the same parallel as that of the region of Meroë and projecting far into Libya"*

This statement is correct diagrammatically if one uses the Nile of *Strabo.* The parallel is that of the junction of the two rivers Nile, but some 350 Km west, i.e. 2200 *stadia* of 157.5m. It is hardly projecting well into Libya, being only 120Km or 760 stadia west of the next section of the river Nile. (Diagram 3, title, The Nile according to Eratosthenes.)

17.1.2: *"and making the second turn flows towards the north five thousand three hundred stadia to the great cataract,"*

The actual river Nile flows some 10 degrees west of north before turning to the north east and the second cataract.

17.1.2: *"turning aside slightly towards the east, and then one thousand two hundred stadia to the smaller cataract at Syene,"*

The information given is corrupt or misunderstood by *Strabo*. There is either a measurement missing to determine the length of *"turning aside slightly towards the east, and then"* or, the phraseology is wrong. The *"and then"* signifies the 5300 and 1200 stadia measurements are not contiguous. However we do have two known points with which to compare *Eratosthenes*' and geographical maps for the first and second cataracts.

17.1.2: *"and then five thousand three hundred more to the sea."*

Here we read how *Strabo* dismisses the most important portion of the river Nile, a portion he has sailed from Syene to the Delta and the Aegyptian Sea, the whole of Lower Aegypt. Perhaps the information had been known for millennia, but, the fact *Strabo* continually describes it wrongly (as follows), leads one to suspect he has totally misunderstood the text of *Eratosthenes*. Therefore we must ask, "Would *Eratosthenes* have dismissed this section without a full description?

Strabo later describes the river Nile in 17.1.3 as follows; *"But it alone passes through Aegypt, through the whole of it and in a straight line, beginning from the little cataract above Syene and Elephantine"* and reiterates the point again in 17.1.4 as is discussed later.

However the next sentence in the text is made without introduction to a major place change within the information, and is perplexing in its context within the prose.

17.1.2: *"Two rivers empty into it, which flow from some lakes on the east and enclose Meroë, a rather large island."*

We depart from the Aegyptian Sea and suddenly discuss a place 13.5 degrees latitude south comprising two rivers and an island, which is not an island, merely a tract of land encompassed by rivers, (A situation which exists to this very day.) But why has *Strabo* suddenly returned to the south? Are we in fact reading misplaced text and should this be the general text commencing the journey of the river Nile in the south?

17.1.2: *"One of these rivers, which flows on the eastern side of the island, is called Astaboras and the other is called Astapus, though some call it Astasobas and say that another river, which flows from some lakes in the south, is the Astapus and that this river forms almost all the straight part of the body of the Nile, and that it is filled by summer rains. Above the confluence of the Astaboras and the Nile, he says at a distance of seven hundred stadia, lies MEROË, a city bearing the same name as the island."*

Thus, when these sentences discuss the rivers south of Meroë, and allow us to pin point actual places and measure the distances, we can consider the methodology of *Eratosthenes* and the translation of the distances quoted. Also indicated, is how a geographer such as *Eratosthenes* would have worked, setting out his details from point to point, rather than nebulous bends.

Strabo however is really interested in the history and the indigenous peoples of the regions, and therefore ignores/elides the boring though perhaps accurate geography and geometry. His penultimate statement of 17.1.2 is;

17.1.2: *"and there is another island above Meroë which is held by the Aegyptian fugitives--------- and are not subject to the Aethiopians but are divided into several separate kingdoms."*

17.1.2, is then completed in the most extraordinary fashion;

"The extent of Aegypt along the sea from the Pelusiac to the Canobic mouth is one thousand three hundred stadia. This, then, is what Eratosthenes says."

This statement would have been far more appropriate following the distance stated from Syene to the Aegyptian Sea, as we are now 13.5 degrees north again.

Book 17, chapter 1, paragraph 3, commences with a general description of the upper Nile: *"But it is necessary----------because of the same lack of water"*.

The next section then commences with the misnomer that the river Nile is straight.

17.1.3: *"However, the Nile does not pass through the whole of Aethiopia, nor alone, nor in a straight line, but it alone passes through Aegypt, through the whole of it and in a straight line, beginning from the little cataract above Syene and Elephantine, which are the boundaries of Aegypt and Aethiopia, to its outlet on the sea coast."*

The river Nile from Syene/Aswan may be described as many things but not a straight line. This may have been a general comment by *Eratosthenes* when comparing it to the Aethiopian Nile which is as a snake, sinuous. However, now is the point to re-iterate that in 2.5.12, *Strabo* clearly stated he had sailed this part of the Nile and we must therefore ask, 'where are his powers of observation'? He has sailed upstream

from Alexandria to Syene and is unaware of the rather large 'S' bend that occurs from Naj Hammadi to Qena and thence at Luxor and Armant. From the vertex of the river Nile to Naj Hammadi the course is south, then slightly east of south; after this we have the double bend and a slightly east of south journey to Syene (Aswan). From Aswan/Syene to the vertex we can draw a straight line, which possibly represents part of the rivers course, but, the deviation north of Qena is c100Km or 650 stadia of 157.5m to the west.
 But at the start of Book 17, chapter four, Strabo again states;

> 17.1.4: *"The Nile flows from the Aethiopian boundaries towards the north in a straight line to the district called "Delta", and then, being "split at the head", as PLATO says, the Nile makes this place as it were the vertex of a triangle, the sides of the triangle being formed by the streams that split in either direction and extend to the sea- the one on the right to the sea at Pelusium and the other on the left to the sea at Canobus and the neighbouring Heracleium, as it is called- and the base by the coastline between Pelusium and the Heracleium. An island, therefore, has been formed by the sea and the two streams of the river-----. Now the island as a whole is as much as three thousand stadia in perimeter;-----. The parts above the Delta are also watered in the same way, except that the river flows in a straight course about four thousand stadia through only one channel-----.*
>
> *In short Aegypt consists of only the river-land, I mean the last stretch of river-land on either side of the Nile, which, beginning at the boundaries of Aethiopia and extending to the vertex of the Delta, scarcely anywhere occupies a continuous habitable space as broad as three hundred stadia.*
>
> *Accordingly, when it is dried it resembles lengthwise a girdleband, the greater diversions of the river being excepted."*

Strabo has stated categorically several times that the river Nile from Syene to the Aegyptian Sea is a straight line (5300 *stadia*) with approximately four thousand *stadia* from Syene to the vertex of the Delta. But, he then within his analogy of the Nile to a girdleband tells us there are **greater diversions** upon this supposed straight length. In other words *Strabo* has used the wording of *Eratosthenes'* who has described his direct measure from Syene to the Aegyptian Sea, which would be a straight line, and applied it mistakenly to the actual river Nile, forgetting in the process anything he has witnessed. The text editor[6] comments upon this passage regarding the girdleband as follows;>>*But the text seems corrupt, Strabo must have written "accordingly, it resembles lengthwise an unwound girdleband" or else "accordingly, it resembles a hand outstretched to full length", meaning both arm and hand, and thus referring to the Delta as well as the stretch of river land from Aethiopia to the Delta itself.*<< This of course can also indicate greater diversions from the shape of the arm elbow wrist and hand, which is the Delta.
        As if to confirm the above comments, *Strabo* continues in 17.1.4;
        "this shape of the river land of which I am speaking, as also of the country, is caused by mountains on either side, which extend from the region of Syene down to the Aegyptian Sea;-----.
(Mountains are hardly, if ever, a straight line.)
The text analysed above encompasses the main data for the river Nile, its dimensions and distances and is copied from Book 17, chapters 1-4. The chapters 5-10 of Book 17 contain data which *Strabo* most desired to portray, the history of the peoples and their interactions with the land.

EVALUATION OF THE DATA   Diagram ES2D03

        Therefore, we may begin to evaluate the geographical information *Strabo* attributes to *Eratosthenes*, endeavour to eliminate both original and copyist error and redress the misunderstandings which are so apparent in his text, as it has survived over the millennia. But, perhaps the most important function of our research is to finally determine the *stadion* length which *Eratosthenes* used in his geographical explanations, and thus calculate the world measure he proposed.
        By studying the *Eratosthenes/Strabo* measures and applying them to a geographical map of the river Nile we can assess the likely unit length of the *stadion.* This may simply be resolved by the text measure given in 17.1.2 as the distance from the Astaboras River to Meroë City, 700 *stadia*. Meroë City is some 45 kilometres north east of Shendi, a city of Sudan on the river Nile. The Astaboras River is now known as the Atbara River and joins the Nile near the city of Atbara. The geographical distance is c110Km. Thus, 700 *stadia* equal to c110Km produces a *stadion* of 157.5 metres. This is the same *stadion* as calculated from the *Eratosthenes'* reading of the solstitial calculation between Syene and Alexandria. Thereby, 5000 *stadia* equal $1/50^{th}$ of the world circle, which *Eratosthenes*, as we are told by Cleomedes[7] increased to 252,000 *stadia* to ensure that the $1/60^{th}$ and $1/360^{th}$ part was a whole and recognisable

number. That number is 700 *stadia* per meridional degree. *Strabo* further confirms this point when discussing *Hipparchus*[8].

Far out of context, if we follow *Strabo's* text, but necessary here, is the discussion of the 5300 *stadia* straight line measure from Syene to the Aegyptian Sea. This distance is quite correct when the alignment of the distance line is drawn from Syene through the Delta vertex to the sea. Thus we emulate the basic river route described by *Strabo* as a straight line. This basic alignment is measured at 835 Km and thus each *stadion* is 157.5 metres. This alignment is however some 18 degrees west of north and the basic *Eratosthenes'* world circle calculation relies upon a due north or meridional bearing. From Syene to Alexandria, measured on a meridian it is c5000 stadia, with only a minor discrepancy. Calculated using simple mathematics it would be, 5300 x Cos18 = 5040 *stadia*. There is north and there is northerly and we must be careful not to be too literal when reading *Strabo's* text.

Having indicated that the base measure of the *Eratosthenes*' world is most likely a *stadion* of 157.5 metres, we can evaluate the *Strabo* measures for the river Nile.

1)   2700 *stadia* from Meroë to the first bend.
As stated we do not know a precise point for 'Meroë' in this context, but the "first *bend towards the setting sun in winter*" can be located on the river Nile opposite Abu Hamed. Thus if we measure 2700 *stadia* or 425.25 Km upstream we can locate the point zero. It is in fact the SIXTH CATARACT, and this is an entirely logical point from which to take measurements. *Eratosthenes* has obviously correctly translated the original Aegyptian measure for this section of the river Nile.

2)   The two following measurements of 3700 and 5300 *stadia* to the Second or Great Cataract are not reconcilable at this juncture and we must therefore move to the next measure of 1200 *stadia,* which Strabo states is from 'after the bend towards Syene'. The actual text words are worth repeating;'*5300 stadia to the great cataract, turning aside slightly towards the east, and then 1200 stadia to the smaller cataract at Syene'*. This can be reconciled in two ways: A) from the first to the second cataract it is actually 2100 *stadia* and thus a mis-transcription of numbers has occurred, i.e. possibly reading 1200 and writing 2100; or, B) there is a feature marker south of Syene now under Lake Nasser with the "*turning aside slightly to the east*" accounting for some 900 *stadia* which *Strabo* has not included in his text. The matter is probably resolved by the following: from the second cataract to the second bend, i.e. upstream (see diagram 2) the actual distance is 3300 *stadia*. *Strabo's* text notes this as 5300 *stadia* and may therefore be considered an error in transcription. This is not to say it is necessarily a mis-reading of the original Greek acronomic numerals, as indicated upon diagram2, but this is a distinct possibility[3]. However, as both distances are increased by 2000 *stadia,* and the following distance is the same at 5300 *stadia,* we can imagine the confusion.

3)   From the second bend upstream to the first bend (Abu Hamed) it is actually 1700 *stadia. Strabo's* text has 3700 *stadia,* and has already been discussed.

4*)*   But it does allow us to assess the original data of *Eratosthenes'*, the 157.5 metre *stadion.*
The distances are thus tabulated;

Text locations given;	Strabo/Eratost.	Geographical distance
1) Meroe to first bend	S/E = 2700 *stadia*	Geog = 2700 *stadia*
2) 1st bend to 2nd bend	S/E = 3700	Geog = 1700
3) 2nd bend to 2nd cataract	S/E = 5300	Geog = 3300
4) 2nd catar to 1st cataract	S/E = 1200	Geog = 2100
5) Syene to the Sea	S/E = 5300	Geog = 5300
6) Atbara to Meroe	S/E = 700	Geog = 700
7) Delta at Sea	S/E = 1300	Geog = 1850
8) Delta triangle	S/E = 3000	Geog = 3870
9) Syene to vertex	S/E = 4000 *stadia*	Geog = 4350 *stadia*

Each comparative measure uses a 157.5 m *stadion,* and it is quite apparent that if the Greek *stadion* of 184.88m (185m) had been used there would be no coincidence with the actual geographical measure which each of *Strabo's* measures purports to be.

An analysis of the Delta Region information supports this conclusion.

THE DELTA AREA OF THE RIVER NILE   Diagram ES2D04

Within Strabo's text, 17.1.15-24 there is a complete description of the "*Country from Alexandria to the vertex of the Delta*". *Strabo* has already quoted several times that the distance-measure from the Canobic mouth (western) to the Pelusiac mouth (eastern) is 1300 *stadia*, but in 17.1.6 he states it is also a sea-measure. However, Canobus is 30.05E and Pelusium 32.55E, which at 31N equates to 2.5^0 x 600 *stadia* = 1500 *stadia* direct measure. By sea, dependant upon the route, direct is 1750 *stadia* and coast hugging is 1850 *stadia*. There is obviously a problem with the distance measures, which may be an error of transcription from *Eratosthenes'* original text, or, one of mis-translation of Aegyptian measures. It also indicates that at some period in the early first century BCE, there may have been a change to the more normal *Greek Stadion* of 185 metres.

In 17.1.24, *Strabo* quotes *Artimedorus* regarding the "*voyage up the river (Alexandria to vertex) as 28 schoeni[3], that is, 840 stadia reckoning the schoenus as 30 stadia*". The actual distance along the Canobic stream of the Nile is c190Km or c1200 *stadia* of 157.5 metres. If the *stadion* were 185 metres then the distance is c1025 *stadia*. Even the direct route of c175Km equates to 1110 *stadia*, (or 945). Referring to Aubrey Diller's paper[9], the Schoenus is 12 000 cubits of 0.525 metres, or, 6300 metres, and thus equal to 40 *stadia* of 157.5 metres. We must therefore equate the distance of 28 schoeni with the geographical measure of c1200 *stadia* of 157.5m or, c1025 *stadia* of 185m. The calculation gives either, 42.86 or 36.61 *stadia* per schoeni, or perhaps the 28 schoeni equals 1110 *stadia* of 157.5m. But, it would seem the direct route is meant to be 40 *stadia* per schoeni.

Strabo also states, "*When I made the voyage however, they used different measures at different times when they give distances, so that 40 stadia, or still more, was the accepted measure of the schoenus, according to the place*". We then read in 17.1.24 that, "*Memphis to Thebes; schoenus = 120 stadia, and Thebes to Syene, 60 (stadia), and as one sails from Pelusium to the same vertex of the Delta,* 25 schoeni, *that is 750 stadia, using the same measure.* (i.e. schoenus = 30 stadia)

The Pelusium branch is in fact similar in length to the Canobic branch at c175Km or c1110 *stadia*/945 *stadia*. Therefore, the Delta is a triangle nearer 4000 *stadia* in girth than the 3000 *stadia* quoted by *Strabo*.

But, from Memphis to Thebes is c600Km by river, and that is c3800 *stadia* of 157.5m. If that is divided by 120, we have 31.667 schoeni, or perhaps by a simple transposition of figures we have 120 schoeni of 30 *stadia*, i.e. 3600 *stadia*.

Thebes to Syene is c220Km or 1400 *stadia* of 157.5m. But it is also c1200 *stadia* of 185m. Thus 1200 divided by 60 equals 20 schoeni, and a plausible figure. But it could be 40 schoeni of 30 *stadia*, and perhaps another example of to many similar units. Thus, perhaps we see not only the 157.5 metre *stadion* but also the beginnings in usage of the 185 metre *stadion*, and utter confusion.

CONCLUSIONS

When we read in *Strabo's* own words that he has sailed the river Nile from Alexandria to Syene and the borders of Aethiopia, but has failed to notice the actual course of the Nile, severally stating it is a straight line, we must be cautious when reading the text. The slight disclaimer he adds regarding greater diversions excepted cannot be included as we do not know to what he refers. He cannot have considered it significant or it would not be a minor 'throw-away' comment.

Also, he appears to have no interest in accurate reporting of geographical bearings which detail place to place positioning. He is very lax with the actual measures he quotes, and has not confirmed, or even stated, one actual precise method of measure. It would have been perfect for historians had he so written.

The information regarding the Nile does however enable us to reconstruct the probable original measures and infer the length of the *stadion* utilised.

We can also, from *Strabo's* '*Geography'*, with its information, however uncertain we are concerning the measurement of the landscape provided by *Strabo* from *Eratosthenes'* and *Hipparchus' information,* establish that there was a measurement for the world circumference. And, from original Aegyptian measurements, confirm that the dimension of the world circle was known prior to 250BCE, the era of *Eratosthenes,* with an extraordinary degree of accuracy. This information also indicates that the transition period from an Aegyptian world to a Greek world may have been a long slow process of assimilation, and was probably not complete even when it became a Roman world.

The analysis of the measurements given by *Strabo,* as attributed to *Eratosthenes* and *Hipparchus*, infer only *one stadion*, that of 157.5 metres. This *stadion* is the equivalent of, 420 Remen, 350 ordinary cubits or 300 Royal cubits of ancient Aegyptian measure.

The Aegyptian world of 3814 Iteru is 254,267 *stadia* of 157.5m, and thus is 40047Km.

The *Eratosthenes/Hipparchus* world is 252,000 *stadia* of 157.5m, and thus is 39690Km.

The geographical world is 254,025 *stadia* of 157.5m, and thus is 40009Km meridional measure.

It would appear our ancestors knew the dimensions of the world.

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APPENDIX 1: SUPPORTING DATA   Diagram Es2D05

Strabo Book1, chapter 4-2*. 'Next, in determining the breadth of the inhabited world, Eratosthenes says that, beginning at Meroe and measuring on the* **meridian that runs through Meroe**[7]*, it is ten thousand stadia to Alexandria; and thence to the Hellespont about eight thousand one hundred; then to the Borysthenes five thousand; then to the parallel circle that runs through Thule (which Pytheas says is a six days' sail north of Britain, and is near the frozen sea) about eleven thousand five hundred more. Accordingly, if we add three thousand four hundred stadia more to the south of Meroe, in order to embrace the Island of the Egyptians, the Cinnamon-producing country, and Taprobane, we shall have thirty eight thousand stadia'.*

Thus we may evaluate these distances using the 157.5 metre stade as follows;

1)   Meroë to Alexandria, 10,000 *stadia* due north measure. It is in fact due north c1550 Km or 9850 *stadia*. In fact the direct distance is 10,000 *stadia*.

2)   Alexandria to the Hellespont, 8100 *stadia* given is in fact a due north measure of 6500 *stadia,* but curiously the sailing route would give 8500 *stadia.*

3)   Hellespont to Borysthenes, 5000 *stadia,* is commensurately 4400 *stadia,* or 6.25 degrees of 111Km, but again with a sailing measure of 6300 *stadia.*

4)   Borysthenes to Thule, 11500 *stadia.* As Thule (Iceland) was always thought to be at 63 degrees north, rather than the correct 65 degrees north, we have two figures to consider; at 65N it is 13200 *stadia* but at 63N it is 11800 *stadia* of 157.5 metres.

Logically we may assume that in Aegypt, the actual land was measured and from Alexandria to the Hellespont etc, they are sailing distances, converted or not, to distances on a meridian. This was no doubt aided by Latitudinal readings.

Before making any conclusive statements upon the foregoing it is necessary to consider the following text by *Strabo.*

Strabo Book 2, chapter 5-34. Firstly *Strabo* discusses what *Hipparchus*[8] (c150BC) says, starting with, *" But it will be sufficient for me to set forth the significant and simplest differences noted by Hipparchus, taking as a hypothesis, just as he does, that the magnitude of the Earth is 252,000 stadia, the figure rendered by Eratosthenes. For the variation from this reckoning will not be large, as far as the celestial phenomena are concerned, in distances between the inhabited places, If, then we cut the greatest circle of the Earth into 360 sections, each of these sections will have 700 stadia.*

Strabo 2.5.35, then quotes *Hipparchus* as follows; "*Meroë to the Cinnamon producing country equals 3000 stadia south of Meroe and then 8800 stadia distant to the Equator.*

In geographical terms Meroë is at 16.9N or 11900 *stadia* of 157.5 metres from the Equator. *Hipparchus* who follows *Eratosthenes* gives a total of 11800 *stadia.* Later in the text we read that Syene is 5000 *stadia* distant from Meroë. The direct distance is 780 Km or 4950 *stadia* of 157.5 metres. (Diagram 5, Equator to Thule.)

APPENDIX 2: THE MEASUREMENT OF THE WORLD

Regardless of the fact that many reams of paper have been expended on this subject, it is necessary to question the various dimensions attributed to ancient geographers for the great circle of the Earth. In 1948, *Aubrey Diller*[9] answered a question posited by *Professor Sarton* regarding, *"a convenient summary of what was known about ancient measurements of the Earth."* The paper duly published in *ISIS* describes the people involved and the measurements attributed to the great circle. However, there is one telling paragraph which must be quoted in full:

"The only direct evidence of the length of Eratosthenes' stade is a solitary, but apparently reliable statement in PLINY XII 53; "schoenus patet Eratosthenis' ratione Stadia XL". This transfers the problem from the stade to the schoenus, which was an Egyptian measure of 12,000 cubits. Now Egyptologists, on the basis of measurements of the pyramids and other archaeological evidence, have long maintained that the Egyptian Cubit was about 0.525 of a metre. On this showing the schoenus would be 6300 metres, and Eratosthenes' circumference would be 6300 schoeni or 39690 Kilometres. The result is very near the truth but the stade involved is unknown and irrational (157.5 metres, c9.45 to a Roman Mile). This is at present one of two acceptable conversions of Eratosthenes' measurement of the earth."

There are as *Aubrey Diller* makes plain several schoeni;
1) 20,000 royal cubits = 1 schoene = 6.5245 miles or 10.50 Km
   This measure is of course also the ITRW or ITERU previously discussed.
2) 1 schoene = 2 parasang = 60 Greek stadia or 6.71 miles/ 10.8 Km.
3) 1 schoene = 1 parasang = 30 Greek stadia
4) 12,000 royal cubits = 1 schoene = 3.9148 miles or 6.3 Km.
   However, the 157.5 m *stadion* is not an 'irrational' unit as can be shown.

Many author/researchers[10] have commented adversely[11] upon the 157.5 metre *stadion.* But it converts perfectly to 350 ordinary cubits of 450mm or 300 Royal cubits of 525mm. Thus using the Schoene of 12000 royal cubits, there are 40 stadia therein and the Schoene of 20,000 royal cubits contains 66.667 stadia.

But, there is one more simple calculation to consider. From the Royal cubit of 28 digits is formed the REMEN of 20 digits by the most simple of methods. The Royal cubit is the diagonal of a square formed by the Remen of 20 digits; in other words the mathematics are 20 x root2 = 28 digits (in our terms 28.284). This is an Egyptian calculation and thus gives a ratio of 20/28. Apply this ratio to the world figure of *Claudius Ptolemy[12]* and we have his 180,000 *stadia* expanded to the 252,000 *stadia* of *Eratosthenes* and *Hipparchus*. Thus it would appear that *Eratosthenes'* based his unit on the Remen of 375mm, of which there are 420 in the *stadion* of 157.5m., and *Ptolemy* et al perhaps used the Royal Cubit of 525mm, with 350 producing a *stadion* of 183.75 metres. This is virtually the same as the Greek *stadion* of c185m. It is worth repeating that the 157.5m *stadion* is 350 ordinary cubits of 450mm, and the Greek *stadion* is fairly represented by 350 Royal cubits of 525mm.

M J FERRAR, 2009

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1) Strabo, *'The Geography'*, (trans. H.L. Jones), Loeb Classical Library Edition, Harvard and London, 1917-1932. It is now partially available in the public domain at
http://penelope.uchicago.edu/Thayer/E/Roman/Texts/Strabo
   Many texts refer to the *Geography of Strabo* including that of Germaine Aujac, page 173, in The History of Cartography. (See note 2) But few analyse the whole text comparing the geographic world to the world of *Eratosthenes'*.
   Oxford Classical Dictionary, 3rd edition, 2003, Oxford University Press.
   'Strabo', page 1447
2) Oxford Classical Dictionary, 3rd Edition, 2003. Oxford University Press.
   'Eratosthenes', page 533
   Harley, J.B. & Woodward, D. (Eds.) (1987), The History of Cartography: Vol. 1: 'Cartography in Prehistoric, Ancient, and Medieval Europe and the Mediterranean'. University of Chicago Press.
   Aujac, Germaine. in The History of Cartography, chapter 10; "Greek Cartography in the Early Roman World", pp166/67 and pp173/75; "The Map of the inhabited world recommended by Strabo" and discusses the work of *Hipparchus*. Chapter 9; "The growth of an empirical cartography in
   Hellenistic Greece", pp148/60, but see 153/57.
   Cortesao, Armando. (1969-1971). 'History of Portuguese Cartography', Coimbra, Junta de Investigacoes do Ultramar-Lisboa, 2 vols, see1:82, where he speculates that Egyptian cadastral surveys may have been available to *Eratosthenes* in his calculations of the distance between the two points of
   observation.

Rawlins, D.(2008) "*Eratosthenes Lighthouse Ploy, Earth Radius 40800 Stades*" DIO, International Journal of Scientific History, Vol. 14, 2008, March.pp3-12. (Web site as 7). Publication also contains "The 'Ptolemy Geography's' Secrets".

This paper argues that Eratosthenes' did not use original Aegyptian measures for his 5000 stadia measure and the world circle, but instead utilised the Pharos Lighthouse and its horizon view of the light beam for the same calculation.

3) Doursther, Horace.(1840),"Dictionnaire universel des poids et mesures anciens", Brussels, M. Hayez, Imprimeur de L'Academie Royale, 1840.

This publication contains all of the ancient Aegyptian measures, such as the Remen, Cubit (common and Royal), Iteru, and many more. The *Stadion* is on page 504 and the *Schoinos* page 481. The measures used by The Bematistai, the Bême-aploun and Bême-diploun, are on page 53.

Ifrah, G. (1994-1998), '*The Universal History of Number'*", The Harvill Press, London. Chapters 16 and 17, pp182-226. Greek and Roman Numerals.

Go to, http://wwwhistory.mcs.standrews.ac.uk/HistTopics/Greek_numbers

This web site explains the Greek number system, and indicates how in the acrophonic numeral system, numbers like 50, 500 and 5000 can so easily be mis-read. This was a system in use at the time of *Eratosthenes* and was superseded by the classical Greek alphabet where the capital and lower case

letters were used. We do not know the number system used in c225BCE, but from carvings it is apparent that it was used from the 5th century BCE to the 1st century BCE.

4) Egyptian World measures.

Zeidler, J. (1997), Die Länge der Unterwelt nach ägyptischer Vorstellung. Gottinger Miszellen 156, 1997, 101-112.

General notes. The text at the beginning of the Amduat states, 'This god enters the western gate of the horizon. Seth stands along the shore. It is 120 iteru coming to this gate, before the bark reaches the netherworld dwellers. One then continues to Urnes (i.e. once equated with Ouranos).'

 An early division of the Duat is the Urnes, 309 iteru long. The other divisions are of equal length, and produce an overall length of 12 x 309 = 3708 iteru, to which must be added the distance for Egypt. The length of Egypt is stated as early as the Middle Kingdom as 106 iteru. Thus we have a total of 3814 iteru, or 3814 x 20000 x 0.525m = 40047Km.

5) The Egyptian ITRW or Iteru is found in inscriptions called a 'river unit'. An early source for this unit is the White Chapel of Sensuret 1 at Karnak, dated to   the middle kingdom from c1700 to c1625 BCE. It is 20000 cubits. The Greek term for this measure is *Skhoinus.* The New Kingdom, c1550 to c1069 BCE, has written sources referring to a smaller unit, the 'cord measure' (Egyptian = xt n nwH), corresponding to 100 cubits.

6) The Translator of *Strabo, 'The Geography'* has added a large number of explanatory notes for each 'Book'. The Bill Thayer web site, *Lacus Curtius* (and as 1) contains extra explanations and many translations of other Greek and Roman Latin texts.

This web site is comprised of Latin and Greek texts which are in the public domain and facilitates the research of geographical and cartographical subjects.

7) *Cleomedes*; "De Motu Circulari Corporum Caelestrum Libri Duo"; (trans. H. Ziegler). Teubner; Leipzig,Germany, 1891.

An English translation of Book 1, chapter 10, appears in Cortesao, (see 2) "History of Portuguese Cartography", 1; 141-43.

8) Oxford Classical Dictionary, *Hipparchus*, page 708

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Shcheglov, Dmitriy A, (2005),' Hipparchus on the latitude of Southern India'. Greek, Roman and Byzantine Studies; 45 (2005) pp 359-380.

 9) Diller, A. (1948), '*The* Ancient Measurement of the Earth', ISIS, vol. XL, p6/9

10) Fischer, I.(1975) *"Another look at Eratosthenes' and Posidonius' determination of the Earth's circumference",* in Q. JL. R. Astr. Soc. 16   (1975), pp 152-167.

This paper discusses not only the *Strabo* data, the *Hipparchus* data and *Ptolemy's* input, but endeavours to discuss the situation prior to the *Eratosthenes'* world view.

11)   Rawlins, D. (1982) *"The Eratosthenes-Strabo Nile Map. Is it the earliest   surviving instance of Spherical Cartography? Did it supply the 5000 stade Arc   for Eratosthenes experiment?* in "Archive for History of Exact Science", 1982, vol. 26 pp211-219
        This paper, as we have come to expect from its author is full of equations, and accepts of no other stade than the 185 metre unit.
12)   Stevenson, E L. (1932/1991), *Claudius Ptolemy,' Geography'*. New York Public Library and Dover Publications Inc. New York.
        See also, Diller, A. (1934), *Review of above book*, ISIS, vol. 22, pp533-539.
         See also Diller, A. *'Translation of Book VIII, Claudius Ptolemy, 'The Geography' in* DIO, The International Journal of Scientific History,Volume 5 now available at www.dioi.org

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