Early Observations and Modern Ephemerides

E M Standish

Caltech/JPL

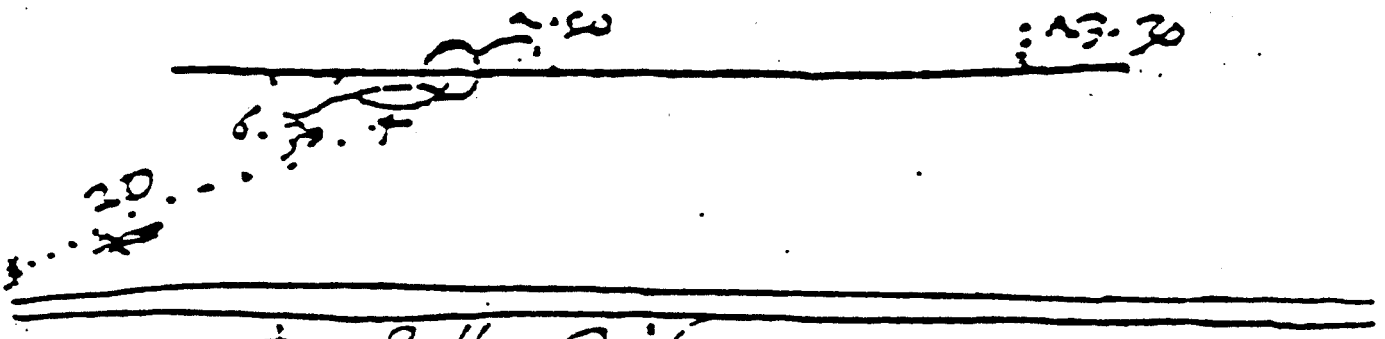
IAU Joint Discussion 6

August 2000

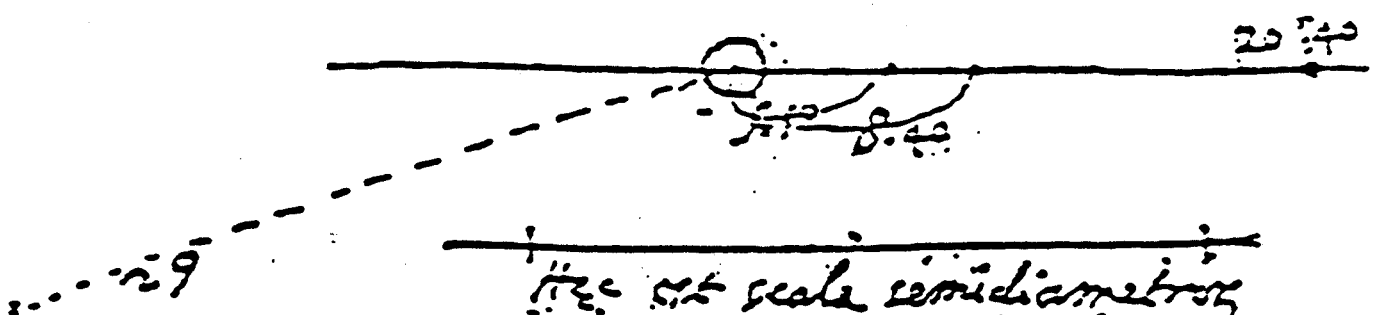
Mss. Gal., P. III, T. IV, car. 140r.

1613. Januarij

☽. 27. hō. 5. 40. ab. occ.



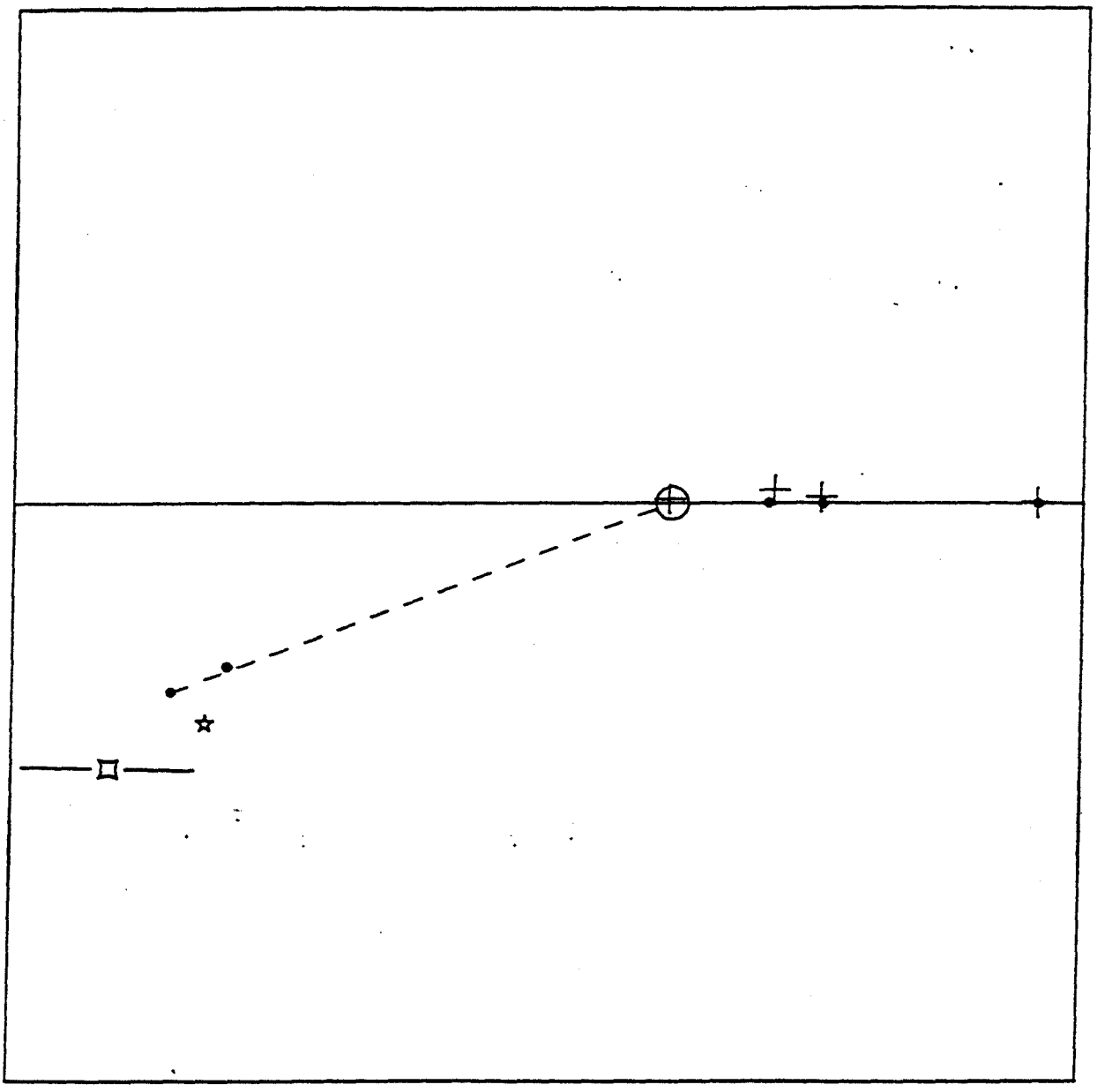
☽. 28. hō. 5. 20 occ



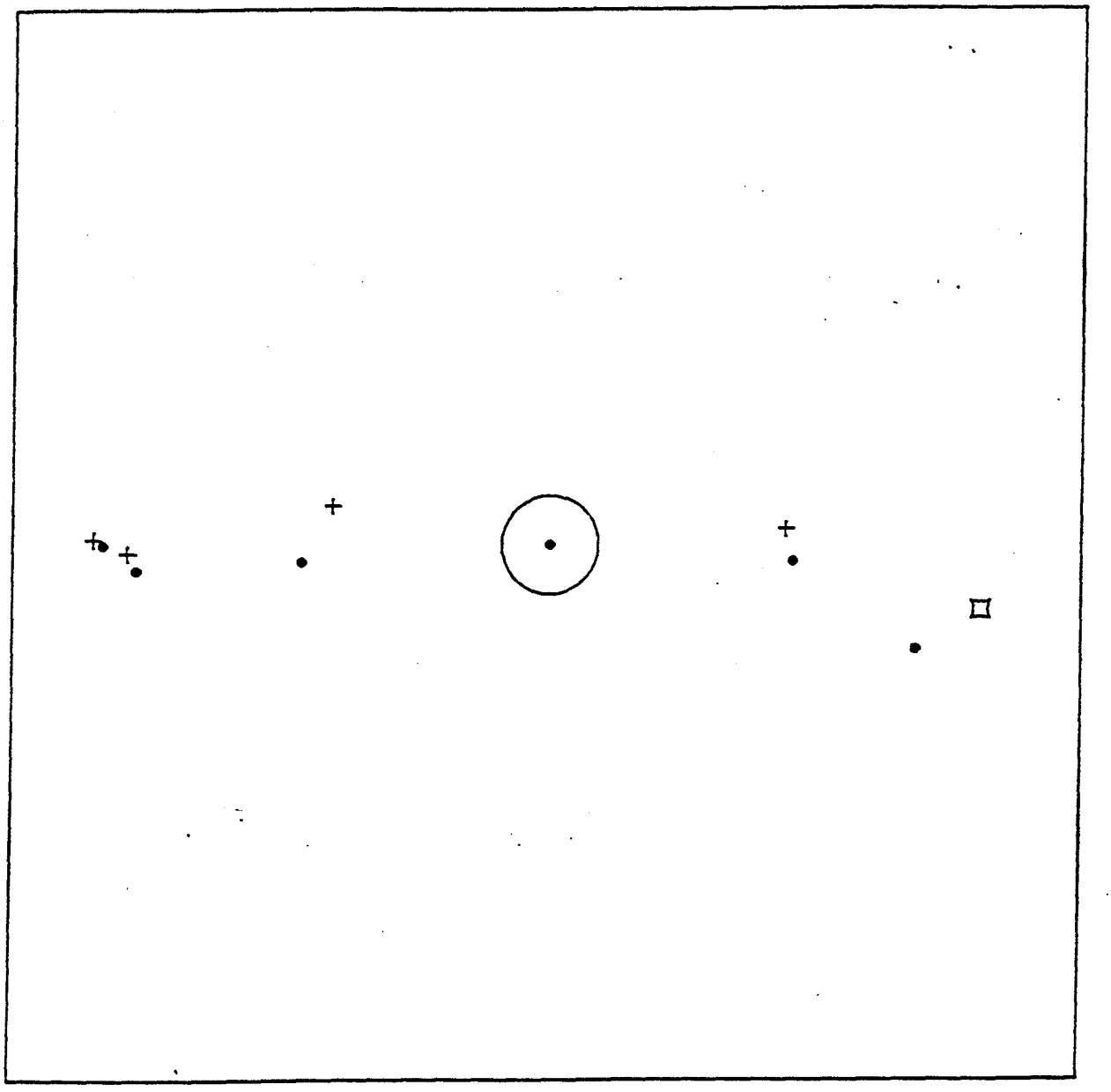
Hæc est scala semidiametros 24. exactę collatas ante

a post stellā fixā a.
alia in eadē linea sequebat ita,
ut ex 5. quę eiā precedēti nocte
observata fuit; ita videbat
remotiores inter se

1613 JAN 28 22:35:36



1613 JAN 06 05:35:39



Conclusions

To Scale or Not To Scale

If YES :

bad ephemeris

incomplete model of solar system

Planet X ? New gravity ?

If NO :

good ephemeris

(~) complete model of solar system

Neptune si, Planet X no ?

If the spot ***was*** an intentional measurement of Neptune,

the ephemeris of Neptune is quite accurate

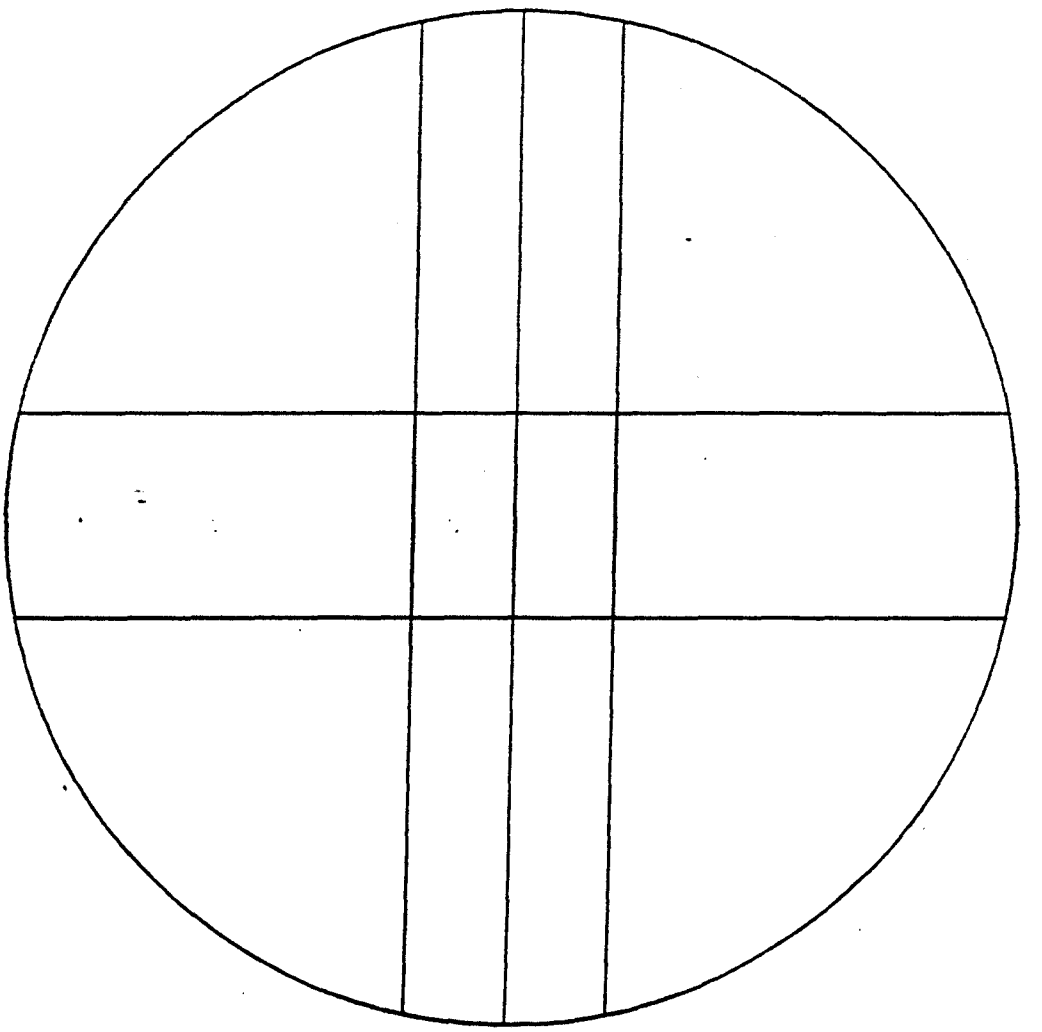
If the spot ***was not*** an intentional measurement,

there is no conclusion.

In any case, one-dimensional observation

"Lalande's observations cannot be fit with a reasonable Neptune orbit"

3—wire eyepiece



9	14 24''	61 56 40			42' 27''.7		
	15 51				55	59 50 50	
7.8	16 17''.4	61 10 20			43' 50''.5		
				8.9	44' 18	61 51 7	
	25 18						
576 moyen 7.8. 7.8	45''.5	60 10 16		9	45 2''	62 0 30	
8	28 59''.6	61 57 0		8	46 5	60 35 49	
	29 28						
578 moyen 8.9 16h 9' (60 10) 8.9		60 10 34		7.8	46 15''.4	60 23 50	
	34 10''.5						
	35 40''.5						
9	36 8	60 54 42	[51]	8.9	47' 9''.5	60 43 48	140 étoiles
	35 56''.5						
6.7	36 23''.5	60 45 43		Nous avons été jusqu'à 15h 7' sans voir d'étoile			
	51''.5			il y a des images dans notre zone			
				Thermomètre + 13°			0.991 de fil
8.9	37 17''.5	61 2 50		Baromètre 28'' 5''.6			
			39. 45''00.	Le fil applaudit est presque tangente intérieure à droite			
7 pl. c Saturne 6.7 gr. planétaire		62 4 43		il faut ôter 5'' des différences au zénith			
	38 19''.4			7 pl. c Saturne	14h 30. 9' 51.		
				39. 21. 25''00.			
8.9	39 4''.5	59 57 16		39. 21. 25''.5	14 37 4''.50		
					+ 22''.52		

		14 heures		
	8		59 16 10	
		0 16,5		
		1 11,5		
gu Rl m 4°	4	1 38,5	58 6 37	38,5 / 38,5
		2 6,5	il en a passé une de γ.8	
			59 39 55	
		4 2,5	60 4 30	
		4 23,	60 1 20	
		5 31,5		
Arcturus		6 0,5	28 33 30	
		6 24,5		
		7 14,5		
mon 4.	4,5	7 41,5	61 12 43	
		8 10,3		
	8	9 23,5	60 12 45	
		9 56	59 14 43	
	9	10 50,5	59 39 37	
	7,8	11 24	59 54 40	

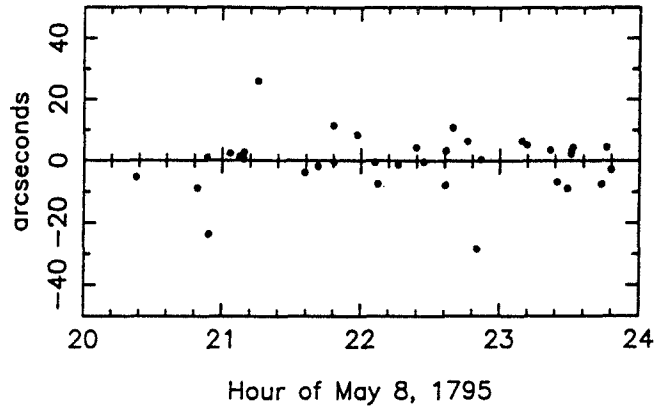
voyez le 10 mai.....
Il y a trois positions de hauteur et trois sur le passage de l'étoile
l'étoile suivante

18 Mai 1769

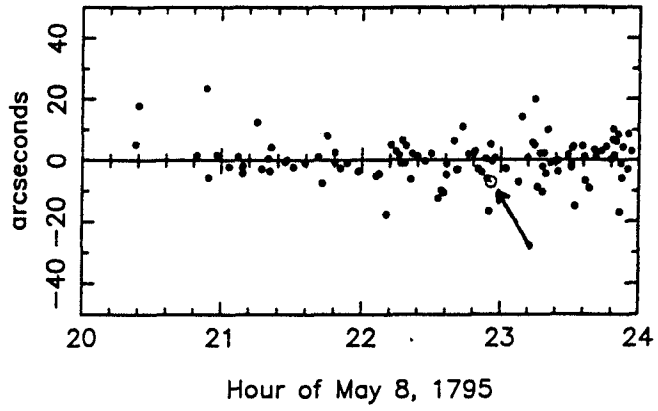
		14 heures		
	7	11 36,5	60 8 17	
				4,6 / 31 / 17,45
28 Bélier	6	12 4,5	59 33 55	
		12 32,5		
571 moyen	7	13 20,5	59 31 36	
		13 48		
		16 12,5	58 26 20	
	9		59 44 49	
		20 03,5		
	9		58 49 4	
		21 19,3		
	9	23 45	59 25 15	
		24 52		
	8	25 19 8	59 32 8	
575 moyen 28.	6		60 13 12	
		26 14		
		27 13		
577 moyen 28.	7	27 40	58 27 22	
		28 8		

10 mag.	13 heures	Hte 2e du Diff. au Zenith			14 heures		10 mag
8.9	56 31.4	60 22 47		9.10	5 17.4	61 34 0	
	58 25.5						
8	53	62 1 46		9	6 8.8	61 51 0	
9	59 47.5	60 15 18		9.10	5' 59"	61 44 22	
8	14 heures 0 27.4	60 25 25	30 ♎ 27	4	7 13.8 / 41.3	61 12 50	
9 10	0 57.5	60 8 34		9	7 46	61 16 20	
7.8	2 15"	61 40 55		8	16 7.5	61 33 0	
8.9	2 21"	61 38 45		9	9 50"	60 12 45	
6	2 51	61 10 5		7.8	11 23.5	60 7 19 voyez le 8 mai	♆
					Soleil	il y a transposition de tout le cercle d'étoile qu'est 59 54 40	
8	4 1.5	60 4 30	à Balance	6 mag	12 3.4 / 31.5	59 33 59	
8	4 32	60 1 22		8.9	11' 50.5	59 54 40"	voyez le 8 mai

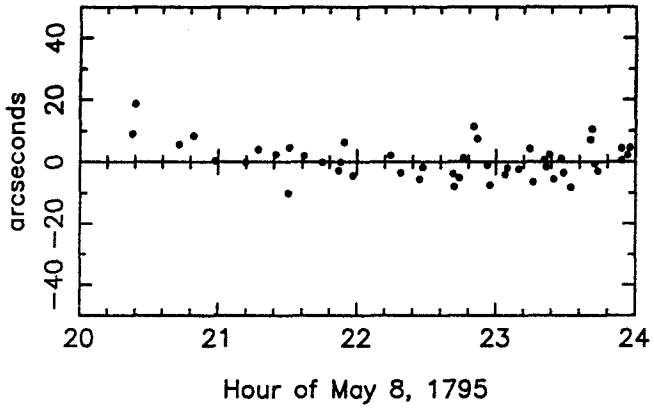
R.A. : Leading Wire



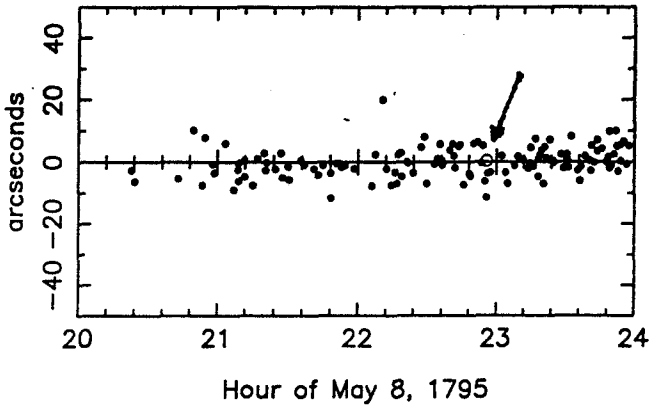
R.A. : Central Wire



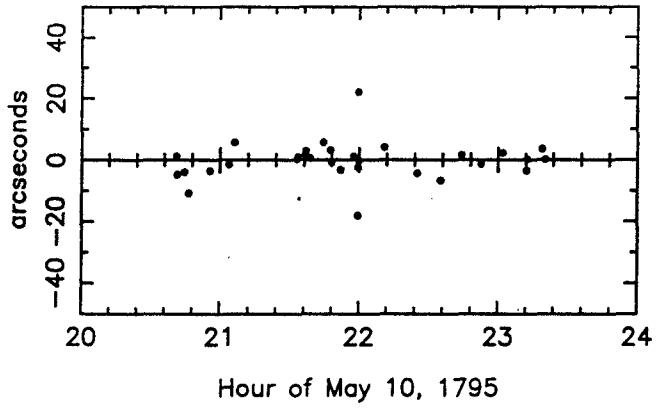
R.A. : Trailing Wire



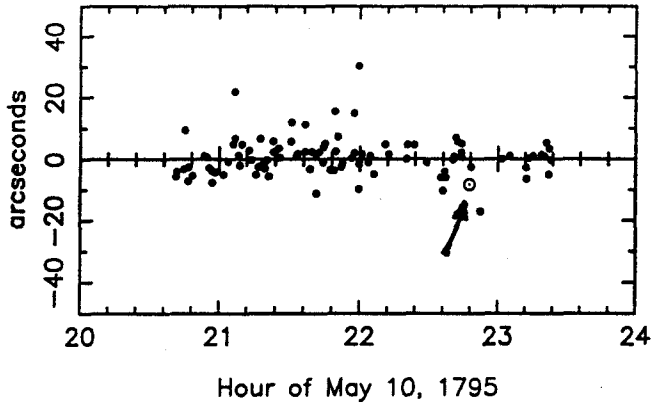
Declination Residuals



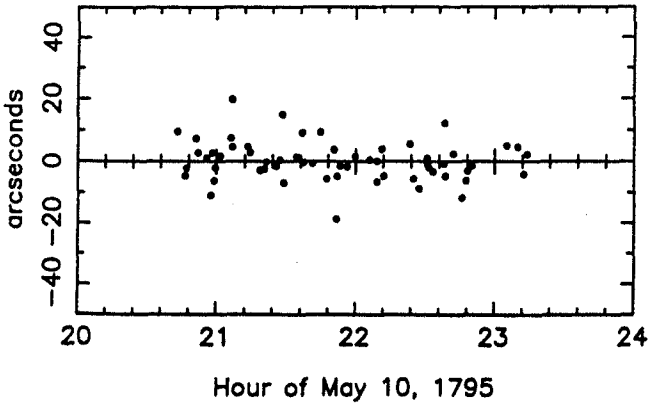
Right Ascension Residuals from the Leading Wire



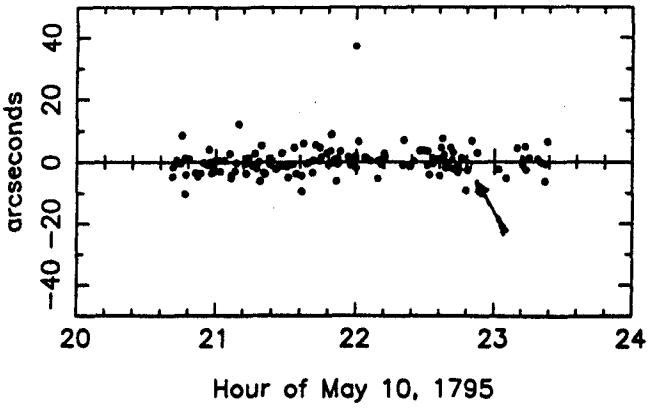
Right Ascension Residuals from the Central Wire

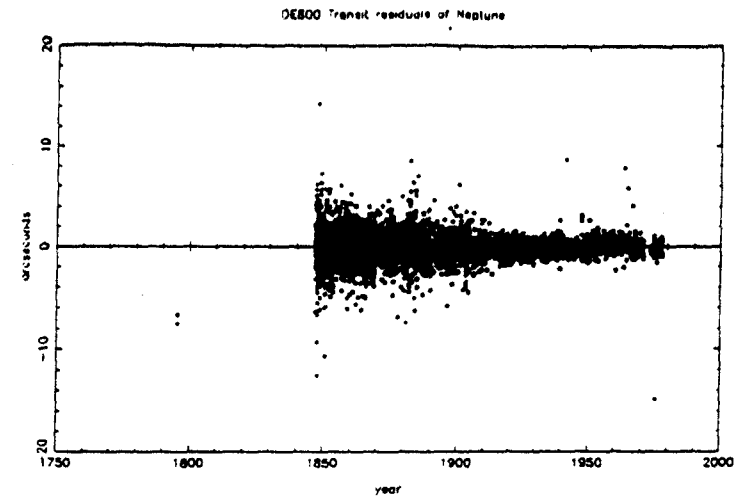


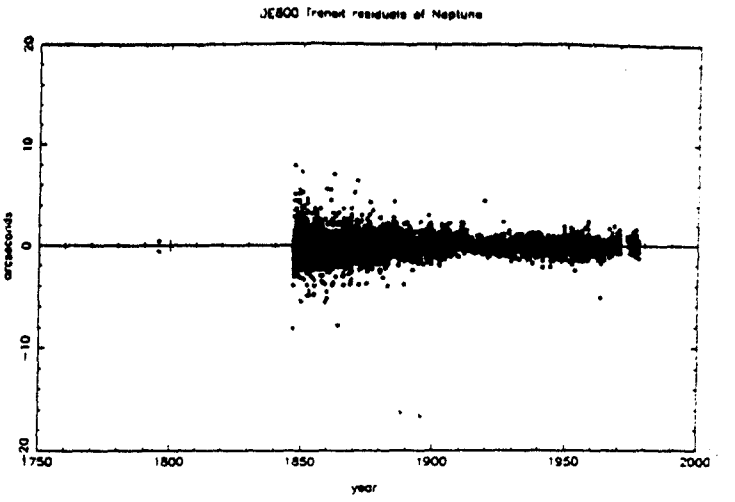
Right Ascension Residuals from the Trailing Wire

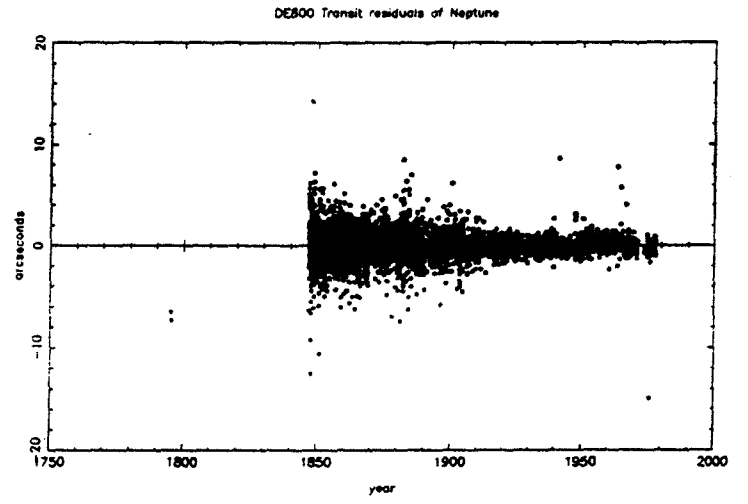


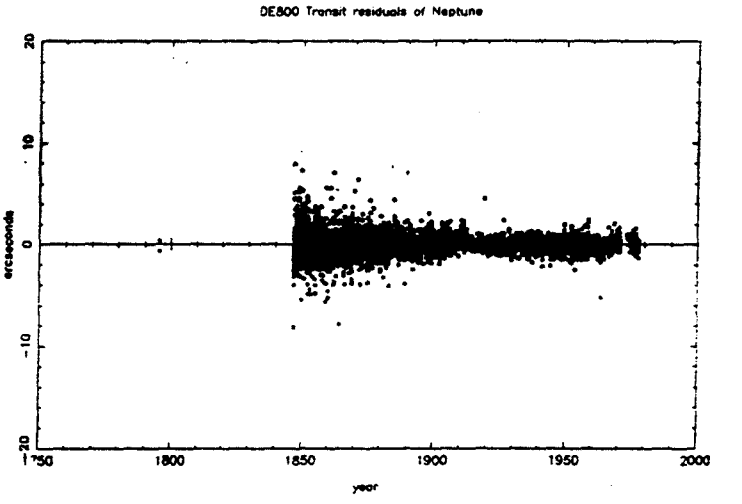
Declination Residuals

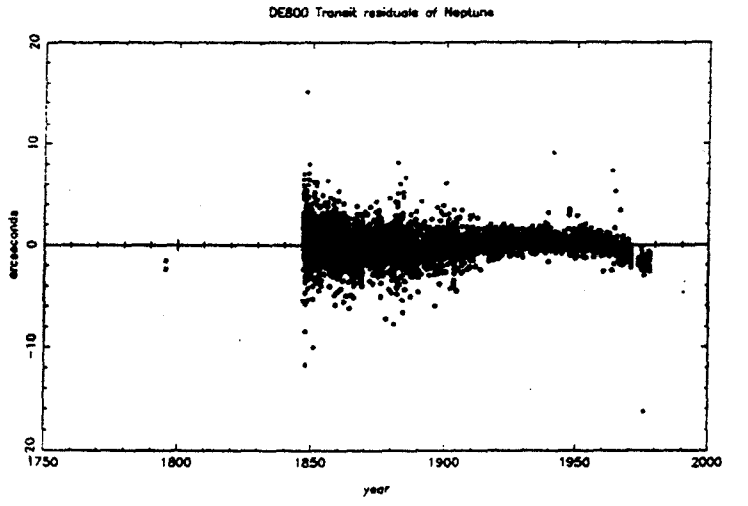


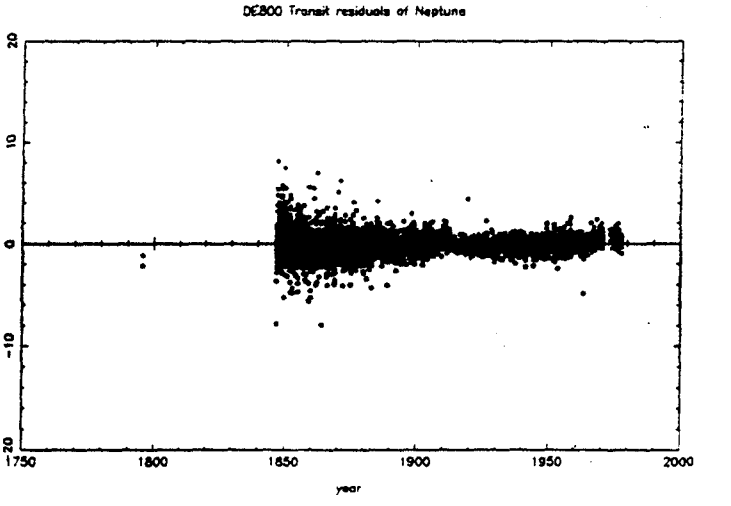

DE800 Transit residuals of Neptune
arcseconds
year

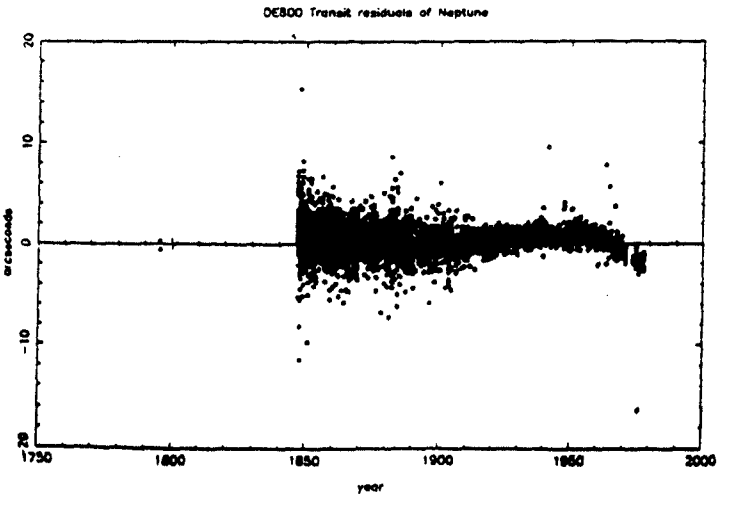

DE800 Transit residuals of Neptune
arcseconds
year

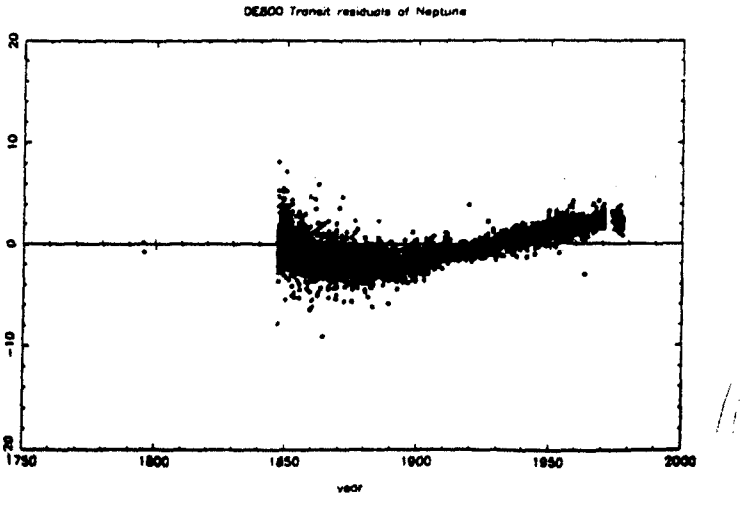

DE800 Transit residuals of Neptune
arcseconds
year


DE800 Transit residuals of Neptune
arcseconds
year


DE800 Transit residuals of Neptune
arcseconds
year


DE800 Transit residuals of Neptune
arcseconds
year


DE800 Transit residuals of Neptune
arcseconds
year


DE800 Transit residuals of Neptune
arcseconds
year

Conclusions

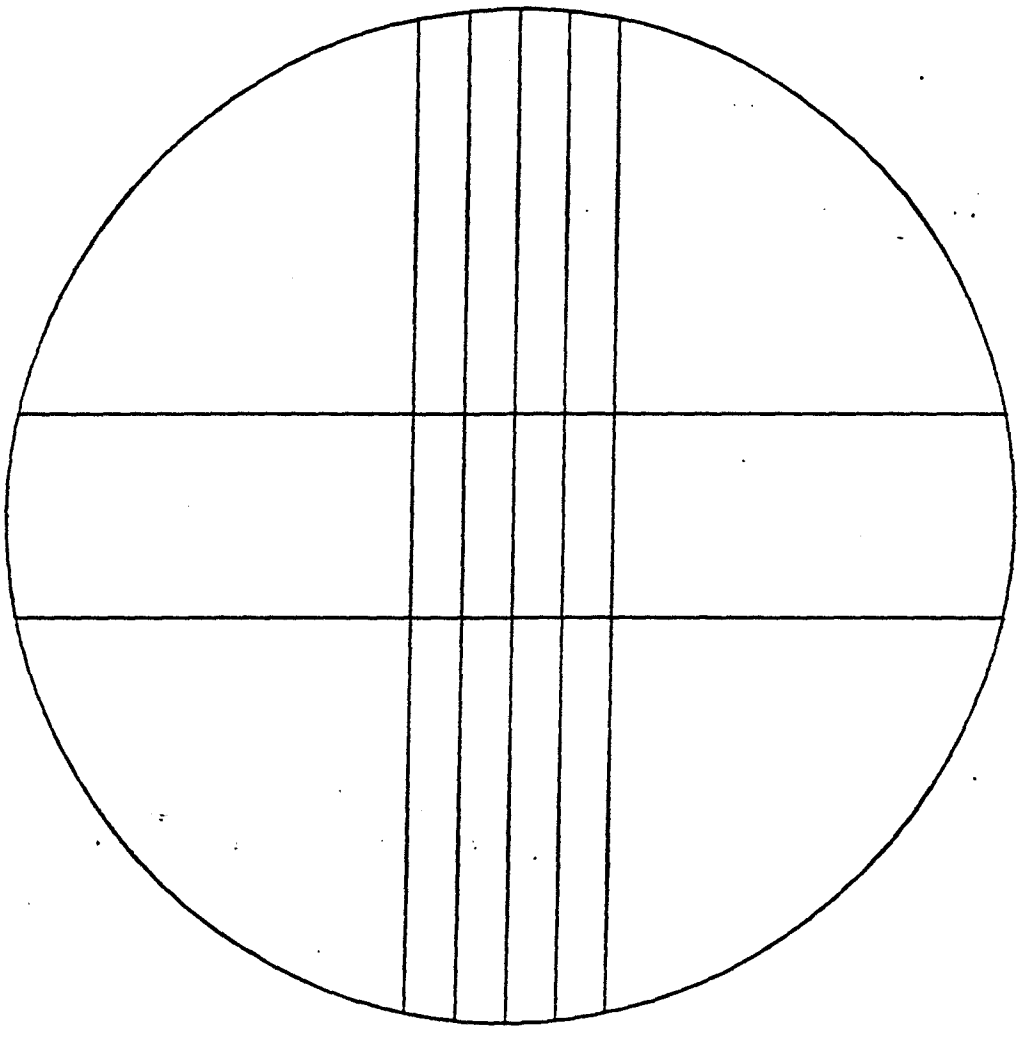
Lalande's residuals cannot be fit as given, ***but***

they are $< 2\text{-}\sigma$ numbers

Neptune looks weird in a telescope

possible "quantité" effect

5–wire eyepiece



JANUARY 1811

Day		1st Week	2d Week	3d Week	4th Week	5th Week	
☉	6	2 .. 54,6	18,3	19 .. 3 .. 41,8	4 .. 5,2	28 ..	☉'s 1st Limb
		5 .. 16	39,4	19 .. 6 .. 2,9	26,5	50	☉'s 2d Limb
		7 .. 17	10	2 .. 7 .. 53	8 .. 16	31	υ Cetii
		49 .. 45	50 .. 8	2 .. 50 .. 31	54	51 .. 17	α Cetii
		After his declination 5 p.m. the Clock forward 2'.					
		25,5	25 .. 48	4 .. 26 .. 11	34	57	Aldebaran
☽	7	34 .. 50	35 .. 21	20 .. 35 .. 52	23	36 .. 54	α Cygni
		9	32	4 .. 25 .. 55,5	26 .. 18	41	Aldebaran
		31,5	3	5 .. 2 .. 35	3 .. 6	37	Capellae
		21	46	5 .. 14 .. 11	36	15 .. 1	β Tauri
♂	8	53 .. 24	48,5	22 .. 54 .. 13	37,5	55 .. 2	β Pegasi
♀	11			1 ..		56 .. 7	α Aritis
		15 .. 43	17 .. 57	2 .. 20 .. 9	22 .. 25	24 .. 41	P.D. 9° .. 22'
		10 .. 2	24,75	4 .. 10 .. 47,5	11 .. 10,75	11 .. 33	61. δ. 1. Tauri
		15 .. 37		4 .. 15 .. 23		17 .. 9	79 Tauri
		23 .. 4	26,75	4 .. 23 .. 49,5	24 .. 12,25	35	Aldebaran
		12 .. 15	40,25	5 .. 13 .. 5,5	30,75	56	β Tauri
☉	13	27 .. 50,5	28 .. 18,5	28 .. 28 .. 46,5	29 .. 14,5	42,5	α Lyra
		33 .. 27,8	51,5	19 .. 34 .. 15,3	39,1	35 .. 2,8	☉ 1st Limb
		35 .. 49	36 .. 11,7	19 .. 36 .. 35,5	59,3	37 .. 23	☉'s 2d Limb
♂	15	26 .. 15	26 .. 43	18 .. 27 .. 11	27 .. 39	28 .. 7	α Lyra M:28
		51 .. 25,5	50	22 .. 52 .. 14	39	53 .. 4	β Pegasi
		14 .. 58,6	15 .. 20,7	2 .. 15 .. 42,8	16 .. 4,9	27	ξ 2 Cetii
		~~21 .. 3,8~~	~~30,1~~	~~2 .. 21 .. 56,4~~	~~22~~		
		21 .. 3,8	30,1	2 .. 21 .. 58,4	22 .. 22,7	49	15 Trianguli
		37 .. 32,4	56,8	2 .. 38 .. 21,2	45,6	39 .. 10	41 Aritis
		44 .. 4,2	26,4	2 .. 44 .. 48,6	45 .. 10,8	33	η Eridani
		23	56	3 .. 8 .. 29	9 .. 2	35	α Persei
		13 .. 33,4	56,3	3 .. 14 .. 19,2	42,1	15 .. 5	Jupiter's Center
		20 .. 52,3	21 .. 14,6	3 .. 21 .. 36,9	59,2	22 .. 21,5	ε Eridani
		57 .. 32,1	58 .. 5,7	3 .. 58 .. 38,3	59 .. 11,4	44,5	μ Persei
		5 .. 52	6 .. 15	4 .. 6 .. 38	7 .. 1	24	γ Tauri
		21 .. 54	22 .. 17	4 .. 22 .. 40	23 .. 3	26	Aldebaran
☿	16	48 .. 23	48 .. 58,5	17 .. 49 .. 34	50 .. 9,5	45	γ Draconis
		18 .. 31	18 .. 54,5	19 .. 46 .. 18	46 .. 41,5	47 .. 5	☉'s 1st Limb
		47 .. 51	48 .. 14,5	19 .. 48 .. 38	49 .. 1,5	25	☉'s 2d Limb
♃	17	16	3 .. 39	4 .. 6 .. 2	25	48	χ Tauri
		13 .. 49	14 .. 12	4 .. 14 .. 35	14 .. 58	15 .. 21	ξ Tauri
		21 .. 18	21 .. 41	4 .. 22 .. 4	22 .. 27	22 .. 50	Aldebaran
		25 .. 31	26 .. 1	4 .. 26 .. 31	27 .. 1	27 .. 31	59 Persei
		17,4	38 .. 44,8	4 .. 39 .. 12,2	34 .. 39,6	35 .. 7	f Aurigae
		41 .. 49	42 .. 15	4 .. 42 .. 41	43 .. 7	.. 33	3 Aurigae
		47 .. 44	48 .. 19	4 .. 48 .. 54	49 .. 29	50 .. 4	g Aurigae
		8 .. 59,5	9 .. 24,75	5 .. 9 .. 50	10 .. 15,25	40,5	β Tauri
		18 .. 56,6	38 .. 19,2	5 .. 38 .. 41,8	39 .. 4,4	27	137 Tauri
♀	19 18	28,5	52	19 .. 54 .. 15,5	54 .. 39	55 .. 2,5	☉'s 1st Limb
		48	56 .. 11,5	19 .. 56 .. 35	56 .. 58,5	57 .. 22	☉'s 2d Limb
		After his declination 7 p.m. the Clock forward 4'.					
		0 .. 6,8	29,6	6 .. 0 .. 52,4	1 .. 15,2	38	ξ Orionis

A. Robertson.

Wire 1	Wire 2	Wire 3	Wire 4	Wire 5	1+5	2+4	2x3
23 4	26.75	4 23 49.5	24 12.25	35	**39**	**39.00**	**39.0**
12 15	40.25	5 13 5.5	30.75	56	**11**	**11.00**	**11.0**
27 50.5	28 18.5	18 28 46.5	29 14.5	42.5	**33.0**	**33.0**	**33.0**
33 27.8	51.5	19 34 15.3	39.1	35 2.8	**30.6**	**30.6**	**30.6**
35 48	36 11.7	19 36 35.5	59.3	37 23	**11**	**11.0**	**11.0**
26 15	26 43	18 27 11	27 39	28 7	**22**	**22**	**22**
51 25.5	50	22 52 14	39	53 4	29.5	29	28
14 58.6	15 20.7	2 15 42.8	16 4.9	27	**25.6**	**25.6**	**25.6**
21 3.8	30.1	2 21 56.4	22 22.7	49	**52.8**	**52.8**	**52.8**
37 32.4	56.8	2 38 21.2	45.6	39 10	**42.4**	**42.4**	**42.4**
44 4.2	26.4	2 44 48.6	45 10.8	33	**37.2**	**37.2**	**37.2**
23	56	3 8 29	9 2	35	**58**	**58**	**58**
13 33.4	56.3	3 14 19.2	42.1	15 5	**38.4**	**38.4**	**38.4**
20 52.3	21 14.6	3 21 36.9	59.2	22 21.5	**13.8**	**13.8**	**13.8**

Conclusions

Robertson definitely fabricated observations

his reason for doing so is not clear

"quantité" effect (?)

October 20

Corresponding altitudes of the sun taken with a reflector fitted with vertical and horizontal wires.

. . .

Mean
Equation of altitudes
⊙ 's center on the meridian
Clock too fast 5 30,25

October 21

. . .

Mean
Equation of altitudes
⊙ 's center on the meridian
Clock too fast 7 02, 5

Clock gains in 24 hours 1 32,25

October 22

Thick fog all day. No astronomical observations

At 8^h 15', A.M. I put the clock back 15', and lengthened the pendulum.

October 23

Thick fog all day. No astronomical observations

Williams' 1780 Micrometer Measurements

h	m	s	div	rev	parts	'	"
11	27	58	1	11	16	25	12.8
11	29	1	1	10	16	24	31.8
11	30	12	1	09	12	23	42.5
11	33	38	1	08	07	22	51.0
11	35	49	1	07	18	22	32.6
11	38	14	1	05	12	20	57.9
11	42	24	1	03	04	19	19.3
11	45	24	1	01	06	18	1.2
11	49	36		23	15	16	16.3
11	51	53		22	07	15	18.8
11	54	33		21	18	15	0.3
11	56	16		19	13	13	27.8
11	58	35		18	07	12	34.4
12	0	48		17	19	12	17.9
12	4	0		16	10	11	18.3
12	6	52		13	07	9	8.8
12	9	3		12	02	8	17.4
12	12	48		10	15	7	21.9
12	13	38		9	16	6	42.8
12	17	26		7	02	4	51.9
12	19	36		6	17	4	41.5
12	21	24		5	14	3	54.3
12	22	51		4	18	3	21.4
12	25	13		2	10	1	42.7
12	26	50		1	13	1	7.8
12	28	48			12	0	24.7

"Immediately after the last observation, the sun's limb became so small as to appear like a circular thread, or rather like a very fine horn. Both ends lost their acuteness, and seemed to break off in the form of small fine drops or stars ... After viewing the sun's limb about a minute, I found almost the whole of it thus broken or separated in drops, ...

"... This appearance remained about a minute, when one of my assistants, who was looking at the sun with his naked eye, observed that the light was increasing ...'

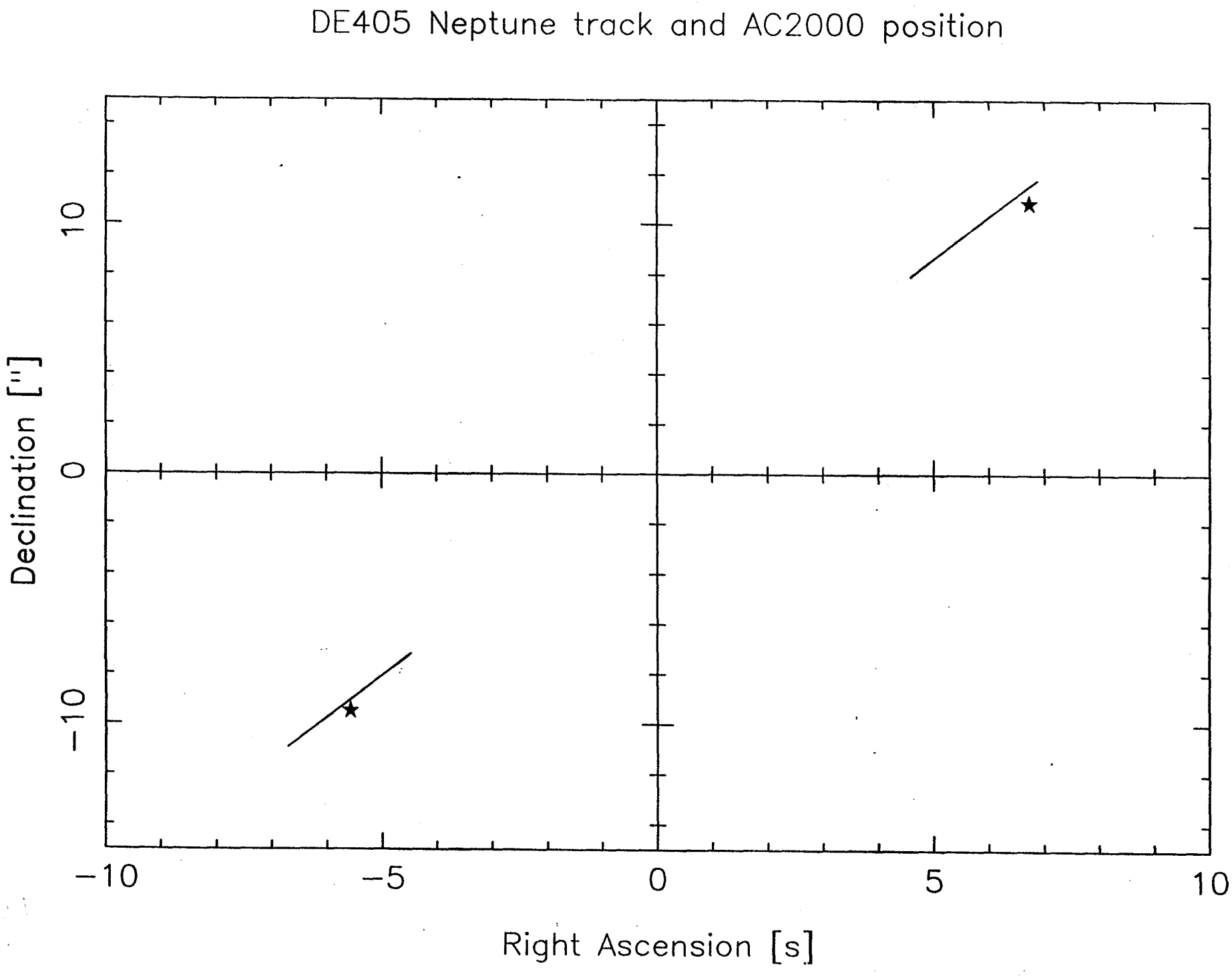
"Williams was eventually driven out of Harvard because he tried to falsify some documents relating to a debt. With respect to the eclipse, was Williams also a scoundrel engaged in a cover-up to conceal his own incompetence?"

XXXIII. *A Letter from* Jofeph Willard *to the Rev. Dr.* Mafkelyne, *Astronomer Royal, concerning the Longitude of* Cambrige *in* New England.

"I hope, Sir, no umbrage will be taken at my writing to you, on account of the political light in which America is now viewed by Great Britain. I think political difputes fhould not prevent communications in matters of mere fcience; nor can I fee how any one can be injured by fuch an intercourfe.

I am, &c.

Beverly in Maffachufetts,
February 16, 1781."


DE405 Neptune track and AC2000 position
Declination ["]
10
0
−10
−10
−5
0
5
10
Right Ascension [s]