GOLDSMITH

THE PYRENEES HERITAGE PRESERVATION MAGAZINE

Edition 161 April 2021 Lake Goldsmith Steam Preservation Association Inc.

WELCOME TO THE 2021 AUTUMN LAKE GOLDSMITH RALLY

1234 LAKE GOLDSMITH-CARNGHAM ROAD LAKE GOLDSMITH. VIC. 3373

RALLY 117 MAY 1 & 2 2021

PLEASE CHECK OUR WEBSITE FOR POSSIBLE COVID RESTRICTIONS

www.lakegoldsmithsteamrally.org.au

RALLY THEME

SMALL ENGIMES– ALL TYPES &

AND HORSE DRAWN OR POWERED VEHICLES & MACHINES

UNFORTUNATLY THERE ARE NO FACILITIES FOR HORSES

Everything else welcome

Our Mission Statement

To foster, nurture, encourage and demonstrate technical, agricultural and life skills associated with the Industrial Era.

To provide a quality environment where these skills may be used to educate and entertain members and visitors.

To run two weekend rallies each year, and be available at convenient time for other interested groups or individuals.

To conserve and develop a heritage collection.

Find us on the net at:- www.lakegoldsmithsteamrally.org.au

Contact us at:- info@lakegoldsmithsteamrally.org.au **or The Secretary P.O. Box 21 Beaufort 3373**

Note:- The February and August editions are normally email only.

They can be Download from:- www.lakegoldsmithsteamrally.org.au/magazine.html

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To register for this "cost & obligation free" bi-monthly e-magazine

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Lake Goldsmith Steam Preservation Association Inc.

Registration:- A0032895 Correspondence to:- The Secretary PO Box 21 Beaufort 3373

Welcome to Goldsmith Edition 161 April 2021

All is looking good for a return to Heritage Rally's at Lake Goldsmith with May 1 & 2 2021 set for the 117th rally. Whilst the worst of Covid is being held at bay, it is still hovering in the background. If you have any thought that our regulators may cancel the rally, please check our website at :-

www.lakegoldsmithsteamrally.org.au

before you load up and head off to Lake Goldsmith. Any requirements in force at the time regarding social distancing, masks or sanitisers must be followed.

The theme for rally 117 was covered in the February edition 160 of Goldsmith which unfortunately was an email only edition. That edition is available on our website as shown above under the magazine tab.

The Theme is horse drawn or horse powered equipment and small engines. How small should the engine be, well that is up to you, but if you can get it there I guess that is small enough. Unfortunately we do not have provision for horses themselves, but the machinery that they drew or powered is of interest and it is all relevant to the transition from Horse powered to horse power. The ingenuity of past generations adapted the power of these magnificent animals to drag us into the modern world. Without them and the crops that they could harvest we would still be swinging scythes

For this edition, the subject has turned to collectable instruments, and in particular the instruments developed in the "Age of Enlightenment" when Science responded to the needed of an expanding maritime world. Henry the 8th opened the world for science and brought down the wrath of Spain, which required some urgent upgrades to Naval capability. This continued under his daughter, Elizabeth 1 and by the 1600's the need to improve navigation in the Atlantic was imperative. By the 1700's the inability of navigators to determine longitude with any accuracy was deadly. In 1714 the Government of Great Britain put up the sum of £20,000 for a solution to the problem.

It took 50 years, but in that time Harrison, who built the most accurate long case clocks developed a Chronometer, Maskelyne printed the Nautical Almanac, and "Luna's", the reflecting Sextant, Theodolites, reflecting telescopes, optic micrometres, Quadrants and the Plane Table all arrived. Then into this world came James Cook, who brought it all together and became one of the Greatest Navigators and Chart makers.

The Sea became a safer place and the science has never ceased, Mars is next.

Mark Dye has provided some background on Marine development, and by absolute coincidence the Lignum Vitae timber that is the focus of the story is also embedded in Harrisons Long Case clocks. This is an amazing timber, thanks to Mark for his story

Lets look forward to a great Rally on May 1 & 2 2021

The Navigation & Survey Instruments

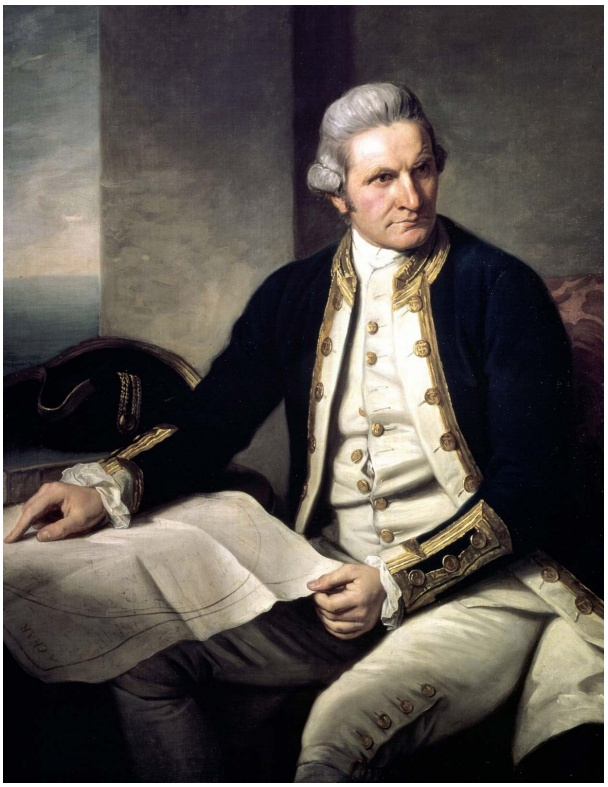
Of

Captain James Cook

Much has been written about the exploits and discoveries of Cook on the 250th anniversary of his charting of New Zealand and the Eastern Coast of Australia in 1770.

In fact a lot has been written about Cook and most of his records and charts have been published and are on record in Museums and collections around the world. His contribution to science and discovery, and to new standards in the preparation of Charts created a legend.

His death in 1779 predated the arrival of the first Fleet in Australia in 1788 so he did not have a direct role in the settlement of Australia or New Zealand, and both had been discovered by the Dutch explorer Able Tasman in the 1600's.



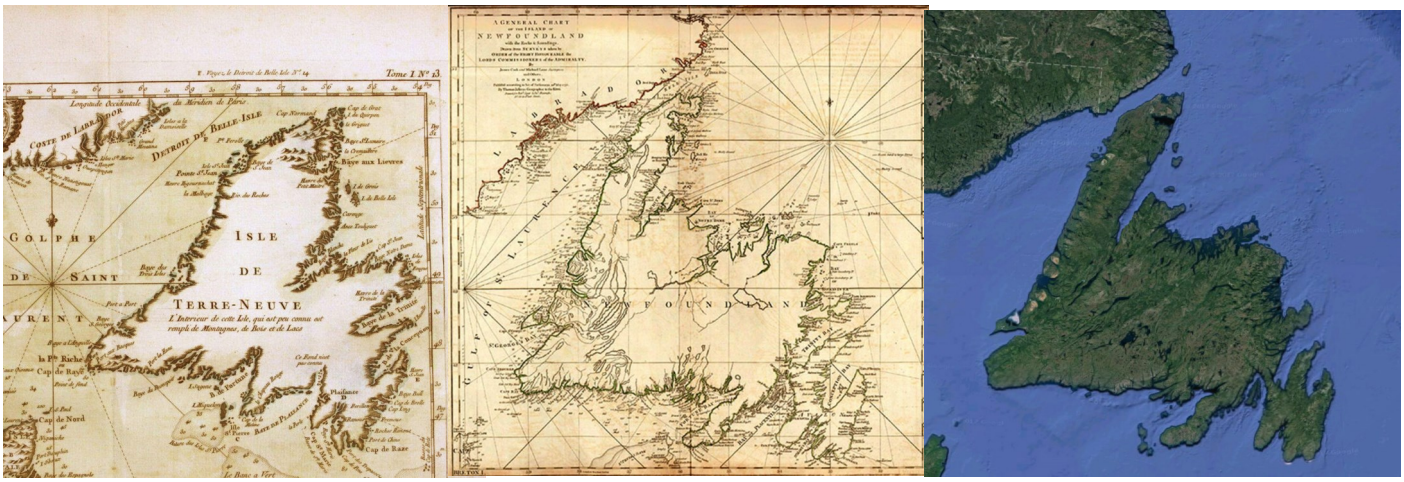
Cooks background on a farm working with his father as a farmhand in Yorkshire England did not hint at his future. His apprenticeship to a Whitby shipbuilder started an association with a boat that would eventually make history. These sturdy reliable ballasted round bottom Whitby Cats proved ideal for the heavy loads of Coal

that they transported on the North Sea, proved ideal for his future trip, with the Royal Navy, to the Pacific Ocean to observe the transit of Venus across the Sun from recently discovered Tahiti, in 1769, and then to search for a mythical continent thought to exist in the vast expanse of the Pacific.

Cook gained great experience building and sailing these ships commercially. A trip to Canada and the St Lawrence river gave him the opportunity to find and chart a safe

passage up the St. Lawrence river as a preliminary to capturing Quebec from the French. Good fortune had him serve with a military survey/engineer to survey his soundings and marker buoys to mark and chart a safe passage to Quebec. Cooks Commander encouraged him to learn the technique of Plane Table surveying that the army was using, and teach himself the maths involved from the technical library that the commander had on board. Cooks navigation experience was expanded and combined with the plane table which allowed him to prepare an excellent chart of the St Lawrence and other coasts in the area.

At the conclusion of the war Cook was paid off from the Royal Navy, but was soon brought back to map parts of the Canadian coast. This continued from 1763 until 1767. During this period he established his abilities as an exceptional Cartographer.



1854 map of Newfoundland Island compared to Cook's 1863 map and Google Earth.

His experience commanding and navigating ships was now combined with the a high standard of coastal surveying and map preparation.

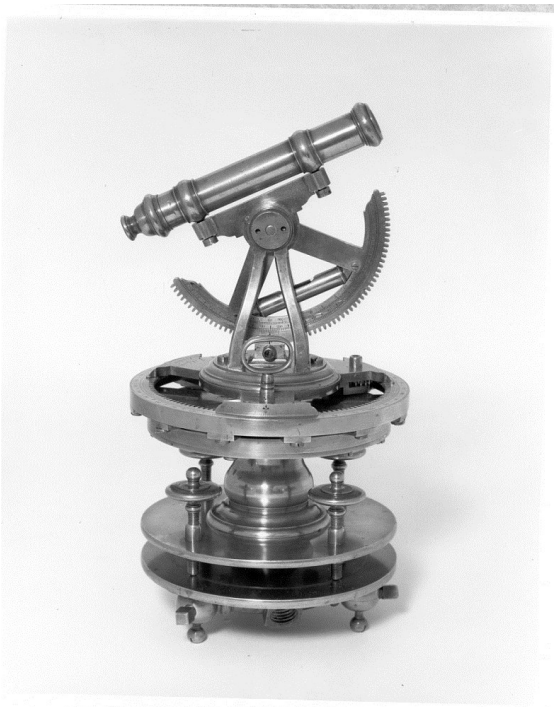
He also observed an annular eclipse of the Sun on August 5 1766 on the South coast of Newfoundland which was used to determine the time difference with Oxford in England where similar observations were made. These observations and calculations were presented to the Royal Society. The observations were made using a Brass Telescopic Quadrant manufactured by John Bird in London. The Astronomical 12" Quadrant on the right was made by John Bird in 1769 and is believed to have been used by Cook later in Tahiti.

It is held by the Royal Society as No R.S. 62

In Canada, Cook used shore based "Plane Table" surveys to record the shoreline and

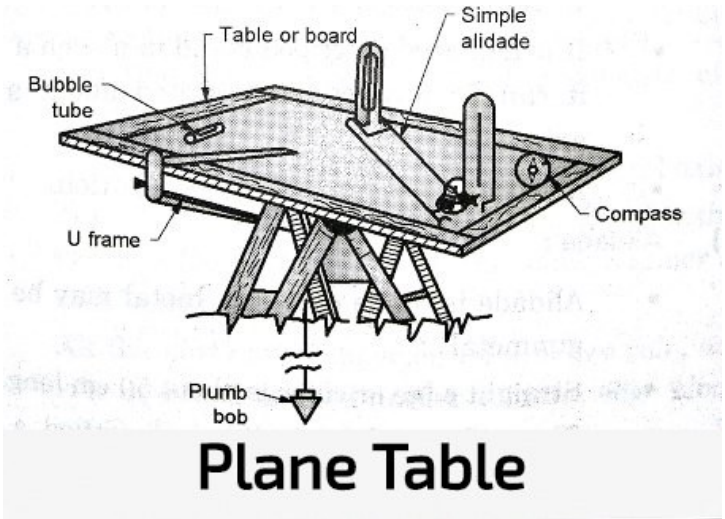
The offshore position of a boat at the time the crew took soundings to record the water depth. These maps were coastal charts for use by navigators and mariners, so not a lot of onshore detail was shown. Cook had the right to sell prints of his charts as an additional income, the originals were retained by the Royal Navy. Later in the 1793 the Royal Navy set up a Hydrographic Office to oversee Chart production and circulation.

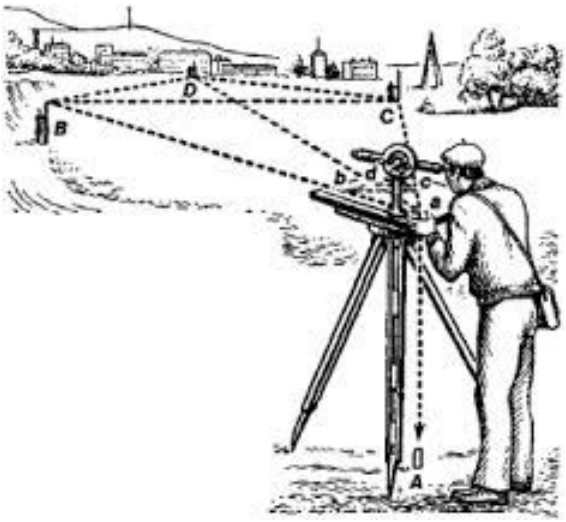
Cook also had a Theodolite made by Jonathan Sissons, who had invented it in 1737. This Theodolite (see image on the right) had the basic features common to modern theodolites, although a lot of detail development went on over the next two centuries.



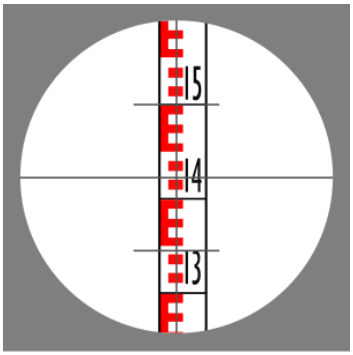
The basic plane table shown below on the left, includes a table which could be set level using levelling screws and a spirit bubble, A compass was used to ensure that directions had a common origin when used in positions. A simple " Alidade" or sighting ruler was fitted with a sighting slot and a vertical horsehair foresight. The surveyor aligned the alidade with a surface target while the ruler edge touched the end of the "U" bar above the ground station. The surveyor then draws a line along the edge of the Alidade in the direction of the target and repeats the operation until he has a "ray" to each target.

The table had to be set up in at least 2 positions a known distance and direction apart. These points were plotted a scale distance apart on the true direction, and the new point was set above the ground point with the "U" frame and plumb bob and new rays drawn and intersected to reveal the target positions on the plan on the table.





*The Plane Table at the lower right of page 6 shows a later Alidade with a Telescope and vertical circle which could be used to determine elevations. (These arrived after Cooks time and some were fitted with "stadia lines" on the crosshair reticule. These stadia lines could be used to determine the distance (see image on right, the difference of the upper & lower readings * by 100 is the distance) to a Levelling Staff and avoid intersecting two rays to fix a point on a table.)*



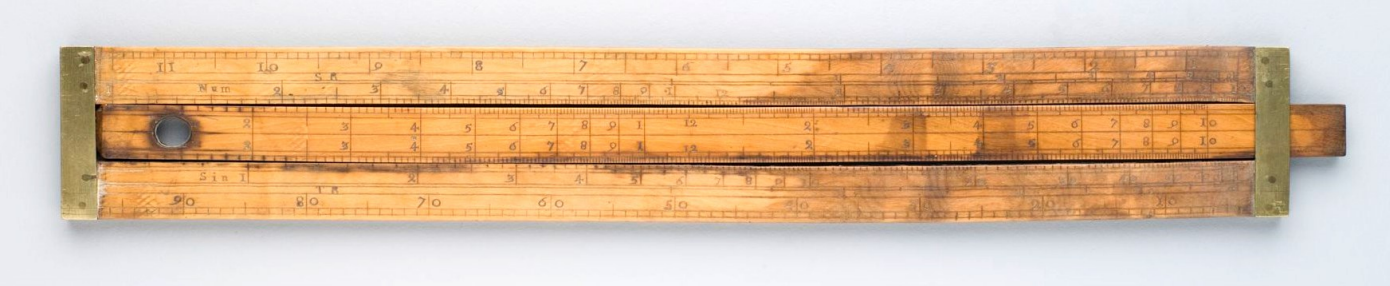
The Plane Table was in use by the Military to determine distances that they could not measure directly, over water or gullies, and ground occupied by an enemy. The above picture shows how the intersection of two rays can be used to determine the range needed to set the elevation of Artillery.

The Plane Table remained in use for map making until it was surpassed by Aerial Photography when it was combined with land surveying to produced high standard feature and contour surveys during and after WW2.

Its big advantage around Cook's time was its ability to produce an accurately scaled feature map of an area with very little or no calculation.

In the 1700's calculation for surveying was laborious when compared to post 1970's when hand held calculators were introduced. Logarithms and Trigonometry Tables had been developed a century before Cooks time by Napier and Briggs and the slide rule followed soon after as an early calculator for multiplication and division.

Captain Cooks slide rule, which he used on his first Pacific trip was stolen, along with his dividers and silver pencil, from the Australian Museum in Sydney in 1952.



The early slide rule shown above dates from Cooks time and it is typical of those used for navigation. It is held in the MAAS museum in Sydney. These had been developed from "Gunter Scale" where dividers were used to compare scales on a fixed rule.

The 17th and 18th Centuries in the "Age of Enlightenment" were times of rapid scientific development. Navigation was seen as an science that needed much development. The Sextant had made it possible to determine a ships Latitude with some precision, as the the Altitude of the sun at noon local time revealed the latitude of the observer, and it provided the North (or South) direction for a check on the magnetic deviation of a magnetic Compass.

However it did not improve the accuracy of finding Longitude. This could be many Degrees out, and was the frequent cause disasters at Sea.

Cook used a John Bird Octant for Moon and Sun shots. These had only been invented in 1731, and in 1757 Bird invented the Sextant which outperformed the Octant, and eventual became the standard for navigation. The Quadrant, Sextant & Octant were all named from how many calibrated arcs fitted into a circle. During his Canadian surveys he used land based plane tables The field observations were made over Summer, and the Charts were drawn in England during the Winter.

Following a serious disaster, the Royal Navy was in need of a new way to determine Longitude at sea. In 1714, The Longitude Act, was signed in by Queen Anne and the "Board of Longitude" was formed. Prizes were offered for:-

£10,000 for a system to locate a point within 60 Nautical miles of true

£15,000 for 40

£20,000 for 30 Nautical miles of true

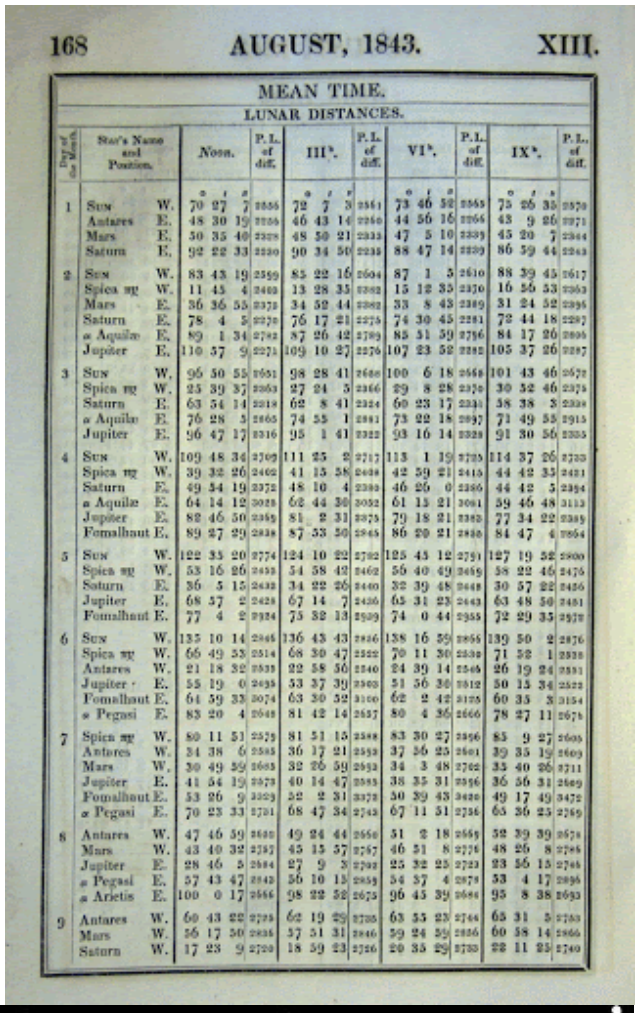
for a trip across the Atlantic Ocean. These were large sums. In our days of GPS a target of better than 60 Nautical Miles seems enormous, and it gives some idea how serious the problem was. Typically, navigators sailed to a Latitude and then went East or West until they found the spot.

Longitude is your position on the surface of the earth East or West of the Prime Meridian through the Greenwich Observatory, (then) on the Thames near London. As the Earth rotates 360° once in 24 hours, your longitude is the time which has elapsed since the Sun passed the Prime Meridian.

It took a while too come up with a system that worked. Two systems were developed.

The first System was based on Lunar Distances, and it came into use with the first issue of the Nautical Almanac by the Royal Observatory in 1767. (see image on the right)

The key to this system was the difference in the apparent rate of rotation around the Earth of the Moon and the Stars including the Sun. The Moon moves through the Stella background.



168 AUGUST, 1843. XIII.

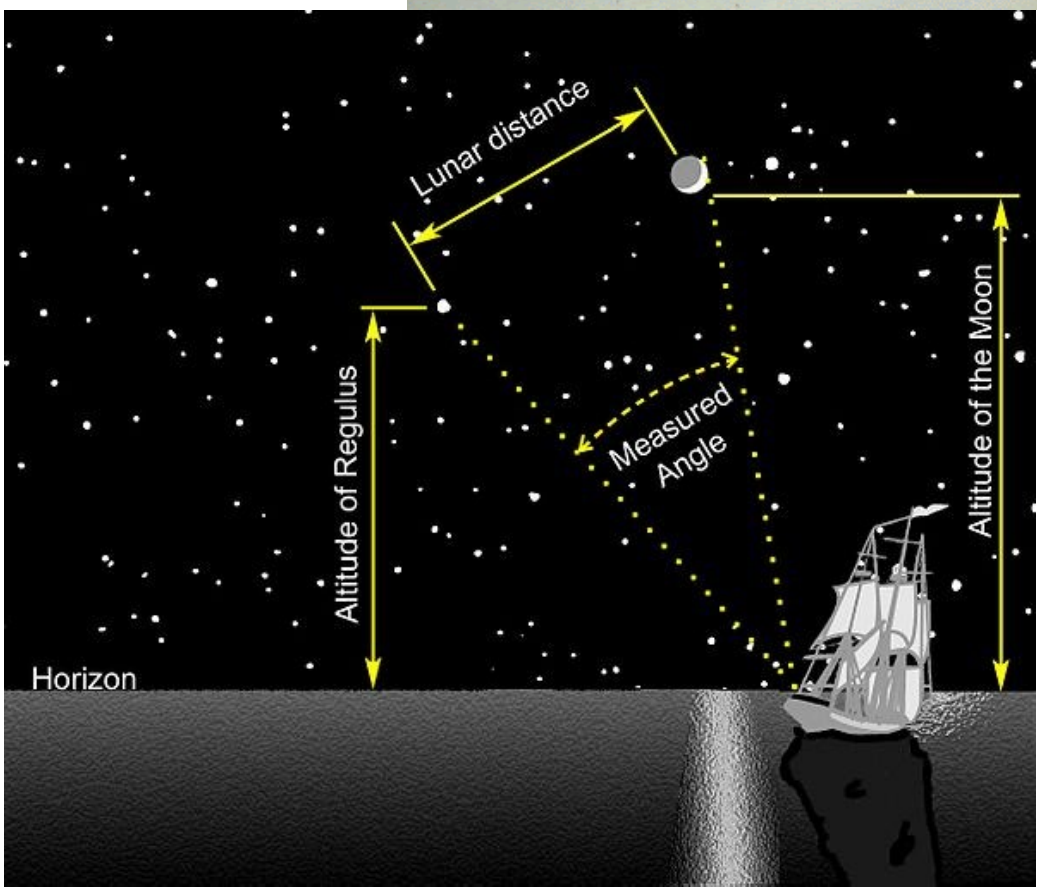
MEAN TIME.

LUNAR DISTANCES.

Day of Month	Star's Name and Position.		Noon.	P.L. of diff.	III^h.	P.L. of diff.	VI^h.	P.L. of diff.	IX^h.	P.L. of diff.
			° ′ ″	″	° ′ ″	″	° ′ ″	″	° ′ ″	″
1	Sun	W.	70 27 7	2866	72 7 3	2861	73 46 58	2855	75 26 35	2850
	Antares	E.	48 30 19	2226	46 43 14	2246	44 56 16	2266	43 9 26	2271
	Mars	E.	30 35 40	2328	48 50 21	2333	47 5 10	2339	45 20 7	2344
	Saturn	E.	92 22 33	2230	90 34 50	2235	88 47 14	2239	86 59 44	2243
2	Sun	W.	83 43 19	2559	85 22 16	2604	87 1 5	2610	88 39 45	2617
	Spica ng	W.	11 45 4	2402	13 28 35	2392	15 12 35	2370	16 56 53	2363
	Mars	E.	36 36 55	2373	34 52 44	2362	33 8 43	2389	31 24 52	2396
	Saturn	E.	78 4 5	2276	76 17 21	2276	74 30 45	2281	72 44 18	2287
	α Aquilæ	E.	89 1 34	2762	87 26 42	2769	85 51 59	2756	84 17 26	2805
	Jupiter	E.	110 57 9	2274	109 10 27	2276	107 23 52	2282	105 37 26	2287
3	Sun	W.	96 50 55	2651	98 28 41	2666	100 6 18	2668	101 43 46	2672
	Spica ng	W.	25 39 37	2363	27 24 5	2366	29 8 28	2370	30 52 46	2375
	Saturn	E.	63 54 14	2318	62 8 41	2324	60 23 17	2331	38 38 3	2338
	α Aquilæ	E.	76 28 5	2865	74 55 1	2861	73 22 18	2857	71 49 35	2915
	Jupiter	E.	96 47 17	2316	95 1 41	2322	93 16 14	2328	91 30 56	2335
4	Sun	W.	109 48 34	2709	111 25 2	2717	113 1 19	2720	114 37 26	2720
	Spica ng	W.	39 32 26	2402	41 15 58	2408	42 59 21	2415	44 42 33	2421
	Saturn	E.	49 54 19	2372	48 10 4	2380	46 26 0	2386	44 42 5	2394
	α Aquilæ	E.	64 14 12	3023	62 44 36	3052	61 15 21	3081	59 46 48	3113
	Jupiter	E.	82 46 50	2269	81 2 31	2275	79 18 21	2282	77 34 22	2289
	Fomalhaut	E.	89 27 29	2838	87 53 50	2845	86 20 21	2852	84 47 4	2864
5	Sun	W.	122 35 20	2774	124 10 22	2762	125 43 12	2751	127 19 52	2800
	Spica ng	W.	53 16 26	2432	54 58 42	2462	56 40 49	2489	58 22 45	2476
	Saturn	E.	36 5 15	2432	34 22 26	2440	32 39 48	2448	30 57 22	2456
	Jupiter	E.	68 57 2	2423	67 14 7	2426	65 31 23	2443	63 48 50	2461
	Fomalhaut	E.	77 4 2	2924	75 32 13	2929	74 0 44	2935	72 29 35	2978
6	Sun	W.	135 10 14	2846	136 43 43	2846	138 16 55	2855	139 50 2	2876
	Spica ng	W.	66 49 53	2514	68 30 47	2522	70 11 30	2530	71 52 1	2538
	Antares	W.	21 18 32	2533	22 58 56	2540	24 39 14	2546	26 19 24	2551
	Jupiter	E.	55 19 0	2433	53 37 39	2303	51 56 36	2312	50 15 34	2322
	Fomalhaut	E.	64 59 33	3074	63 30 52	3100	62 2 42	3125	60 35 3	3154
	α Pegasi	E.	83 20 4	2643	81 42 14	2657	80 4 36	2666	78 27 11	2678
7	Spica ng	W.	80 11 51	2575	81 51 15	2588	83 30 27	2596	85 9 27	2603
	Antares	W.	34 38 6	2585	36 17 21	2593	37 56 25	2601	39 35 19	2609
	Mars	W.	30 49 59	2663	32 26 59	2693	34 3 48	2702	35 40 26	2711
	Jupiter	E.	41 54 19	2373	40 14 47	2383	38 35 31	2396	36 56 31	2409
	Fomalhaut	E.	53 26 9	2393	52 2 31	2372	50 39 43	2422	49 17 49	2472
	α Pegasi	E.	70 23 33	2721	68 47 34	2743	67 11 51	2736	65 36 25	2769
8	Antares	W.	47 46 59	2620	49 24 44	2650	51 2 18	2665	52 39 39	2674
	Mars	W.	43 40 32	2787	45 15 57	2767	46 51 8	2776	48 26 8	2786
	Jupiter	E.	28 46 5	2384	27 9 3	2792	25 32 25	2723	23 56 15	2746
	α Pegasi	E.	57 43 47	2842	56 10 13	2855	54 37 4	2879	53 4 17	2896
	α Arietis	E.	100 0 17	2666	98 22 52	2675	96 45 39	2681	95 8 38	2693
9	Antares	W.	60 43 22	2723	62 19 29	2705	63 55 23	2744	65 31 5	2783
	Mars	W.	56 17 50	2826	57 51 31	2846	59 24 59	2826	60 58 14	2866
	Saturn	W.	17 23 9	2720	18 59 23	2726	20 35 29	2733	22 11 25	2740

The Lunar Distance is the Angle at the centre of the earth between the Moon and the Star when the Moon crosses the Prime Meridian at Greenwich.

If a Navigator measures this angle, (see diagram on right) and corrects the observation for refraction and the earths radius he has an angle that he can compare with the



Nautical Almanac to find Greenwich time at that instant. If the Navigator compares that with his local time taken from Meridian transits he knows his Longitude East or West of Greenwich. These Luna position fixes were a bit inconvenient as the Navigator had to be skilled, and the Moon and Star needed to be visible and you had to have an Almanac. Position fixes were general within 15 Nautical miles. The navigator used dead reckoning between " Lunas" using compass readings and surface speeds using a float (or log) and an hourglass.

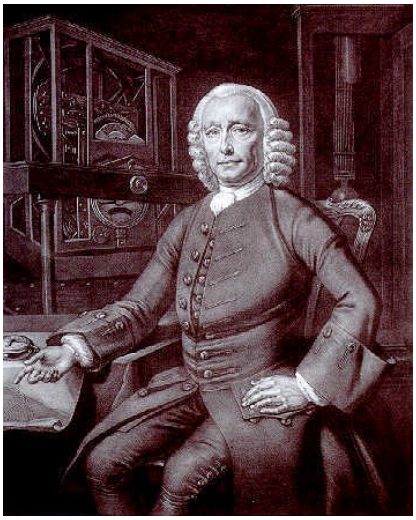
Cook became very proficient with "Lunas" and dead reckoning. He used this method on his first Pacific voyage to Tahiti and during his mapping of New Zealand and the East Coast of Australia.

The Luna distance tables were initially proposed by Tobias Mayer (centre right) in Germany and developed by Maskelyne (right) at the Royal Observatory. Mayer's Wife received a reward of £3000 for her late husbands work. Swiss mathematician Leonard Euler, (lower right) who proposed the method received £300.

On land he determined his position using Jupiter's Moons, which had been in use since Galileo discovered Jupiters Moons with his Telescope in the early 1600's . This method of determining Longitude was too difficult to observe from a ship.

Lunar Distances were in use up to the 1850's when affordable Chronometers became available. Some still use it today as modern programmable calculators do the reductions, you only need a sextant, and it is a back up for GPS failure.

The Moon has a cycle that repeats about every 18 years. So it took some time to gather data for the Almanac which had to have predictions for years ahead. In Cooks time it could take about 3 years to circumnavigate the earth.

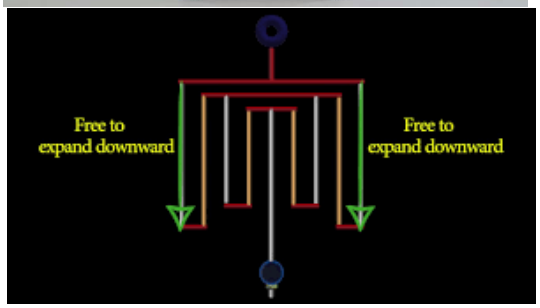


Roughly the moon moves about half a degree per hour against the star background. By coincidence this is about its diameter. It moves slower than the star background.

The most famous outcome of the Board of Longitude trials was John Harrisons (see left picture) development of the Marine Chronometer. *Cont next page*

John Harrison was an English carpenter and amateur clock maker. He built long case Pendulum clocks, mostly using components made of timber, generally Oak and Lignum Vitae. The pendulum Clock was invented in 1656 by Christians Huygens. This design improved the accuracy of clocks to about 15 seconds a day (it was previously about 15 minutes per day). He also improved Telescope design when he invented the Huygens Eyepiece).

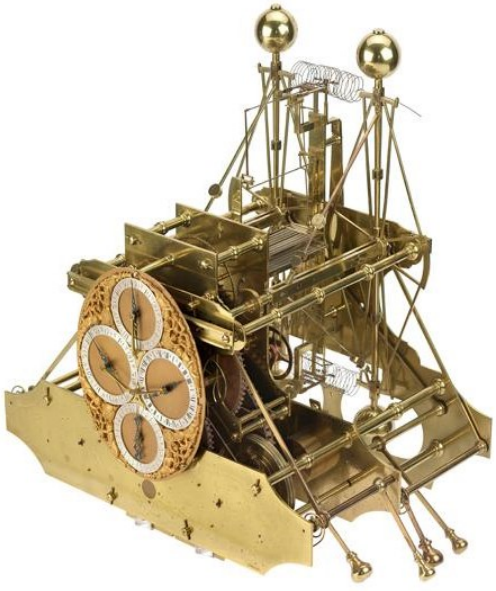
Harrison developed the bimetallic gridiron Pendulum which compensated thermal expansion, and he developed the Bi-Metallic strip to stabilise the escapement wheel, and caged roller bearings to reduce friction. He invented the Grasshopper escapement to reduce the pendulum swing, and developed a design that allowed the clock to be rewound without having to stop the clock or effect its accuracy. These improved the accuracy of his clocks which kept time accurate to a few seconds a month. He is believed to have made the most accurate clocks of the period.



Gridiron Pendulum operation

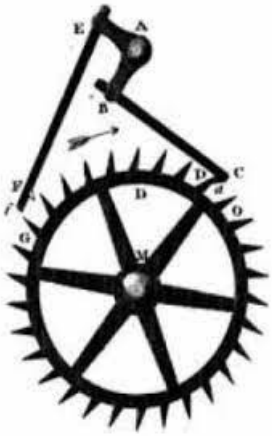
This was quite an achievement for someone whose education, including how to read and write, was self taught. He never went to school or University.

Harrison commenced a design for a clock suitable for use at sea with the ambition of winning the £20,000 Longitude prize.



Harrison H1 Sea Clock

Pendulums are not practical at sea so something new was needed. Two compensating weights were used to counter the movement of the ship at sea. At age 43, he submitted "H1" for trial to Portugal and back in 1736. It performed well and Harrison was granted a £500, £250 of which was payed in advance for an improved model.



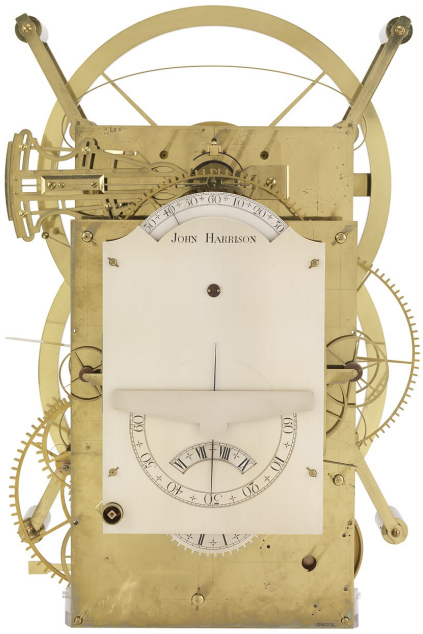
Grasshopper escapement

Models H2 & H3 followed but were not submitted for sea trials. Size weight and complexity were offsetting gains made by development of new components which eliminated manufacturing variations.

Harrison H2

Harrison did an about turn on Clocks and decided that a Pocket Watch would offer a more practical "Sea Watch", He reached an agreement with London Watchmaker John Jeffery to build a watch to his design.

This model is now known as H4 and it was completed in 1759 and submitted to the Longitude Board.



Harrison H3

It's first trip was to Jamaica with a time difference of 5 seconds, (±1 Nautical Mile) and a second trip took it to Barbados with a time difference of 39 seconds (±10 Nautical Miles). The Lunar Distance method was also tested with a difference of ±30 Nautical Miles. Neville Maskelyne, who proposed this method was on the trip, and on his return he was appointed Astronomer Royal and appointed to the Longitude Board which was not a good move for Harrison and his son William as they had great difficulty having their claim recognised by vested interests and being paid,
It was not until 1765 that he received £10,000 pounds on condition that he reveal his design details so that it could be copied.

Harrison No 1 "Sea Watch" H(4)

Harrison went on to build his second and last Sea Watch H5. In an effort to get his final payment King George 3 who had it tested over 10 weeks during which it was accurate to 1/3 of a second per day. With the Kings support he was eventually paid £8750, but neither he nor anyone else was recognised as the Prize winner.

Larcum Kendall, who had worked with Jefferies went on to build a replica of H4 known as K1, and later K2 & K3 as modified designs.

Harrisons first three sea clocks all ran without lubrication and are restored and operational in the Royal Observatory at Greenwich as is H4 which requires lubrication and is non operational. H5 is held at the Science Museum in London.

Kendall's K1 was the first Marine Chronometer to go to sea. It was completed in 1770 and it was used by Captain Cook on his second voyage the Pacific, 1772 to 1775 in HMS Resolution. He checked the accuracy from time to time with ground based Astronomic observations. It provided a vast improvement in position fixing for charts with longitude available very quickly as K1 kept Greenwich Mean time.He recorded that it "exceeded the expectations of its most zealous advocate"

K1 was on his last Pacific voyage 1776 to 1780. A spring broke and it was returned to Kendal who repaired it. K1 then joined HMS Sirius and arrived in Australia with the First Fleet, Sirius was wrecked on Norfolk Island and K1 was transferred to HMS Supply and used on voyages to Batavia for more supplies for the Sydney Colony.

K1 returned to England and in 1793 it went to the West Indies and was used in the Mediterranean and near Portugal at the Battle of Cape St Vincent by Admiral Sir John Jervis. It was retired in 1802.

The Battle of Cape St Vincent

K1 cost £450 new, plus a £50 bonus in 1770, the cost was a third the price of a ship.

K2 (1772) was a design modified by Kendall. It had slightly less precision but it only cost £200. K2 was used in the early explorations to find a North West passage across the top of Canada. It was later assigned to Captain William Bligh on the HMS Bounty. The Mutineers took it to Pitcairn Island where it was later purchased and eventually arrived in Britain in 1840 and it is now in the Maritime Museum at Greenwich.

K3 (1774) was a further modified version (it cost £100) with a further loss of precision. It was used by Cook on his third Pacific voyage, and later by George Vancouver in his survey of the South West Coast of Australia near Albany and the North America. It was later given to Mathew Flinders, but he was by then in 1801 using later designs.

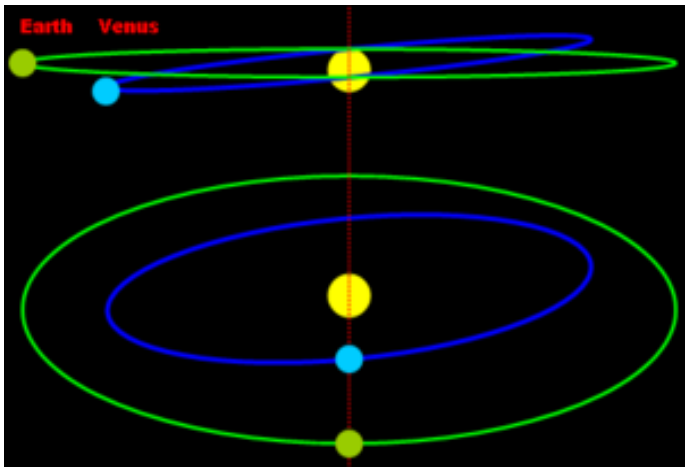
K3 is now also at Greenwich. K1,2 & 3 all came to Australia for the Bicentenary exhibition in 1988 and K2 was here in 1960 for a Bligh exhibition.

Both Bligh and Vancouver served on HMS Resulution with Cook and became excellent Navigators.

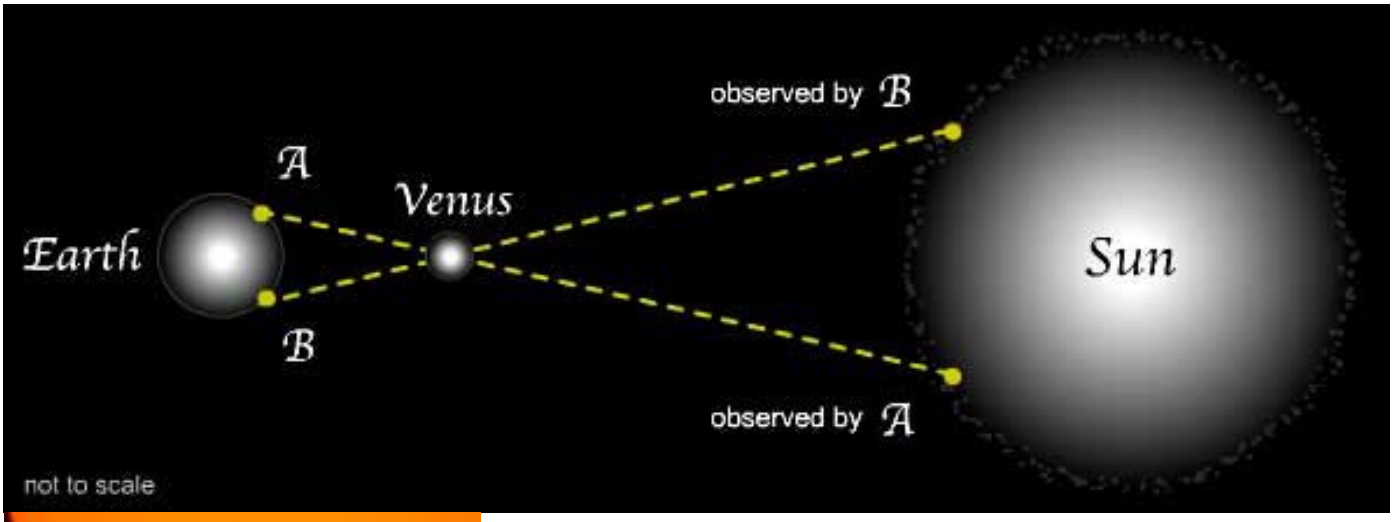
Cook's voyages to the Pacific started out as an expedition to observe the Transit of Venus from the recently discovered island of Tahiti. It seems like an enormous trip to watch a Transit but there was purpose in it.

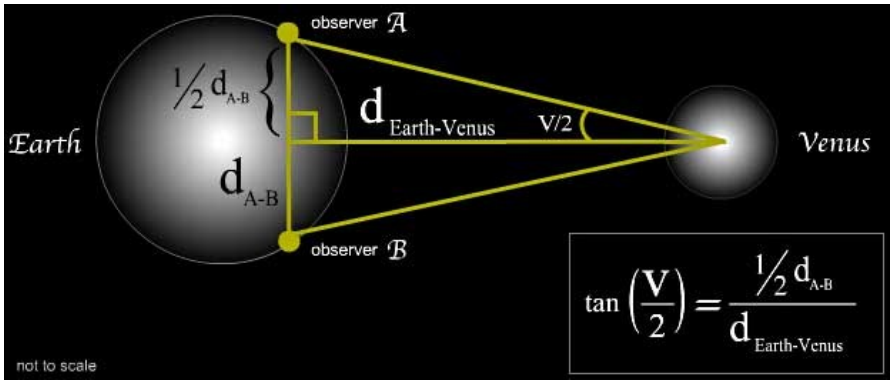
Astronomer Kepler in 1619 had worked out the relative positions of the Sun and the known Planets, the thing that they did not know was scale. The Transit offered an opportunity to determine the "Astronomical Unit (AU)", that is the distance from the earth to the Sun, and hence the actual distance apart of the Planets.

The idea for using transits of Venus or Mercury was suggested by James Gregory in 1663. In 1716 Sir Edmund Halley of the Royal Society outlined how and when this might be done using Venus, in 1761 or 1769. Halley died in 1742 but the idea did not. The next opportunity would not occur until 1874. The pattern repeats every 243 years with 4 transits at uneven periods.



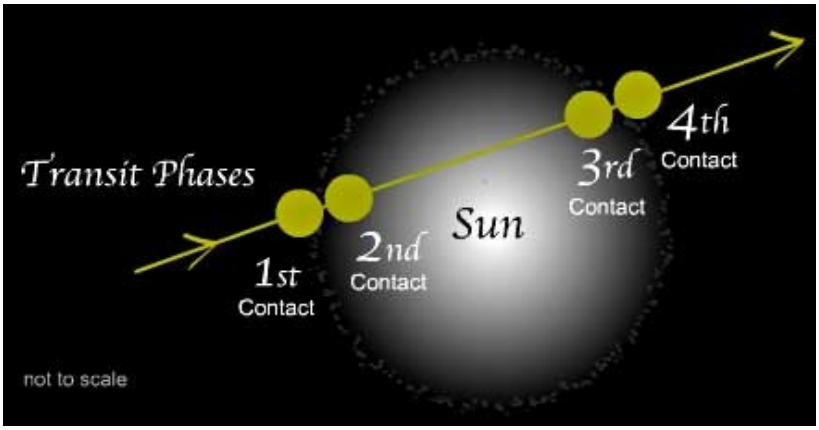
Earth, Venus orbits around the Sun



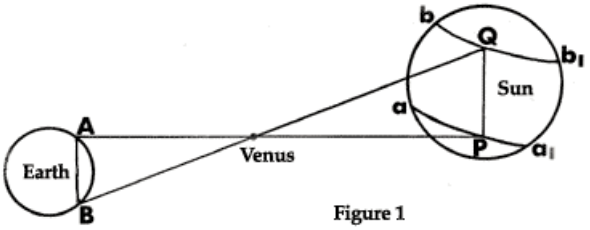


Attempts were made in 1761 but weather obscured the event, so June 1769 was going to be must. The idea was to observe the moment that the edge of the sun and the edge of Venus touched as it passed across the Sun. By observing these contacts from different points on the earths surface as far apart as possible, the chord distance be-

tween observer A and observer B could be calculated Amazingly the Circumference (and hence diameter) had been determined by the Greek Astronomer Eratstheries reasonably well in 200BC. By 1617 Snellies had a diameter of about 12,307OK (versus an average of 12,742KM today). Observations were made in West Mexico and Norway as well as Tahiti. There were other observations from various places including those made by King George 3 in England.



Observations were made for the time of each of the four contact points using a long case pendulum clock. The same observations were made from each of the points a few seconds of time apart around the world to derive the parallax angle at Venus at the instant that centre of Venus was on a line between the Centres of the Earth and the Sun.



Halley's proposal for Venus Transit

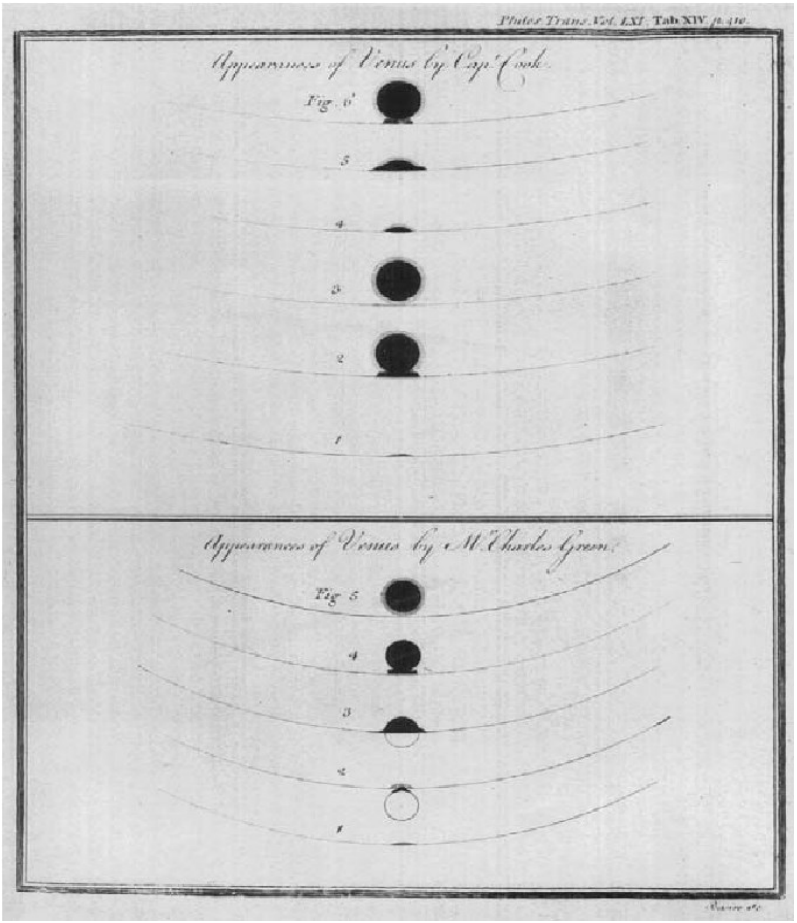
This small angle is about 10 seconds of arc.

From Kepplers third law the distance from the Earth to the Venus is .28 of the distance from the Earth to the Sun. (the AU).

In spite of some unexpected observational problems due to the "Black Drop Effect", they came up with a mean distance for the AU of 93,726,900 miles against the current figure of 92,955,000 miles. (149,597,000KM). Considering what they had to work with this was an incredible result.

Observations for the 1874 & 1882 transit of Venus improved the distance to 149,590,000KM using much improved equipment.

The current figure derived from Satalites and Radar is thought to be within 30 metres.



Recordings from two observers in Tahiti

The most recent transit of Venus were in 2004 and 2012, and the next pair are due in 2117 and 2125.

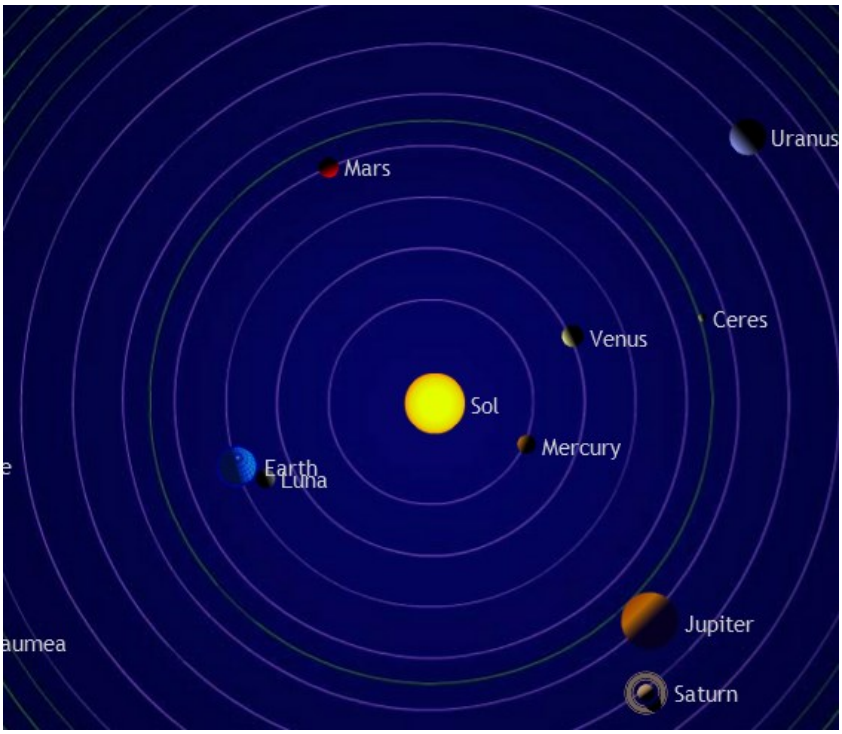
So much for the reason for the trip. The Royal Society, the Royal Navy and King George 3 all supported the project and special equipment and instruments were ordered. Cook was experienced and well qualified to lead the trip.

The trip included staff from the Royal Observatory, and Joseph Banks, at his own expense, joined in with a team of artists and botanists to make it a trip for science.

Cook (now promoted from Master to Captain of HMB Endeavour) did not have a Chronometer on this trip, H4 was deemed to valuable to risk at sea and K1 was on sea trials. Captain Cook used his "Lunas" at sea but on Tahiti (and other places, including Cooktown) used Jupiter's Moons to establish Longitude.

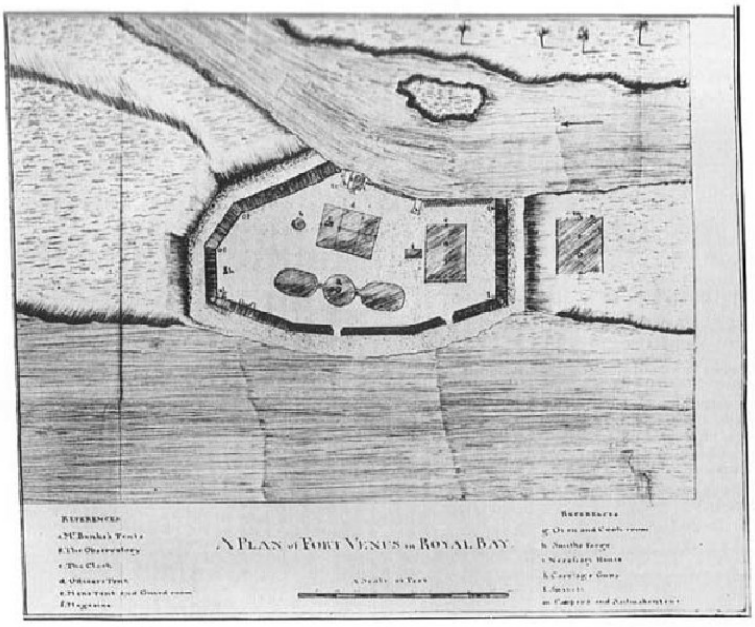
Galileo had first seen these Moons with his telescope, and recognised their potential to determine time and Longitude. As it turned out it was difficult to observe these moons from a ship at sea, but it was ideal to use on land where they gave much more precise result. (a comparison of Cooks position at Cooktown in 1770 is within 2 nautical miles of todays figure)

The Astronomer Royal, Neville Maskelyne, included data on Jupiter's Moons (above right) in the first Nautical Almanac published in 1767. 1000 copies were printed under a new Longitude Act The prediction period was only months ahead in these early editions. Cook headed off with the first two editions which covered the Venus Transit, and got him to Cooktown in Queensland in1770. Later editions carried predictions up to 10 years ahead.

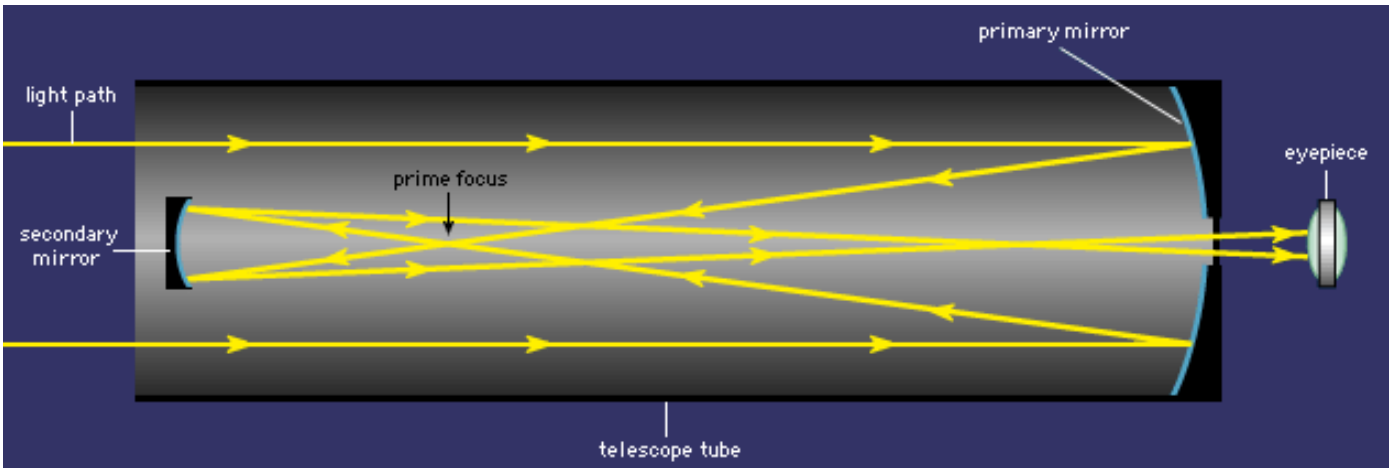


Unlike the Sun and Moon the distance between the Earth and Jupiter, depending on where they are on their orbits, varied much more than between the Earth and the Moon or Sun. At the time they were not aware that of the velocity of light, The vast change in position that gave time variations up to 10 minutes of time. These can be corrected now, but they were an unknown in the 1700s.

In order to minimise the chance that clouds would obscure their view of the Venus Transit from Tahiti there were 3 observation stations, the main one was at Fort Venus, a second was on the other (East) side of the Tahati and a third was on neighbouring Moorea Island. This required 3 sets of instruments. The main telescope was a Gregorian Reflector Telescope made by James Short. These telescopes had been designed in 1663 by Scottish Astronomer/Mathematician James Gregory but were not built until 1673. These reflecting telescopes used two con-



Plan of Fort Venus Tahiti



cave metal reflectors made of Speculum, an alloy of Copper and Tin which could be highly polished. Reflectors had minimum chromatic distortion but they only reflected 66% of the light. They also tarnished and needed repolishing which risked distorting the surface.

However their folded optics allowed for a short overall length and they had an erect image.

The picture on the right shows a typical unit and,

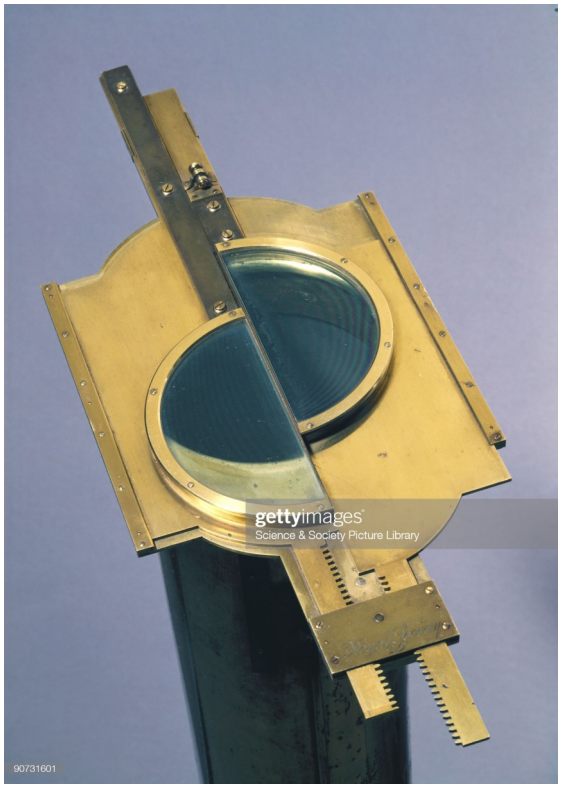
separately an objective split image micrometre or Heliometer, originally used to measure the Suns apparent diameter which varies over the year.

These micrometres evolved until a practical unit was developed by Telescope maker Peter Dolland in 1754. These micrometres were fitted to two of Cooks Telescopes on Tahiti.

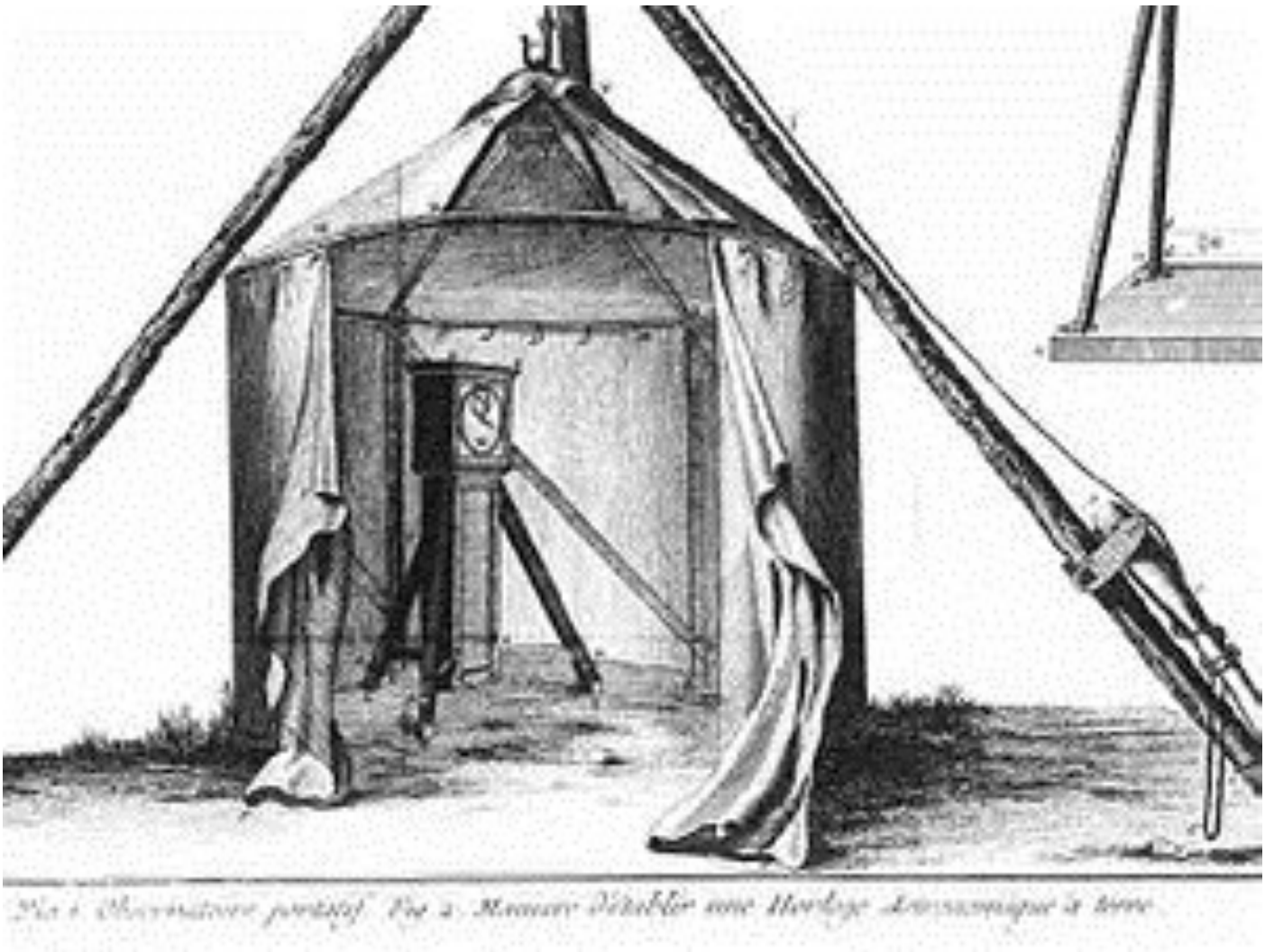
The picture below, taken at a later time shows a typical set up as used by Cook at Fort Venus.

The Refracting (ie Lenses) telescope (46" focal length) on the tripod is fitted with an aiming telescope and a "Quadrant Quarter circle scale" for measuring Altitudes.

The Reflecting telescope is mounted on a Barrel of wet sand for Stability. It has a focal length of 24".



The observing tent in the background is similar to those used by Cooks teams in Tahiti



The above sketch shows one of the observing tents with a Long Case clock made by Shelton and fitted with a Grid Iron pendulum as described previously. The Pendulum was set to the length used at Greenwich. For stability, the clock was mounded in a timber frame which had been made in England. The frame was set in the ground to a depth which just allowed the pendulum door to open. A 12 inch air gap was maintained around the clock base.

A "Journeyman Clock??" and the 12" radius Astronomical Quadrant were setup at the entrance to the tent. The quadrant (made by Bird) was set on a barrel filled with wet sand. The Quadrant used a plumbline as a reference. The Quadrant had been repaired after being stolen and recovered damaged.

21 Meridian Solar transits and 27 Star observations were used to establish latitude. Cook also made 57 Luna Distance observations with his Hadley Sextant (made by Jess Ramsden, who had also invented machinery to engine divide circle divisions). These observations gave a Latitude of 17° 29' 15"S and 149° 36' 36"W.

Cook also observed Jupiter's Moons and which gave a Longitude of 149° 32' 30"W. The journal recorded 17°29'S & 149°30'W. Later observations agreed with the Latitude and used 149°29'W.

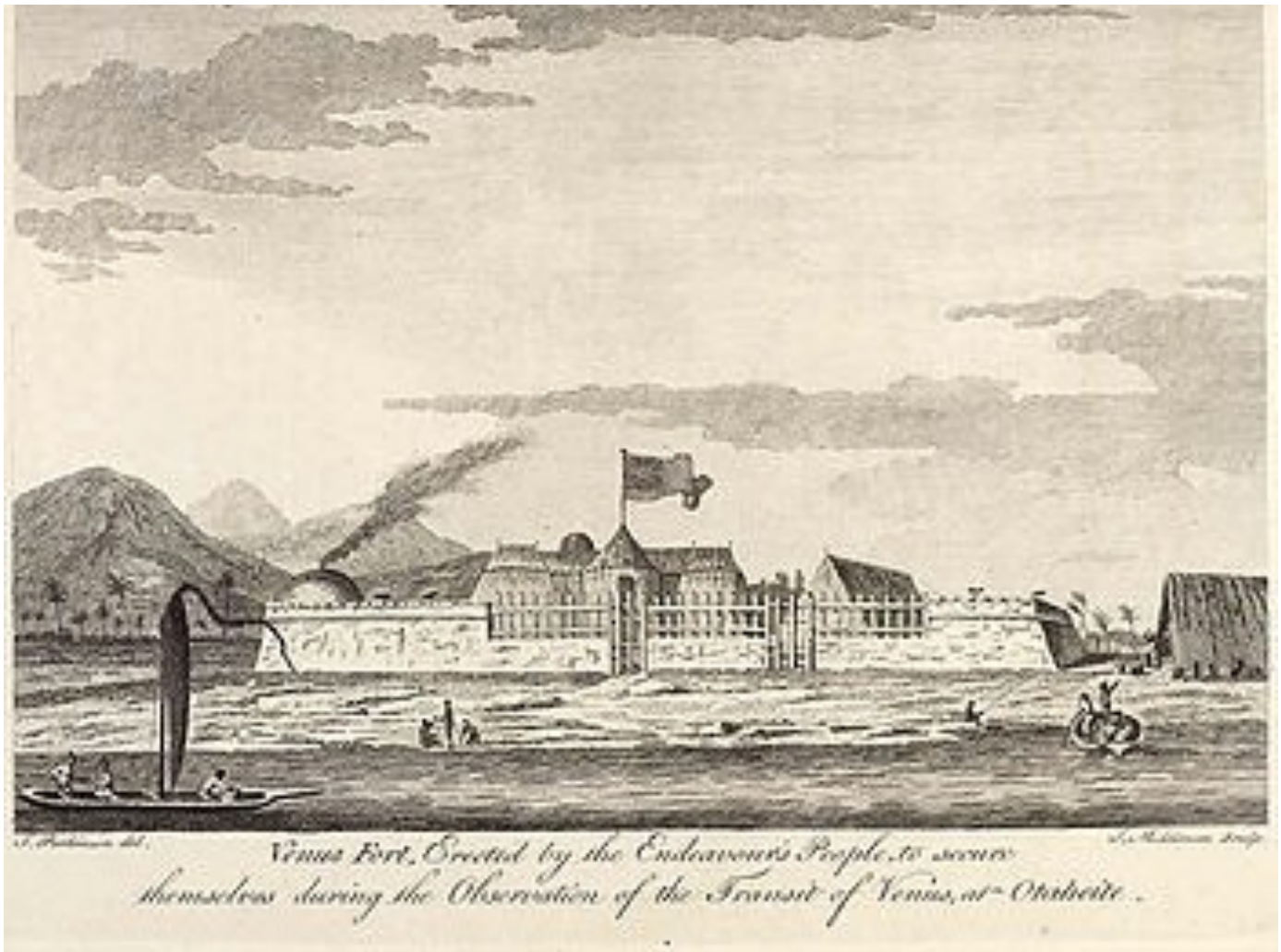
These observations were independent of the observations made on June 3 1869 for

the Transit of Venus for which 3 telescopes were used at Fort Venus.

Two 140 magnification reflector telescopes (24" focal length) made by James Short : one of which was fitted with an Objective Micrometre, were used by Cook and Green (from the Royal Observatory). Dr. Solander used a more powerful reflector telescope with a 36" Focal length. The transit observations were made about 9 20/30AM on June 3 1769. The Temperature as recorded from a thermometer near the clock was an uncomfortable 119° F. The sky was cloudless at all 3 observation points. Green used the Dolland objective end micrometre to measure the diameters of Venus and the Sun midway through the observations,

The telescopes used by Hicks to the East and John Gore on Moorea Island used Telescopes with lower magnifying power. The unexplained "Black Drop Effect" now considered to have been caused by upper atmospheric disturbance was observed at the time as a fuzzy penumbra about 1/8 of the diameter of Venus. This caused some uncertainty in the results which limited the accuracy of the final calculation of the Astronomical Unit. Observations were also made for magnet dip and for gravity variations with Greenwich which was achieved by the clock whose pendulum was set tho the length used in Greenwich with a clock whose pendulum was set to local length.

Fort Venus, on Matavai Bay had over 50 tents inside its earth wall perimeter as seen below on the sketch by Joseph Banks Artist Sydney Parkinson.



Venus Fort, Erected by the Endeavour's People to secure themselves during the Observation of the Transit of Venus, at Otaheite.

Thanks to anyone who made it this far, Ed. After the Transit observations were completed Cook and the Endeavour went on to search for the Mythical South land. They included a circumnavigation of the North and South Islands of New Zealand and then they travelled up and charted the East Coast of Australia. Naturalist Joseph Banks and his team collected a huge collection of specimens before they returned back to England. Cook would have two more Pacific Tours, which would include the Arctic and Antarctic, on which he would use the Chronometers described previously.

Cooks abilities brought together much of the discovery of the age of enlightenment and developed navigation to a point which vastly improved the safety of sea travel. The Chronometer, Sextant, Charts and the Nautical Almanac all came into common use and remained as the backbone of navigation until radio and electronics arrived in the 1900's. It is not hard to compare his impact on the world of his time with the challenge of space travel. Time recording is now accurate to seconds in millions of years and the Global Positioning System (GPS) makes navigation transparent to all.

This story started out to bring some different collections to mind. Cooks 250 anniversary of the first mapping of Australia's East Coast (last Year) was the start, finding how he fitted into everything else was a surprise and his accomplishments are an inspiration to all. As fortune has it many of the instruments have survived in collections around the world, some of it in Australia.

Much has been written about Captain Cook and his endeavours and there is a lot of information available on the net. Thanks to anyone who made it this far, Ed.

Captain Cooks Plane Table Calibrated Edge Clamp Frame in the National Museum of Australia

Arnold, who also shared in the Longitude prize made a Chronometer paid for by Banks for Cook to use on his second trip. Cooks Ramsden Sextant and quadrant.

Wooden Boat? Even the bearings are wood!

Lignum Vitae

By Mark Dye

Wood is arguably the oldest bearing material in use since the invention of the wheel. Bearings made of a dense Caribbean rainforest timber *lignum vitae* bore the rudder shafts of ships in the Golden Age of sail. When the steamship rose to power the propeller shaft spun in lignum vitae bearings too. Despite Isaac Babbits invention of a revolutionary metal bearing alloy in 1839, wood remained popular as a rugged material for low speed, low load applications into the 1950's.

The first record of lignum vitae came when Christopher Columbus returned to Spain with lignum vitae for use in mills and equipment. Thomas Edison first specified lignum vitae bearings in the Appleton Wisconsin Hydro plant in 1882, which are still in service today. In 1900 approximately 70% of the worlds power was Hydro power, 100% of which ran on lignum vitae bearings. Some bearings have been in service for 60 years without being adjusted or replaced,

The first significant shaft driven propeller was installed on the SS Great Britain, launched in 1843, and although shaft bearings at this time were largely bronze greased with tallow, they were beset with problems. English Marine Engineer, John Penn (1805-1878) (below right) solved the problem in 1854. when he introduced the first water lubricated propeller shaft bearings. Penn's success came after an application for this novel approach to propeller shaft lubrication on Brunel's much larger SS Great Eastern. His innovations in engine and propeller systems, led his firm to be the major supplier to the Royal Navy as it made the transition from sail to steam power. He later became the President of the Institution of Mechanical Engineers on two occasions.

Penn's approach formed the basis of an Institute of Mechanical Engineers technical paper published in the February 1856 edition of The Engineer, where he explored the problems encountered with the brass bearings aboard the screw steamers Himalaya and Malacca. He went on to reveal the outcome of a series of experiments using an altogether different material.

The material was lignum vitae, a very dense oily wood native to the Caribbean and noted for its strength and toughness. It was the best material available for use as a stern tube bearing, and for the next 100 years water lubricated Lignum Vitae propeller shaft bearings were commonplace. The first nuclear submarine, the Nautilus used lignum vitae stern tube bearings.

The reason lignum vita wears so little?

It is the hardest densest wood in the world: coupled with about 25% of its weight as Gusaic Gum embedded in the wood, which comes up when heated by load, and glazes the bearing surface. When combined with water it becomes more slippery than Teflon. The wood also has a interwoven structure allowing the material to withstand working loads up to 12,000 lbs per square inch, with the ability to absorb grit and keep it away from the metal shaft.

Lignum Vitae stern tube strips held in place by brass strips.

The development in 1948, by Hamburg's Blohm+Voss, of the oil lip seal, enabled oil lubrication with White Metal bearings supporting the propeller shaft. The seal technology created a controlled environment for the bearings. Extending shaft withdrawal and inspection periods and increased bearing life spans. As demand for reliability increased. More complex oil filled systems were employed leading to class societies (such as Lloyds) giving extended shaft withdrawal periods of up to 15 years; a major benefit to shipowners. But in those days of course environmental sustainability was not of great concern, and the oil sheen that covered Ports and Harbours was considered normal operational practice.

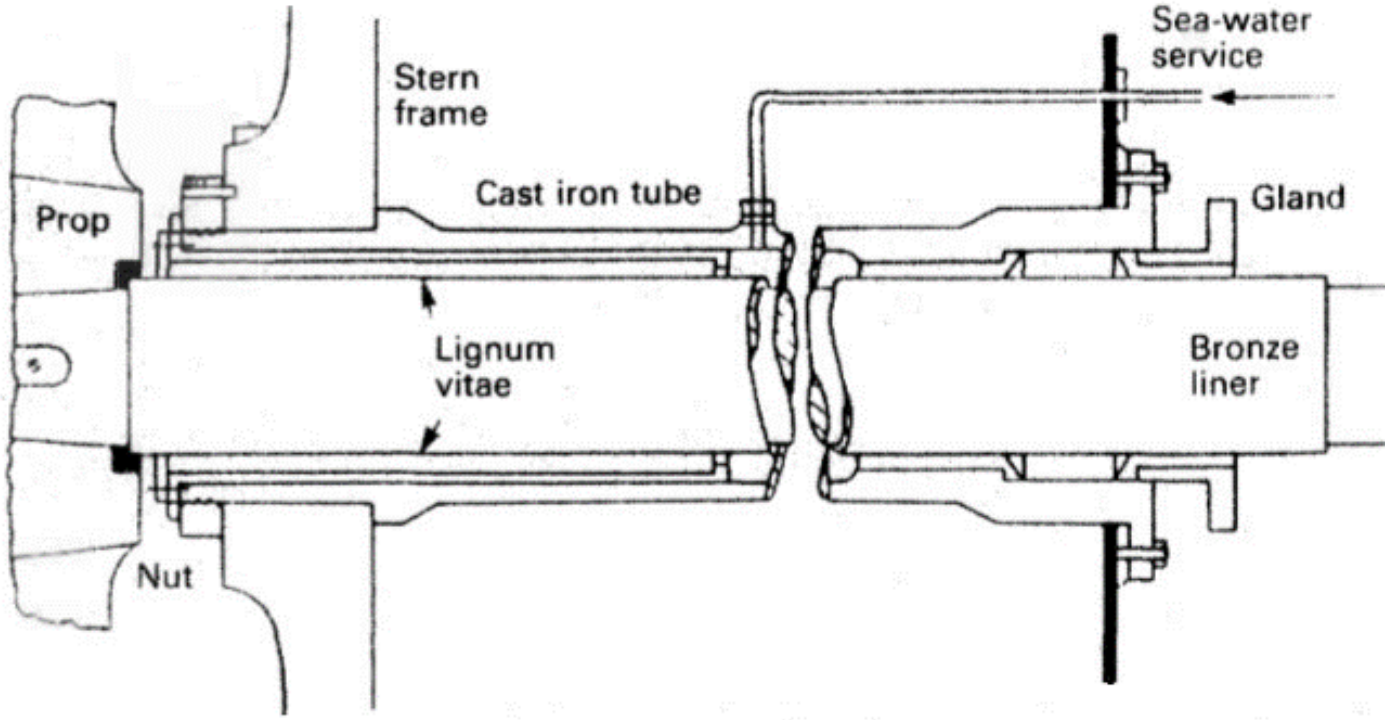
Although oil seals were adopted by most commercial vessels, seawater lubricated bearings continued to be used by most Navies for safety reasons and for their non catastrophic failure mode: if a Naval ship took a torpedo hit and the shaft seals were damaged, all the oil would leak out and the shaft would seize. With seawater lubricated bearings, they still had propulsion capability.

Leather seals that were developed in the 1920's, with the first patent issued in 1927 for a seal composed of rawhide packed between two metal rings with the intention of keeping lubrication in, and contaminants out. Later a garter spring was added to increase the sealing force against the shaft face. In 1936 Blohm+Voss began experimenting with bearings and lip sealing rings for propeller shafts, with the successful in-

troduction of their Simplex Sterntube seal in 1948. In 1957, it was observed that the lubricating film at the contacting surface between the Elastomer lip and the shaft, is neither fluid nor dry, but in boundary lubrication with a mixture of both, This led to the development of the elastic polymer materials to support this revelation leading to the modern seals we see today.

I can recall from the old ships that I have worked on, an oil header tank located on the top of the aft bulkhead in the engine room which had to be filled with a heavy oil to give a positive head on the stern tube against the pressure from the incoming sea. (My own boat uses grease, forced into the stern tube.)

With modern environmental considerations.oil pollution has now come under increasing scrutiny, with regulators making changes to their rules. The US EPA, for example, made changes to the Vessel General Permit requirements in 2013 and the new IMO code states: “Any discharge into the sea of oil or oily mixtures from any ship shall be prohibited.” And while Environmentally Acceptable Lubricants (EAL’s) EAL’s are part of the solution, all EAL’s are are typically 3-5 times mor expensive than mineral pils and their performance reliability is unproven. This is leading many shipowners to



return to water as a clean and cost effective way to comply.

So a great new revolution is underway with a great new concept, water lubricated bearings! Although the concept isn’t new, instead of wood there is a push towards plastics and other fancy polymer bearings using a lubricant that is both free, and environmentally compatable with its surroundings; sea water. And can something as agricultural as wood compete in the modern world? With so many positive stories I have heard about Lignum Vitae water lubricated bearings, I wonder why we ever went away from them? A hydro turbine in Mississippi USA has been in operation for 70 years

without even the need to adjust the original bearings! The Ameron-Osage power plant in Missouri USA, built in 1931 and originally fitted with L+V bearings which were later replaced with composite bearings has recently returned to the original L+V Bearing material.

I remember in the late 1990's the Marine Board Victoria insisted on having the propeller shaft of the old Steamtug Wattle pulled for her 12 yearly inspection.

Fitted with Lignum Vitae bearings since 1933, the propeller shaft was checked for

The Author fitting the propeller to the Wattle

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clearance when returned. A jack applied a set pressure under the shaft and the displacement was measured as half of the specified maximum allowable clearance.

Lignum Vitae forests in the Caribbean were left so depleted after WW2 that the wood became endangered. With the switch to other bearing materials, the forests have made a come back, and so too has the thinking of water lubricated bearings because of the pollution issues faced by shipowners when modern environmental standards are applied to their operation. Even though modern polymer technology seems to be the preferred option, lignum vitae is also making a comeback, with new companies in the USA pushing for a revival of the old technology of wood bearings for hydro turbines and ship propeller shafts.

LOCKINGTON'S VINTAGE RALLY
24 & 25 APRIL, 2021

HERITAGE COMPLEX' 23rd RALLY

Bring your Vintage Tractors, Engines, Trucks, Motorcycles, Cars, Farm Machinery, Your Pride & Joys, etc.

Saturday: 9.00AM - 4.00PM

Sunday: 10.30AM to 4.00PM

(No activity please until after the 9.00am ANZAC service at Lockington Community Centre, to which you are invited, preceded by 8.45am march through town)

Entry fee per person: $10
Primary aged children free
(when accompanied by an adult).

Free entry for Exhibitors to rally - Proof of Insurance, regardless with whom, must be shown or entry could be denied.

(Dogs on leash only on rally property please).

NB: THIS IS A COVID SAFE EVENT

LOCKINGTON & DISTRICT LIVING HERITAGE COMPLEX INC.
2-10 Market Street, LOCKINGTON, VIC., 3563
Phone/Fax: 03 5486 2515
Website - www.lockingtonvic.com.au

Also in town

LOCKINGTON SCARECROW COMPETITION AND DISPLAY

Terri Hateley,
Coordinator
Tel: 0499 170 329
Email:
nhldbc@gmail.com

RALLY CONTACTS:

Lindsay Govett
0419 527 661

Joe Chappel 5486 2226

Beryl Marshall (Secretary)
0428 862 353
Email: lbmarshall@bigpond.com

CATERING:
Saturday & Sunday

STALL SITES AVAILABLE
Contact: Lorry Forster
Tel: 5486 2563

ACCOMMODATION

Camping, Showering & Toilet Facilities available next to rally ground. Phone: 0447 787 581.
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Timetable March to December 2021

The timetable below shows all currently planned open days. Please note that all dates are subject to change, potentially at short notice. More information can be found below. Please check here before you travel or by ringing our number for the latest information.

GROUP BOOKINGS AND INFORMATION 0427 509 988

Trains depart frequently between 10.00am and 3.45pm.

Steam or Diesel Train operates to 3.00pm, then petrol hauled service

Subject to change without notice due to fire regulations, volunteer unavailability, Covid-19 restrictions or other unforeseen events. Please check here or ring our number for up to date information before travelling from afar.

Month	Days	Date	Train	Remarks
March	Sunday	28		CLOSED
April	Saturday	3	Steam	Easter Gala
	Sunday	4	Steam	Easter Gala
	Saturday	10	Petrol	Alexandra Market
	Sunday	11		CLOSED
	Sunday	25		CLOSED
May	Saturday	8	Petrol	Alexandra 'Winter' Market
	Sunday	9	Steam	Historic Tractor display
	Sunday	23	Diesel	Malcolm Moore locomotive display
June	Sunday	13	Steam	Queen's Birthday Weekend
-	Sunday	27	Steam	Steam into Winter at the Timber Tramway
July	Sunday	11	Diesel	
	Sunday	25	Diesel	Kelly & Lewis Diesel Loco's Celebration Day (1935/36)
August	Sunday	8	Steam	
	Sunday	22	Diesel	
September	Saturday	11	Steam	Alexandra 'Spring' Market
	Sunday	12	Petrol	Heritage Machinery Festival
	Sunday	26	Diesel	Historic Photographic Exhibition
October	Saturday	9	Petrol	Alexandra Market
	Sunday	10	Steam	
	Sunday	24	Diesel	Volunteers Memorial Garden display
November	Saturday	13	Petrol	Alexandra Market and Alexandra Spring Show
	Sunday	14	Steam	
	Sunday	28	Diesel	
December	Saturday	11	Petrol	Alexandra 'Christmas' Market
	Sunday	12	Steam	Christmas specials

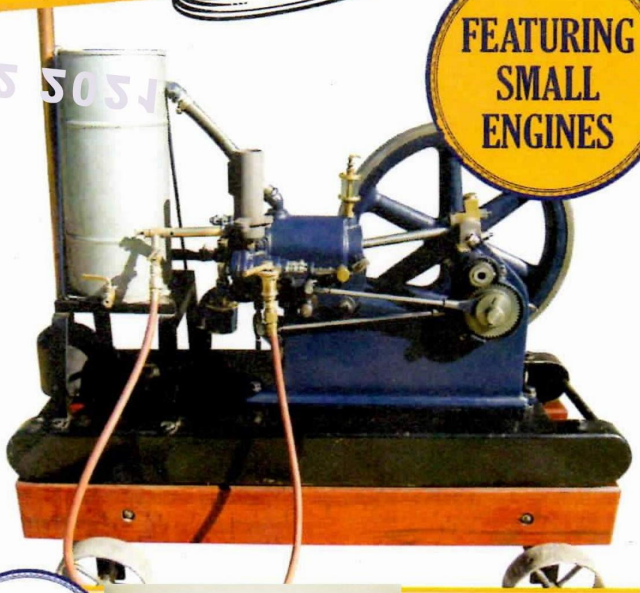
ALEXANDRA TIMBER TRAMWAY AND MUSEUM 0427 509 988

LAKE GOLDSMITH

117th STEAM AND VINTAGE RALLY

May 1 & 2 2021

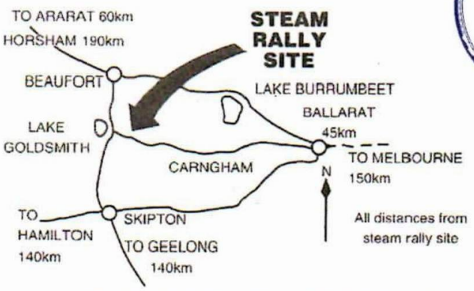
FEATURING SMALL ENGINES



Regular attractions include:

- 65 Display Sheds
- Steam & Oil Engines
- Steam Powered Shovels & Saw Mill
- Displays of Earthmoving, Cars, Motorcycles, Tractors & Trucks
- Radio Controlled Model Boats
- Attractions for Ladies & Children
- Blacksmithing
- Threshing
- On-site Catering

CAMPING FOR EXHIBITORS ONLY | FREE, NON-POWERED



VIC ROADS DIRECTORY MAP 75 G5 2.4

ADDITIONAL FEATURE →

Horse Drawn & Horse Powered Machinery & Gear

ADMISSION PRICE: • Adults $15.00 • Children aged 5-16 $5.00 • Exhibitors and Children under 5 free

For rally information contact: Trevor Ph: 0407 539 041
or Graeme Ph: (03) 9723 3310 Mob: 0418 388 149

www.lakegoldsmithsteamrally.org.au • PO Box 21 Beaufort 3373

Please check our website above for any possible COVID restrictions on the day.

Ron & Linda Harris hosted another Classic event in Beaufort. Next up Queens B'day

Beaufort 2020

LAKE GOLDSMITH GOODS SHED MUSEUM & VISITOR CENTRE

Queen's Birthday

Sat June 6 & Sun June 7

9AM to 4PM

More information in the April Magazine or at www.lakegoldsmithsteamrally.org
or contact Ron on Ph 0429 156 716 or email *ronatip51@gmail.com*

THE THIRD YEAR OF STEAM IN BEAUFORT FOR ALL TO ENJOY.