STARS Talk April 27 2009
Poseidonius of Rhodes and the Antikythera computer
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(start voice recorder)

Good evening.
When I started this project, I though my love of astronomy, computers and mysteries would be enough. There is so much of the past that is lost.
Here is an old computer
(Stonehenge)
in Amesbury England that still has untold number of questions to answer.

I figured I could go to Greece and get to see the pieces of the AM, take some pictures and come back to you about it.
Ah, if life were so simple. This project took on a life of it's own.
First most of my emails to anyone went unanswered. Then I signed up to be on the list of the AMRP.
(slide)
finally got someone to return my emails. What I found out about the processes of seeing and photographing the mechanism is a whole other story.

First lets go back in time to April of 1901. Compressed air underwater equipment , the forerunner to SCUBA was recently invented and available commercially.
But first I have to apologize to anyone who speaks Greek for my mispronunciation of the names and places. I can read Greek, but can not Talk Greek.
Here is an example of the problems
can anyone tell me the name of the second largest city in Greece?
slide
Here it is in Greek Θεσσαλονίκη…
Here is how it is spelled in English. Thessaloniki
And it is pronounce sell-on-ic-a

A crew of Greek sponge divers on their way home had to stop at Antikythera
(mapa)
Antikythera, anti means in front of. There are so many Greek islands, they started to run out of names. There are over 1400 and less than 700 are habitable
while there they decided to see what was in this new area. The first diver down named Elias Stadiatis
Came up to the surface yelling about finding lots of bodies down there.
What he saw was this
(pic from nam of arm)

To make a long story short, this was the first marine archeological find, it started a whole new science, many treasures were recovered from the wreck including the first of untold number of bronze statues being found. Also a lot of other junk was brought up, some just left to rot in the museum's back lot. One of those pieces cracked open in the heat and dryness and gears where discovered.
The only ancient gears ever found.
Part of the reason is this guy-
(slide)
good old tom and the value and easy of recycling.

People who have gotten the AM bug
#1 Valerios Stais recovery
Rediadis & Svoronos
John Theophanidis 1934 report
2 Eric Desola Price from a land called Connecticut really got hooked.
(slide)
3 Michael Wright
Allan Bromley
4 Tony Freeth
(slide)
From left to right: Martin Allen, David Bate, Tony Freeth, Andrew Ramsey, Eleni Magou, Jim Austin, Gerassimos Makris and Peter Haycock.

HP's Tom Malzbender
5 X Tek Bladerunner CT Roger Hadland
And lastly the archeologist, Dr. Jones of NYU
and a whole lot of support people.
Here is an animation of an early model of the machine
(stop slide show and run animations)

And here is what I found in the farthest back corner of the museum.
Group 500 slides
Show and talk about the Mechanissm

(restart slide show)
two slide of PoR)
OK who made it.
When I started this project the best guess was Posidonius of Rhodes.
First slide is from the Naples Museum, the second I took at the
Rhodes Archeological Museum. They are not sure this one is really him.
He was an amazing man of many accomplishments
List of accomplishments
His work included:

A compendium of geographical and anthropological information on many different countries.

New calculations of the dimensions of the earth, and a new map of the world.

Construction of a globe.

Distribution of the terrestrial and celestial spheres into 5 zones.

Observations on earthquakes and volcanoes. Record of the eruptions of the volcanoes in the Aeolian islands, north of Sicily.

First interpretation of the tides as connected with the action of the sun and the moon.

- The Posidonius Equator: Posidonius fixed as the Equator of the earth the parallel passing through Rhodes, and calculated its length at 180,000 stades (32,400 km). The true value is 32,000 km. That is a 1% error, and they didn't even have paper back then.

His writings, of which all but a few fragments are lost, are:

"On the world"

"On the ocean"

"Periplus or Periegesis"

"On meteorology" (Elements of Meteorology).

"On meteors"

"Histories": History of the period 144 - 82 BC, in 52 books. Continuation of the History of Polybius.

"Commentary on the Timaeaus"

"The Art of War"

OK, so here is what happened.
I flew to Athens Greece
(map line bo-athen)
Went to the national Arc Mus
(pic of NAM)
A very impressive place.
I had to apply in person and fill out a bunch of forms to get a license to photograph just the pieces on public display.
(pic in office)
The other pieces of the AM were under the control of the current team doing research on the device and I would need their permission to see the other 80 fragments that are not on public display.

I was able to get an appointment with YB a few weeks later.

Next stop was a trip to the island of Naxos where he (PR) was reported to have _____

(Pix of ferry, map with line and Nax arh mus)
I went to the Naxos Arc museum and no one ever heard of him there. This was becoming a pattern, that the people manning the museums were just care takers and guards and had no idea what any of the stuff they had was, and they don't allow photography
(slide)
While on Naxos, you should pay a visit to the temple of Appolo, the only part left is the door
(slide)
So next stop was off to Rhodes. I figured there had to be someone there who knew this guy. So next thing was to get a ferry to Rhodes.

The path to Rhodes passed near the island of Thera, which some legends say was the location of the legendary lost city of Atlantis, that was destroyed by a volcanic disaster, so I couldn't pass up a stop there.
Map with line
Fira, ea and volcano pix.
The search for Atlantis is a whole other story, but it was a fantastic place to visit. It really was something special and if I were an Atlantean, it looked like a very nice place to settle. Except for the problem of the Volcano. It last erupted in 1950. We take a three hour boat tour to visit the cinder cone at the middle of the calderas.
(slide)
We really don't want to leave this place, but we have to move on to Rhodes.
(slide) ferry
(map
Some of you may recognize the name of Rhodes, because of the Colossus of Rhodes.
On of the famed 7 wonders of the ancient world.
This is the harbor entrance where it stood. The column with the stag was where one of his legs stood.
(slide)
(slide)
Rhodes is important because it is a great stopping place for ships going between, Three continents. Europe, Asia and Africa.
(map
The ship carrying the AM was believed to have stopped here on it's trip from Asia Minor (present day Turkey) to Rome.
Map of route

The archeological museum of Rhodes is hidden in the old city
Google e

With lots of old streets
(pix)
and it is easy to walk by
slide
slide sign

They weren't of any help at the museum, so the sent me to find the
Archeological service of the Dodecones
Slide
Slide
Slide

Where I made an appointment with archeologist K. Anna Maria Kle then next day.
Her office is in a medieval building, which is fitting as she is an medieval archeologist and I need an Ancient archeologist instead.
She gave me a referral to meet Stratos S, Archeologist, photographer and fellow amateur astronomer and eclipse chaser.

Slide

He thinks the bust which some people think is Posidonius of Rhodes, in not, and tells me about one at the National archeological Museum back in Athens.
Lots more about PoR and the Keskindos tables. Which were found near Lindos.

We have a time for a few days in Rhodes. The history of this place really gets to me.
Here is a street corner we had lunch at.
Slide
Check out the street signs.
Slide
Slide
We even rent a small car
Slide
And visit the ancient city of Lindos which has it's own acropolis
Slide

OK, so now it is back to Athens
(map with lines)
(judy off plane)
Your remember Athens, it is where the big acropolis is
(acropolis shots)
(acropolis shots)
(acropolis shots)

There I meet professor Yanis Bitsakis
(slide)
and Professor Xenophon Moussas,
(slide)
long talks about the AM and startling new information.
The high Resolution CT from Hadland's Bladerunner machine have been bearing much fruit and 2000 more characters of text have become readable.
(slide)

We did not get to meet Agamemnon Tselikas for, the member of the team that was analyzing the language used on the AM

First a quick book report, Jo Marchant just published this new book on the AM last month.
(hold up book)
It is a great book and has just about every scrap of info know about the device.
Analysis of newly discover text indicate the is was from western Greece and from 1st century BCE
The ship carrying the AM sank in approximately 87 BCE or maybe 80 as the dials of the AM were set to that time.
Show slide one of time lines
Right when Pof R lived.

OK, Remember I said her book has just about every scrap of info, ***Had*** is a better term. One Hour ago in Stockholm, Yanis Bitsokis and members of the team delivered a new paper on the AM

Analyses not just of the vocabulary, but of the hand righting / caligraphy analysis places the text 150 to 200 years earlier. So much for P of R being the maker. Did I also mention the adjustment dial to convert to the Egyptian calendar?
It is believed that the device was old, and that there were many of them made over a long period and continued advances to the design, but we will never know.

Meanwhile I am still intrigued with Pof R.
I find an obscure reference, that he is buried in Amesbury England, and not Rhodes, so we fly to England to look in to this.
May 2002 ----
(slide)
(slide)
Anybody remember what else is in Amesbury. Right- Stonehenge.
What is this connection?
So it's off to Amesbury to look for answers, but unfortunately my credit card undergoes spontaneous combustion
(pix of card burning),
We had gotten use to cans of Coke for $5 and the same price for a gallon of gas, so our Odyssey had to end, and we flew back home last week.
(slide)
But that is not the end of the story.
It could also have been Hicarcus or even Archemedies
Hiparcus's accomplishments.

And then there is the Keskindos stone. Found in the south of Rhodes, It may be Hipparchos grave stove or some mathematical text. I don't know when things about it will be published. The Danish researchers whisked it back to Denmark, and not much more information is forthcoming.

I become part of the AMRP, I have run across others looking for answered and hidden data
So much of ancient knowledge is lost.
Why and how?
Natural disasters
War
Religious persecution
Military
Political
Monetary
Recycling
Family Secrets

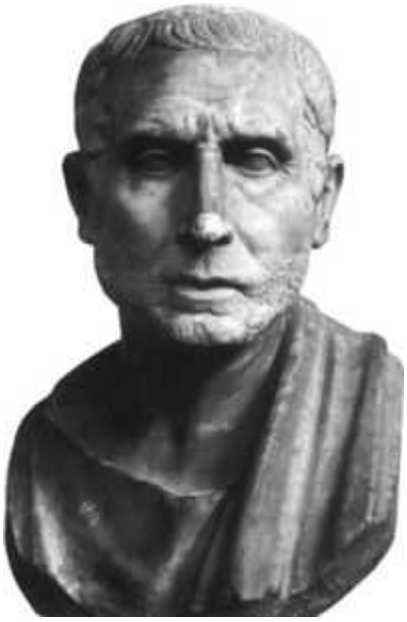
Extra material depending on time
More Cynthia bowl stuff.

Tower of the winds. Macedonian astronomer andro nikos kyrrestes
The Tower of the Winds, also called horologion (timepiece), is an octagonal Pentelic marble clocktower on the Roman agora in Athens. The structure features a combination of sundials, a water clock and a wind vane.[1] It was supposedly built by Andronicus of Cyrrhus around 50 BC, but according to other sources might have been constructed in the 2nd century BC before the rest of the forum.

Meton constructed a solar clock (433 BC) that he set up near the Pnyx He is known for the Metonic cycle

I can go on and on, but I have run out of time for tonight lecture
But what I have learned made the whole trip worthwhile, and that Archeology is not dead, it is alive and every changing as we develop new tools to analyze old data.
Thanks and good night.

Lecture notes not used



But I make lots of mistakes
I tried to figure out the diameter of earth, yes I know it’s round, who doesn’t besides those idiots in Rome.
I figured that Rhodes and Alexandria are at the same Longitude.
Ever been to Alexandria?, No, you should go, they have a great library there.

135- to 51 bce + 2009=2144, I don’t fell like a day over 500

Ever since man had more than one on something, he had to invent counting.
Counting led to computing, and development has never stopped.
The first con artist who could predict the winter solstice, the floods of the Nile, by the position of Leo in the sky or know when an eclipse would happen, either got very rich, very powerful or both. Back in ancient times in the late 1980’s Wall street discovered that out of work rocket scientists could apply complex statistical tools that could run on cheap PC’s and make a fortune on the market. That is how I got mine.

Here is a computer that is even old than me (Abacus)
This thing was made by the Sumerians or Babylonians in 3700 BCE but some think they copied it from the Chinese when they went for takeout.

The Cytherian Bowl might have been called the Babylonian Astronomers' Chalice

Stone henge watch, there is a large scale version in England

Astrolabe
An early rudimentary astrolabe was invented in the Hellenistic world in either the first or second centuries BC and is often attributed to Hipparchus. A marriage of the planisphere and dioptra, the astrolabe was effectively an analog calculator capable of working out several different kinds of problems in spherical astronomy. Theon of Alexandria wrote a detailed treatise on the astrolabe, and Lewis (2001) argues that Ptolemy used an astrolabe to make the astronomical observations recorded in the Tetrabiblos.[1]

The Antikytera could also have been made by someone from the Hipparchos school or Hipparchos himself.

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whose grave was discovered in May 2002, at Amesbury near Stonehenge

One of the most revered philosophers of ancient Greece, and Rhodes's ambassador to Rome. He subscribed to the Stoic view that the cosmos is a single organism.

Only ancient device with gears ever found.
8 astrolabes found.

Antikythera, anti means in front of. There are so many Greek islands, they started to run out of names. There are over 1400 and less than 700 are habitable.
Posidonius "of Rhodes" or, alternatively, "of Apamea", was a Ancient Greece Stoic ..... whose grave was discovered in May 2002, at Amesbury near Stonehenge

Other peoples information

Last Friday I caught the train to snowy Cambridge for a half-day conference on the Antikythera mechanism, organised by the Whipple Museum of the History of Science. Several of the researchers from the Antikythera Mechanism Research Project spoke about their work on the device, so it was a good opportunity to catch up with them and find out where things have got to.

First, Mike Edmunds of Cardiff University and his London-based colleague Tony Freeth summarised the project so far. They didn't add much to what has been said before, however, and it was Alexander Jones, over from the Institute for the Study of the Ancient World in New York, who gave the most interesting talk of the day. He has been collaborating with Tony Freeth and others to decipher the inscriptions on the mechanism, particularly those letters hidden beneath the surface of the surviving fragments and revealed only recently by 3D X-ray imaging.

Most recently the research group has been studying the text on the front of the mechanism, and they have a paper planned on this very soon. Unfortunately Jones didn't pass on any juicy advance details and instead focused on the back of the mechanism, which was the subject of a Nature paper published in July last year.

In that paper, the team reported that the month names used on a 19-year calendar on the back of the mechanism came from a civil calendar, not an astronomical one as assumed, and that a smaller dial didn't show a 76-year calendar as previously thought, but a 4-year cycle marking the timing of the Olympic and other Greek games.

In his talk, Jones told us how surprised he had been to learn that this civil calendar was tightly regulated to lunar and solar cycles. Previously it had been thought that only astronomers used such sophisticated calendars, whereas the calendars used by ordinary people were much more ad hoc. But that clearly wasn't the case. Among other things, the mechanism's dial explained which months should have 29 days and which should have 30 days, and exactly which days to skip.

Jones also talked about the month names used on the calendar, including Phoinikaios, Kraneios, Lanotropios and Machaneus. Different month names were used in different regions of Greece, so in theory these should help pin down where the mechanism was made. Unfortunately knowledge of exactly what months were used where is very patchy, but the closest matches to the ones on the Antikythera mechanism are with regions colonised from the city of Corinth - candidates include Corfu, Illyria and Epirus in northwest Greece, and Syracuse in Sicily. Syracuse is a particularly exciting prospect because this is where Archimedes lived - and ancient writings suggest he once made a device similar to the Antikythera mechanism. But Jones revealed a hint that may implicate northwest Greece instead.

It's on the 4-year Olympiad dial. The different games listed on the dial are Isthmia, Olympia, Nemea, Pythia and Naa (plus one other that hasn't been deciphered). Isthmia, Olympia, Nemea and Pythia were all major games, of importance across the Greek world. But the Naa games, held in Dodona, were a much smaller affair, of only local interest. So Jones speculates that the dial might have been designed for someone who lived nearby. Dodona was in Epirus, one of the regions also implicated by the month names on the calendar, so perhaps the device was made in Epirus. Deciphering the final name on the list might help to confirm or rule out this theory.

Jones said he thinks the Antikythera mechanism wasn't so much a computer, designed for making specific calculations, as a simulator, intended to demonstrate the workings of the universe to a broad intellectual audience. He also revealed that it may be even older than thought, perhaps from the early second century BC. The inscriptions have been dated to around 100 BC. But because we don't know where the device is from, that's only a very rough estimate. Jones pointed out that many of the Corinthian colonies were devastated or taken over by the Romans well before 100 BC: Syracuse in 212 BC, Epirus in 167 BC, Corinth in 146 BC. After Roman conquest the inhabitants would presumably have stopped using their Greek calendar, suggesting that the Antikythera mechanism was built earlier than this. I think he's right when it comes to northwest Greece, but Syracuse was still Greek-speaking and relatively prosperous into the first century BC so its inhabitants could have carried on using this calendar for quite a while.

Also still unanswered is the question of how the mechanism ended up on the ship on which it was found.This was a Roman ship sailing from Asia minor in the eastern Mediterranean, carrying valuable goods (probably war booty) back to Rome. Yet the Corinthian colonies were all in the western Mediterranean. This caused a bit of discussion after the talks between Jones and Edmunds, who believes that devices like this, if not the Antikythera mechanism itself, were being made at the time in Rhodes in the east. I think he's probably right, and that the tradition of these devices spread across the Greek world.

Paul Cartledge, professor of Greek classics at the University of Cambridge, wrapped up proceedings with some entertaining comments about the wider significance of the Antikythera mechanism. In particular, he's interested in what the device tells us about the culture and mindset of the ancient Greeks. His main point was that although historians have often viewed the Greeks as not very technologically minded, the Antikythera mechanism shows that science and technology were central to their world. What's more, it suggests they were moving away from belief in superstition and omens towards a much more modern mindset in which the universe is explainable, and operates according to predictable rules.

I still find that astounding. More than two thousand years ago, you could say that the Greeks were having their own Scientific Revolution.

Tags:

New model of the Antikythera mechanism
28. January 2009 14:17

After letting you know about the upcoming conference featuring members of the Antikythera Mechanism Research Project, today I can update you about Michael Wright, who has been working on the Antikythera mechanism since the early 1980s. He made the first working model of the mechanism (I've previously posted a video of it on youtube). Now he's working on a second model.

The first version was made out of packing crate wood and recycled brass plates from a pub door. Michael built it bit by bit, reworking and replacing different sections over the years as he studied his X-rays of the original Antikythera fragments, and worked out how the machine was put together.

Now that the structure of the mechanism is generally agreed upon (the surviving parts at least), Michael is making a smarter display version, and he has kindly sent me some photos of it. The case is made of maple, with wood panels above and below the front dial instead of the old brass strips. The dials are pretty similar to the older model, but the new ones are neater, and Michael says he has worked out how the calendar ring was held into the front dial, which he wasn't sure about before.

The top two photos show the mechanism from the front - the pointers show the Sun, Moon and the five planets that the Greeks knew about, as they circle through the sky. The inner dial is a zodiac scale, while the outer dial shows the days of the year. In the close up you can see the engravings better - look for the Sun pointer (second from left, labelled

"Helios"). On the zodiac scale you should also be able to recognise Parthenon on the left (the Greek name for the sign Virgo) and Chelai on the right (meaning "claws", this is what the Greeks called the sign of Libra).

The third picture is a close up of part of the upper back dial - it was a spiral calendar inscribed with local month names, with a tiny 4-year dial inside it showing the timing of the Panhellenic Games, including the Olympic Games. Below this is a second spiral (not shown) which displayed the details of upcoming lunar and solar eclipses.

What a wonderful piece of machinery. I've had quite a few emails from people asking where they can buy an Antikythera mechanism for themselves, but as far as I know there are no plans to make them commercially.

Tags:

We even have the names of who could have built this technological wonder. The wrecked ship that the Mechanism was on could be dated to sometime in the first century B.C. and probably from the Greek islands of Rhodes and Cos. On the device itself was a dial to compensate for errors in the Egyptian calendar which was used at that time. This dial was adjusted in such a way that researchers were able to determine an exact date - 80 B.C. - when the Mechanism was last set. Classical scholars also know that just seven years earlier, in 87 B.C., a Greek named Geminus wrote a book which describes a device that sounds remarkably like the Antikythera Mechanism.
Jay Hilgartner sits at a computer station in today's modern Library of Alexandria where he recently visited. The new library is built on the site of the ancient Library of Alexandria, where detailed plans for building a device such as "The Antikethera Mechanism" may have been kept. All photos by the author unless otherwise noted. Click HERE for interior of library, and HERE for exterior.
Perhaps it was built by Geminus himself or by another astronomer mentioned by him - Poseidonius of Rhodes. Poseidonius is also mentioned by Cicero as the designer of an instrument which records the movement of the Sun, Moon, and the five planets. Or, others say, it may have been designed centuries earlier by the brilliant Archimedes or by another Rhodes' astronomer Hipparchus, who died around 120 B.C.

Poseidonius of Rhodes was a scholar of many disciplines including mathematics, astronomy, mechanics and meteorology. As is the case for most of the ancient Greek astronomers, the works of Poseidonius of Rhodes have not survived the ravages of time but, fortunately, have been described in detail by later generation scholars including Cleomedes.

His greatest contributions to astronomy are in relation to his attempts to estimate the size and distance of both the moon and sun as well as the circumference of the earth. For the latter, he noted that the star Canopus is on the horizon when observed from Rhodes whereas it sits at an altitude of 7° 30' when observed from Alexandria and whose distance from Rhodes is 5000 stadia. Using simple arithmetic, he concluded from these observations that the circumference of the earth must be 240,000 stadia (5000 x 360 / 7.5) which is very accurate but contains two off-setting errors in relation to the distance between Rhodes and Alexandria as well as the altitude of Canopus when observed from Alexandria. For the former, a distance of 3750 stadia in lieu of his initial estimate of 5000 stadia is the more accurate figure; for the latter, the altitude used should have been 5° 15' and not 7° 30'. When the correct figures for these two key parameters are employed, the circumference of the earth is computed to be 257,142 stadia which is very close to his original estimate of 240,000 stadia and virtually identical to the 252,000 stadia computed approximately 150 years earlier by Eratosthenes.

With respect to the distance of the moon from earth, he computed a distance equal to 58 earth radii which is short of the modern-day estimate by less than 4%. In his book "Περί του Ηλίου μεγέθους", he estimates the distance of the sun from earth to be only 2.5 times that of the distance of the moon from earth (a gross underestimate). Other works include "Φυσικοί Λόγοι", "Περί Κόσμου" as well as "Περί Μετεώρων" where he discusses physics, the universe and various celestial phenomenon observable with the naked eye, respectively, as well as the altitude of the atmosphere (40 stadia according to his calculations).

Finally, Poseidonius is credited with attempting to use scientific principles to study meteorology and proposed various theories in relation to the formation of clouds, rain, wind, mist, frost, hail and rainbows. Furthermore, he suggested on the possible relationship between the moon and tides and on earth!

Poseidonius of Rhodes has been honored with the naming of a formation on the northeast periphery of Mare Serenitatis (see Rukl: 14) after him. The circular and walled plain formation Poseidonius, measuring 95 km in diameter and located at (31.8° N, 29.9° E), is characterized with high walls and multiple craterlets and is best observed just before first or third quarters. A 70-km long rille on the eastern half of this formation is also named in his honor (Rimae Poseidonius). A wide-field view of Mare Serenitatis including the formation named after Poseidonius is available elsewhere on this site (see here) with additional high-power images of this formation available shortly.

For a thorough discussion on the life and creative work of Poseidonius of Rhodes, the reader is referred to:

Οι Αστρονόμοι της Αρχαίας Ελλάδας (Σπανδάγου Ευαγ., Σπανδάγου Ρ., Τραυλού Δ., ΑΙΘΡΑ, Αθήνα, 2000, ISBN: 960-7007-60-3)
Αρχαίοι Ελληνες Αστρονόμοι (Ελευθεροτυπία, 2-Ιανουαρίου-2003)
Greek Astronomy (Heath T., Dover, New York, 1991, ISBN: 048-6266-20-6)
Poseidonius of Rhodes (O'Connor and Robertson, online)

Mare Serenitatis is virtually a circular formation measuring approximately 650 km in diameter in all directions and covers an area of slightly over 300,000 square km. It is one of the smoothest mare, for the mare floor is characterized with its largest crater, Bessel, whose diameter only reaches 16 km. Inspection of the image below indicates the presence of approximately ten very small and normally hard-to-detect craterlets whose diameter is each well below 7 km. The greatest characteristic features of Mare Serenitatis are perhaps the circular and walled plain formation Posidonius (95 km in diameter) on the northeast periphery and Dorsa Smirnov immediately to the west of Posidonius running north-south (130 km in length, 20 km in width). The southern periphery of Mare Serenitatis includes the 16-km in diameter crater Plinius whose rays leading into Mare Serenitatis suggest an impact of some type. Various ridges of interest but not visible in the image below include Dorsa Owen and Buckland to the west and Nicol and Lister to the south. The ridge immediately to the west of the imaginary line joining the landing sites for Apollo 17 and Luna 21 is Dorsa Aldovandri, a ridge measuring 120 km in length and 10 km in diameter.

Note: The landing of the Apollo 17 lunar module in the Taurus-Littrow area on December 11, 1972, regrettably, marked the final manned mission to the lunar surface. This particular mission involved the collection of 110 kg of lunar samples over the course of 21 hours by Cernan and Schmidt using the Lunar Rover. Approximately two months later, the Soviet probe Luna 21 soft-landed slightly further north on January 15, 1973 where an automated and mobile laboratory ranged nearly 40 km from the landing site performing various experiments. A complete enumeration of all landing sites for Apollo, Luna and Surveyor craft is available elsewhere on this site.

Note: The reimaging of Mare Serenitatis with more favourable colour and contrast will be attempted during the forthcoming lunations.

Poseidonius: fragments about history and geography

Poseidonius (? 135-51 B.C.) was a polymath who wrote on many topics, such as ethics, logic and science, as well as a history of the Greek and Roman world from 146 to about 86 B.C. None of his books survive, but many fragments from them have been preserved in quotations by other authors. About half of the known fragments are about history or

geography, and they were published in volume 2A of Jacoby's "Fragmente der Griechischen Historiker" (FGrH_87).

The fragments which appear in Jacoby's edition are shown here, with a few additional ones. Because most of them are quotations by other authors, which have already been translated elsewhere on the web, this list consists mainly of links to the places on the web where the translations can be found.

The fragment numbers in Jacoby's edition are shown in red. All the fragments of Poseidonius have been translated by I.G.Kidd (Cambridge, 1999). The numbers in Kidd's translation are shown in green.

Born: 135 BC in Apameia, Syria
Died: 51 BC in Rhodes

Posidonius of Rhodes is also known as Posidonius of Apameia. The first of these names refers to where he taught while the second refers to the town of his birth, Apameia on the Orontes. One must not think of these two as different people.

Although he was born in Apameia in Syria, Posidonius was from a Greek family and he was brought up in the Greek tradition. He went to Athens to complete his education, and there he studied under the Stoic philosopher Panaetius of Rhodes. Posidonius travelled widely in the western Mediterranean region and he made many scientific studies on his travels relating to astronomy, geography and geology.

Some time not long after 100 BC Posidonius became the head of the Stoic School in Rhodes. While in this position he also held political office in Rhodes. It was in a political position, as ambassador of Rhodes, that he travelled to Rome in 87-86 BC. There he met a number of men who he had known and taught earlier including Cicero.

In Rome Posidonius visited Gaius Marius, the Roman general and politician who was consul seven times. Marius died on 13 January 86 BC while Posidonius was still in Rome. While there Posidonius became friends with Pompey the Great who had been educated in the Greek tradition. Pompey the Great kept up his friendship with Posidonius and visited him in Rhodes on a number of later occasions when on his military campaigns.

None of the writing of Posidonius has survived but much has been written about his achievements and much work has been undertaken trying to reconstruct his views from the fragments of his writings which are preserved in quotations by later authors.

Posidonius made some minor contributions to pure mathematics where he is [2]:-

> *... quoted as the author of certain definitions, or for views on technical terms. e.g. 'theorem' and 'problem', and subjects belonging to elementary geometry.*
>
> *... he wrote a separate work in refutation of the Epicurean Zeno of Sidon, who had objected to the very beginnings of the "Elements" on the ground that they contained unproved assumptions.*

His work on astronomy is fairly well known to us through the treatise by Cleomedes *On the Circular Motions of the Celestial Bodies*. The work is in two volumes and as Heath comments [2]:-

> *... the very long first chapter of Book II* (*nearly half of the Book*) *... seems for the most part to be copied bodily from Posidonius.*

Cleomedes explains in his work the method used by Posidonius to calculate the length of the circumference of the earth. His method is based on observations of the star Canopus at Rhodes and Alexandria. At Rhodes he observes that Canopus touches the horizon while at Alexandria it reaches an altitude of 7° 30'. Using a distance of 5000 stadia

between Rhodes and Alexandria this gave Posidonius a value of 240000 stadia for the circumference of the earth. This a very accurate value, but it is produced because of two compensating errors.

Both figures used by Posidonius in the above calculation are inaccurate. The 7° 30' should be really 5° 15' while the figure of 5000 stadia for the Rhodes to Alexandria distance is also incorrect. Later Ptolemy informs us via the writings of Cleomedes, Posidonius used the more accurate 3750 stadia for the Rhodes to Alexandria distance but kept his very inaccurate 7° 30' thus obtaining the figure of 180000 stadia for the circumference which is far too small. We should note, however, that Taisbak in [11] attempts to prove that attributing this far too small value of 180000 stadia to Posidonius is unfounded. Eratosthenes had given a much more accurate value of 252000 stadia 150 years before Posidonius.

Posidonius also made calculations of the size and distance to the moon, and the size and distance to the sun. His measurements of the moon are inaccurate partly because he assumes a cylindrical rather than conical shadow. As to his calculations of the sun, Neugebauer writes [3]:-

> *Posidonius's attempts (according to Cleomedes) to determine the size of the sun are rather naive and make it difficult to understand that his astronomy was not ridiculed by authors like Cicero and Pliny who pretend to know the work of Hipparchus.*

As to Posidonius's views on knowledge he believed that [1]:-

> *... fundamental principles depended on philosophers and individual problems on scientists; and he believed that, among early men, the philosophically wise managed everything and discovered all crafts and industry. ... For true judgement the standard is right reasoning; but precepts, persuasion, consolation, and exhortation are necessary; and enquiry into causes as opposed to matter is important.*

Posidonius wrote on meteorology, a topic where he closely followed the teachings of Aristotle. He gave theories to explain clouds, mist, wind and rain. He also gave opinions on frost, hail and rainbows. Lightning and earthquakes interested him and he tried to approach all these topics in a scientific manner although he had little chance of coming up with explanations which were anywhere close to being correct.

In moral philosophy he followed the Stoic teachings and gave opinions on virtue, evil, the soul, and emotions. He wrote historical works covering the period from about 146 BC to about 63 BC. These works give an account of the Roman civil wars and the contacts by the Greeks and the Romans with other peoples such as the Celts, Germans, and peoples of Spain and Gaul.

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Alexander Jones studied Classics at the University of British Columbia and the history of the ancient mathematical sciences in the Department of the History of Mathematics at Brown University. Before coming to NYU, he was for sixteen years on the faculty of the Department of Classics and the Institute for the History and Philosophy of Science

and Technology at the University of Toronto. His work centers on the history and transmission of the mathematical sciences, especially astronomy.

He is the author of several editions of Greek scientific texts, among them Pappus of Alexandria's commentary on the corpus of Hellenistic geometrical treatises known as the "Treasury of Analysis"; an anonymous Byzantine astronomical handbook based on Islamic sources; and a collection of about two hundred fragmentary astronomical texts, tables, and horoscopes from the papyri excavated a century ago by Grenfell and Hunt at Oxyrhynchus. His current research interests include the contacts between Babylonian and Greco-Roman astronomy and astrology, the Antikythera Mechanism and other artifacts of Hellenistic astronomy, and the scientific work of Claudius Ptolemy. He is a member of the American Philosophical Society, a fellow of the Royal Society of Canada, and recipient of several awards and honors including a Guggenheim fellowship and the Francis Bacon Award in the History of Science.

METON OF ATHENS (fl. 5th century BC)

Life
Meton was the son of Pausanias, and a native of Athens (like Demosthenes, he was from the Deme of Leuconoe, between present-day Stavros and Paiania). He studied engineering and geometry (reference in Phrynichus and Aristophanes) and astronomy (reference in Theophrastus) with Phaeinus of Athens, who made astronomical observations from his observatory on Lycabettus Hill (432 BC). He is cited by Theophrastus in his "On signs of weather", and also by Vitruvius. One of the craters on the moon has been named "Meton" in his honour. None of his written work has survived.

Work
Meton is known for the 19-year "Metonic cycle", which he introduced into the ancient Athenian luni-solar calendar as a fixed system for recording astronomical observations. He calculated that 19 solar years (6940 days) corresponded to 235 "lunations" (synodic or lunar months), of which 110 were deficient (29 days) and 125 complete (30 days). Nine of these months were intercalary, that is, they were added to certain years of the cycle as a 13th month. This period of 19 years was known as a Metonic or lunar cycle. The Metonic cycle is still used to determine the date of Easter, since every 19 years the phases of the moon recur on the same days of the solar year.

Meton constructed a solar clock (433 BC) that he set up near the Pnyx. He designed and built a number of waterworks, including the Colonos aqueduct mentioned by Phrynichus (Menotropus): "I know that the one who collects the springwaters... may have built a fountain in Colonos". He was assisted in his work by his pupil Euctemon, and together they made observations of the position of the sun at the equinox. As a geometer he worked on the problem of the squaring of the circle. This is alluded to by Aristophanes in his "Birds".

- Parapegma: Calendar erected in the centre of Athens (432 BC). This was a large marble table on which were placed smaller tablets of bronze. It showed the months, the years, the festivals, and the risings and settings of the sun and stars.
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But there is a twist in the tale. Researchers including Alexander Jones of the Institute for the Study of the Ancient World in New York and John Steele of Durham University, UK, are still deciphering the mechanism's inscriptions. They recently discovered that the month names used on the Antikythera mechanism are from a local calendar used only in western Greece (Nature, vol 454, p 614).

One of the main contenders for the origin of the calendar is the powerful city state of Syracuse, founded by Greek settlers, hinting that the mechanism was made by - or for - someone there. This is puzzling because the ship was sailing west towards Sicily on its way to Rome before it sank (see map). It is possible that the mechanism was made on

Rhodes for a wealthy owner in Syracuse. However, the inscriptions on the device date it to around 150 to 100 BC, suggesting that it was already a few decades old when the ship sank. It now seems more likely that it was originally made in Syracuse then taken east - to show off to the scholars on Rhodes, perhaps, or simply because its owner moved there. Later, the Romans put it on a ship heading back west.

Props to take to lecture

Laptop Computer
Slide rule
Abacus
Eniac gate
Stonehenge book
Startrek to cyntia
Decoding the heaven, Jo M
Copper bowl
Voice recorder
Red laser pointer

Slides

*End of File