Sun – Moon – Jupiter observations, 9 Feb 2011

Averages of altitudes and distances:

WT	$00^h02^m56^s$	Sun LL	11°19,4’
	$01^h42^m36^s$	Moon LL	57°19,2’
	$01^h49^m16^s$	Jupiter	31°42,4’
	$02^h07^m17^s$	Jupiter – Moon near	29°38,4’

The moon’s altitude changes -18,4’/04^m32^s; during the time interval until the lunar observation of 24^m41^s this gives -18,4’ x $1481^s/272^s$, assuming no calculator is available:

1481	log	3,171
272	log	2,435
		0,736
18,4’	log	1,265
	log	2,001

This log equals 100’ = 1°40’, resulting in a moon altitude at the time of the lunar of 55°39’.

The same calculation for Jupiter, -31,1’/03^m57^s, during 18^m01^s gives -31,1’ x $1081^s/237^s$

1081	log	3,034
237	log	2,375
		0,659
31,1’	log	1,493
	log	2,152

equaling 142’ = 2°22’, resulting in Jupiter’s altitude at the time of lunar 29°20’.

Using Stark’s tables with above extrapolated altitudes gives a cleared lunar distance of 30°19,7’ corresponding to

GMT	$18^h08^m09^s$
WT	$02^h07^m17^s$
WE_{GMT}	$16^h00^m52^s$

Details of the lunar clearing are given on the last page.

The sextant altitude of the Sun corrected according to the tables in NA gives an observed altitude of 11°27,0’. With an assumed latitude of 47° N (Nantes area), this altitude is used to find the local hour angle and the azimuth. Declination as per NA at GMT $16^h03^m48^s$ of 14°38,3’ S.

Latitude	47°	log sec	0,16622		log sec 0,16622
Polar distance	104°38,3’	log cosec	0,01433	hav 0,62636	
Altitude	11°27,0’				log sec 0,00873
sum	162°65,3’				
half	81°32,7’	log cos	9,16741		
Altitude	11°27,0’				
remainder	70°05,7’	log sin	9,97325		
		log hav	9,32121		
Latitude-Alt.	35°33’			hav 0,09320	
				hav 0,53316	log hav 9,72686
					log hav 9,90181

The log hav of 9,32121 gives LHA 54°28,9’. This local hour angle corresponds to local apparent time

LAT	$3^h37^m56^s$ pm
	12^h
EoT	14^m12^s
LMT	$15^h52^m08^s$
GMT	$16^h03^m48^s$
time diff	11^m40^s which equals a longitude of 2°55’ W.

The log hav of 9,90181 gives the sun’s azimuth N 127° W, or 233°. Now we have a sun LOP passing through 47° N 2°55’ W at right angle to the azimuth, or 143°, on (or near) which the observer was located. Crossing with a moon LOP will give the place.

Correcting the sextant altitude of the moon observation as per tables in NA gives an observed altitude of 57°58,9’.

WT	$01^h42^m36^s$				
WE_{GMT}	$16^h00^m52^s$				
GMT	$17^h43^m28^s$				
	5°24,0’ (13,6’)				
	10°22,3’				
	9,9’				
GHA	15°56,2’				
Longitude	2°55’				
LHA	13°01,2’	log hav	8,10905		
Latitude	47°	log cos	9,83378		
	16°33,3’ (9,1’)				
	6,6’				
Declination	16°39,9’	log cos	9,98136		
		log hav	7,92419	hav	0,00840
Latitude-Dec.	30°20,1’			hav	0,06846
				hav	0,07686

This last haversine gives the zenith distance, but with a properly arranged table the altitude can be read directly as

Altitude calc.	57°48,6’
Altitude obs.	57°58,9’
intercept	10,3’ towards

The azimuth is easily found with the use of ABC-tables:

A	4,64	
B	-1,33	
C	3,31	giving the azimuth as 204°

Now it remains to plot the two LOPs, or to calculate the fix using a traverse table:

We have a right-angled triangle with one corner at the assumed latitude 47° N and the calculated longitude 2°55’ W. From this point we have the intercept of 10,3’ in direction 204°, then a right angle, then a side with unknown length in direction 204°-90°=114°, crossing the sun LOP (hypotenuse) that starts in the given position and runs in direction 143°. The crossing angle is found to be 143°-114°=29° and thus the length of the hypotenuse can be calculated as 10,3’/sin 29°, or more conveniently as 10,3’ x cosec 29° if logarithms are used.

10,3’	log	1,013
29°	log cosec	0,314
	log	1,327

This logarithm corresponds to a distance of 21,2’, sailed on course of 143°, from the given start position. From the traverse table we find a dLat of 17’ S and a departure of 12,8’ E. The departure is converted to a dLong of 18,7’ E. We now get the position of the fix as

Latitude 46°43’ N
Longitude 2°36’ W

Compared with the published known position of N4642.9W00223.7, my latitude is spot on and my longitude only 12’ or 48^s off.

Clearing of lunar according to Stark's method and table. Those who have the form available will be able to follow and check the calculations.

Height of eye 17 feet, HP 54,6'

29°20,0'	55°39,0'		
4,0'	10.8'		
29°16,0'	55°49,8'	29,12'	534,7
	29°16,0'	0,91'	17,0
	26°33,8'	1,73'	0,0
	31,8'	31,76'	551,7
	27°05,6'		

15,1'		
29°38,4'		
29°53,5'		
26°33,8'		
3°19,7'		3,07397
56°27,3'		0,65033
		3,72430
		1,86215
		551(,7)
27°05,6'	1,26069	1,86767
	0,09594	1,26069
	1,16475	~~0,60698~~

The last K-value (which equals a negative log hav) of 1,16475 gives the cleared lunar of 30°19,7'.

Calculation of true distances:

18^h GMT

	45°47,4'	
	19°56,6'	
	25°50,8'	1,30087
16°42,4'		0,01873
00°21,0'		0,00001
16°21,4'	1,69387	1,31961
	1,31961	0,15303
30°15,8'	~~0,37426~~	1,16658

19^h GMT

	60°49,4'	
	34°29,3'	
	26°20,1'	1,28490
16°51,4'		0,01907
00°21,2'		0,00001
16°30,2'	1,68617	1,30398
	1,30398	0,15069
30°44,5'	~~0,38219~~	1,15329

3,9'	1,7891	
28,7'	0,9223	
	0,8668	resulting in an observed **GMT $18^h08^m09^s$**