
Approximate Determination of Positions in South-Western China

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VIII.—*Approximate Determination of Positions in South-Western China.* By G. COLBORNE BABER.

[Communicated by the Foreign Office.]

WITH the exception of the points established by Captain Blakiston and Lieutenant Garnier, our knowledge of the geographical position of places in Western China rests entirely upon the authority of the Jesuit surveyors, whose results, laid down partly from observation with inefficient instruments, and partly from the collation of native information, are necessarily erroneous in many details, and are never exact. Their observations for latitude often deviate from the truth by so much as 6 or 7 miles, and their longitudes, even as re-arranged by modern geographers, are probably vitiated by a still greater error. Nevertheless their map is for general purposes a most admirable work, and since it was never designed to serve as a route-map for tourists, or a chart for river-pilots, it would be ungracious to find fault with its deficiencies; especially when it is remembered that all existing maps of Eastern Asia are more or less modified reproductions of their survey.

Modern explorers are, however, fair game, and it is at once the duty and the delight of a traveller to search out the defects of his predecessors. But, with the best will in the world, I cannot establish any charge against Captain Blakiston. A severe test of his work is to observe the latitude of places the position of which he had obtained by dead reckoning only, and over a long distance; tried in this way he is always practically exact. But I have applied the still more searching criterium of longitude by chronometer. His lunar observations, as adopted by Mr. Arrowsmith, give $1^{\circ} 55'$ (one degree fifty-five minutes) for the difference of longitude between Sü chow and Chung ching. Selecting a season when a quick run could be made, I carried a chronometer down from Sü chow, and obtained a difference of $1^{\circ} 59'$ (one degree fifty-nine minutes); a most satisfactory agreement. Captain Blakiston's lunar observations seemed to have gained in trustworthiness as he travelled farther west, and at Sü chow his results east and west of the moon are very close together. There seems every reason for assuming that his absolute longitude of Sü chow is as near the truth as lunar series will admit of.

But then comes Lieutenant Garnier and shocks the complacent feeling of finality by removing the position twenty-six minutes westwards. The discrepancy is, after all, not very serious, as sextant observations go; but still it is disagreeable, and I have devoted a good deal of time and labour to its

examination. The first place in which, after much wandering and waiting, I at last found an almost unexceptionable opportunity for obtaining lunar series, was Tzū-ta-ti, the head-quarters of a Sifan chief, in lat. $29^{\circ} 16' 45''$, and a few days later another good opportunity occurred at the village of Na-erh-pa, 8 miles to the eastward. The two results, as may be seen by the record of observations hereto appended, agree exceedingly well, and place the mouth of the Lao-wa torrent, which lies half-way between the stations, in long. $102^{\circ} 41'$. Extending this result by careful dead reckoning to Chia-ting-fu, and thence by chronometer to Sü chow, I came almost exactly upon the point laid down by Captain Blakiston: the four walls of the city would have nearly included both determinations. It seems, therefore, safe to prefer Captain Blakiston's position to that adopted by Lieutenant Garnier, and to suppose that it is very slightly in error.

The position of the more southern portions of my chart, as regards longitude, rests upon the accuracy of dead reckoning corrected by frequent observations for latitude and variation of compass. In this way, on reducing the route-chart which I kept when travelling with Mr. Grosvenor, Yünnan Fu falls upon $102^{\circ} 41'$ (oddly enough the longitude of the Lao-wa river mouth determined as above), differing by four or five minutes only from Lieutenant Garnier's result. Again, if my chart of the mission-route from Yünnan Fu to T'êng-yüeh (Momein) be examined, it will be seen that the difference of longitude between those points, according to the dead reckoning, is $4^{\circ} 17'$ (four degrees seventeen minutes), which, if the position of T'êng-yüeh according to the Sladen mission, viz. $98^{\circ} 26'$, be accepted, would place Yünnan Fu in $102^{\circ} 43'$, practically the situation in which I found it.

I put Tali Fu, by the same process, in long. $100^{\circ} 3'$, some twenty-five minutes west of Lieutenant Garnier's acceptation. But his position also depends upon dead reckoning alone; and since my account of the distance between Yünnan Fu and T'êng-yüeh, taking Tali Fu *en route*, seems correct enough, I submit that probabilities are strongly in my favour.

Accepting Blakiston's determination for Sü chow Fu, Garnier's for Yünnan Fu, and the received position of T'êng-yüeh, all my route-work falls comfortably into place without straining or distortion.

I may add that I obtained a lunar series of poor value at Ch'iao-chia Ting (B.), but I prefer to depend upon dead reckoning for the position. The record marked (D.) is the history of a failure, and I only append it for the sake of fairness. As far as the *observation* is concerned, it was the best

and most deliberate of my lunar series; its want of success may be attributed to two causes: the Eastern Star was the most ineligible, with one exception, of the whole year's category, and the hill-forest below it was on fire.

The record of latitudes needs no comment except in one particular, viz. the rather serious difference from the positions adopted by Lieutenant Garnier between Sü chow and Tung-ch'uan. I do not know if his results for that section rest upon sextant observations. It may be objected that my latitudes in that part of the route depend upon altitudes taken only upon one side of the zenith, but this stricture will not apply to the station of Chiang-ti, where the discrepancy is equally apparent. At Tung-ch'uan and farther south the agreement is satisfactory. For the position of Tali Fu Mr. Garnier appears to have accepted the Jesuits' latitude; indeed, as he had barely time to escape from personal danger in that neighbourhood, it is not to be supposed that he could have devoted much attention to sextant manipulation.

It will be seen that my latitude observations from No. 48 downwards exhibit a considerable intrinsic sextant error, apart and distinct of course from index error; but, being constant, it was of no importance whatever, and I thought it well to refrain from "tormenting the instrument."

The observations for compass variation (Table G.) were all made by sun's altitude and azimuth, no sunset or sunrise sights being anywhere obtainable.

In Table (H.) I have compared my deduced positions of the most important points with the determinations of the Jesuits and of Mr. Garnier. The latter have been measured from his general map, and are therefore somewhat loose.

E. COLBORNE BABER.

Chung-ching, 25th July, 1879.

APPENDIX.

(A.) OBSERVATIONS for LATITUDE.

STATION.	Position of Object observed N. or S. of Zenith.	Result.	Mean, or accepted, Lat.	REMARKS.
1. P'ing-shan Hsien (River bank at east end of City).	Star N. (α Urs. Ma.)	28 39 6	28 39 8	Fair.
2. Ditto	Sun	28 39 10	28 39 8	Good.
3. Yen-tzu-ngai ..	Sun	28 24 0		28 24 0
4. T'an-t'ou	Star S. (Sirius)	28 19 50	28 19 50	Very good.
5. Lin-chiang-ch'i ..	Sun	28 9 23	28 9 23	Good.
6. Top of Li-shan ..	Sun	28 3 21	28 3 21	Fair.
7. Ta-ngai-tung	Sun	27 31 29	27 31 29	Fair.
8. Cha-shang	Sun	27 25 23	27 25 20	Good.
9. Chao-t'ung Fu .. (Examination Hall).	Star S. (Sirius)	27 20 42	27 20 35	Fair.
10. Ditto	Sun	27 20 29		27 20 29
11. Ditto	Star S. (Rigel)	27 20 41	27 20 35	Good.
12. Ditto	Star S. (15 Argus)	27 20 49		27 20 49
13. Ditto	Sun	27 20 43	27 16 25	Very good.
14. Cha-la-hsün	Sun	27 16 31		27 16 31
15. Chiang-ti	Star S. (Rigel)	27 0 0	26 59 50	Satisfactory.
16. Ditto	Star N. (α Urs. Ma.)	26 59 40		26 59 40
17. Ya-k'ou-t'ang	Sun	26 54 52	26 54 45	Good.
18. I-ché-hsün	Star S. (Sirius)	26 49 30	26 49 25	Satisfactory.
19. Shan-hu-shu	Sun	26 42 48	26 42 45	Good.
20. Hung-shih-ngai ..	Star S. (Sirius)	26 37 38	26 37 35	Fair.
21. Tung-ch'uan Fu .. (Examination Hall).	Star S. (Sirius)	26 25 0	26 25 0	Fair.
22. Hsiao-chang-t'ang	Sun	26 19 50	26 19 45	Fair.
23. Ché-chi	Star S. (Sirius)	26 14 37	26 14 30	Fair.
24. Ditto	Star N. (α Urs. Ma.)	26 14 20		26 14 20
25. Lai-t'ou-p'o	Star S. (Sirius)	26 1 42	26 1 40	Not very good.
26. Ditto	Star N. (α Urs. Ma.)	26 1 39		26 1 39
27. Ditto	Sun	26 1 81?	26 1 37	Good.
28. Ditto	Star S. (Sirius)	26 1 37		26 1 37
29. Kung-shan	Star S. (Sirius)	25 45 7	25 45 0	Fair.
30. Ditto	Star N. (α Urs. Ma.)	25 44 49		25 44 49
31. Liu-shu-ho	Sun	25 40 10	25 40 0	Fair.

(A.) OBSERVATIONS for LATITUDE—*continued.*

STATION.	Position of Object observed N. or S. of Zenith.	Result.	Mean, or accepted, Lat.	REMARKS.
32. Hsün-tien-chou ..	Star S. (Sirius)	25 34 6	25 33 50	Fair.
33. Ditto	Star N. (α Urs. Ma.)	25 33 34	25 22 20	Fair.
34. I-lung	Star S. (α Hydræ)	25 23 26		Very rough.
35. Ditto	Star N. (α Urs. Ma.)	25 22 9	25 17 0	Good.
36. Ho-k'ou	Sun	25 17 10		Good.
37. Yang-lin	Star S. (Sirius)	25 13 36	25 13 27	Good.
38. Ditto	Star N. (α Urs. Ma.)	25 13 18		Good.
39. Ch'ang-p'o	Star S. (Sirius)	25 7 46	25 7 45	Good.
40. Ditto	Star N. (α Urs. Ma.)	25 7 43		Good.
41. Fên-shui-ling ..	Sun	25 5 24	25 5 24	Fair.
42. Pan-ch'iao	Star S. (Sirius)	25 3 6	25 3 12	Fair.
43. Ditto	Star N. (α Urs. Ma.)	25 3 18		Satisfactory.
44. Yün-nan Fu ..	Star S. (Sirius)	25 2 41	25 2 40	Good.
45. Ditto	Star N. (α Urs. Ma.)	25 2 35		Fair.
46. Ditto	Star S. (Sirius)	25 2 45	25 2 55	Good.
47. Ditto	Star N. (α Urs. Ma.)	25 2 55		Fair.
48. Liao-i-p'u	Jup.	28 54 35	28 54 0	Fair.
49. Pao-an-ying ..	Do.	28 49 53	28 49 25	Fair.
50. Têng-hsiang ..	Do.	28 28 22	28 27 45	Good.
51. Ning-yuan Fu ..	Do.	27 54 14	27 53 30	Good.
(Examination Hall).				
52. Ditto	Do.	27 54 3	27 40 45	Good.
53. Ditto	Star N. (α Cephei)	27 52 41		A little before meridian: fair.
54. Huang-lien-p'u ..	Jup.	27 41 19	27 40 45	Good.
55. Ditto	Star N. (α Cephei)	27 40 10		Good.
56. Ma-li-chai	Jup.	27 32 8	27 31 35	Good.
57. Hsiao-kao-ch'iao	Do.	27 22 14	27 21 40	Satisfactory.
58. Chin-ch'üan-ch'iao	Sun	27 11 32	27 11 0	Good.
59. HUI-LI-CHOW ..	Do.	26 39 35	26 39 0	Rough.
60. Ditto	Do.	26 39 35		Good.
61. Hsiao-pa	Do.	26 34 10	26 33 40	Very good.
($\frac{1}{3}$ mile N.W. of).				
62. Ditto	Do.	26 34 23	26 35 20	Very good.
(Same Station).				
63. Liu-shu-wan ..	Do.	26 35 56	26 35 20	Fair.

(A.) OBSERVATIONS for LATITUDE—*continued.*

STATION.	Position of Object observed N. or S. of Zenith.	Result.	Mean, or accepted, Lat.	REMARKS.
64. Ch'ê-la (2 miles N.E. by E. of).	Sun	26 38 57	26 28 30	Good.
65. Wa-wu	Do.	26 53 47	26 53 10	Rough.
66. Ch'iao-chia T'ing	Star N. (α Cephei)	26 54 14	26 54 50	Fair.
67. Ditto	Mars	26 55 29		Fair.
68. Ai-chuo	Star N. (α Cephei)	26 55 5	26 55 45	Fair.
69. Ditto	Mars	26 56 32		Fair.
70. Ditto	Sun	26 56 6	26 58 20	Good.
71. Mao-p'o	Star N. (α Cephei)	26 57 55		Fair.
72. Niu-ko-ch'ang ..	Sun	27 2 58	27 2 20	A little late.
73. Lung-shu ($\frac{1}{2}$ mile S. of).	Do.	27 18 27	27 18 0	Rough.
74. Pai-fa-ch'i	Do.	27 33 2	27 32 25	Fair.
75. San-chia-chai ..	Do.	27 39 27	27 39 0	Fair.
76. Miao-wa ($\frac{3}{4}$ mile E.N.E. of).	Do.	27 50 0	..	Not worth much.
77. Yang-liu-shu ..	Do.	27 50 48	27 50 10	Fair.
78. Huang-p'ing ..	Star N. (α Cephei)	27 52 0	27 52 40	Good.
79. Ditto	Mars	27 53 23		Fair.
80. Sha-ho	Sun	27 57 22	27 56 40	Good.
81. Kan-t'ien-pa ..	Star N. (α Cephei)	27 57 16	27 58 0	Poor.
82. Ditto	Mars	27 58 40		Good.
83. Huang-kuo-shu .. (South end).	Sun	28 0 2	27 59 25	Good.
84. Ya-k'ou	Star N. (α Cephei)	28 0 26	28 1 0	Fair.
85. Ditto	Mars	28 1 35		Fair.
86. Ditto	Sun	28 2 10	28 4 45	Not worth much : bystanders troublesome.
87. Ting-chiang-ao ..	Do.	28 5 20		Good.
88. Yu-fang-kou .. (Farm house).	Do.	28 13 26	28 12 50	Good.
89. Ching-ti	Star N. (α Cephei)	28 13 42	28 14 15	Fair.
90. Ditto	Mars	28 14 51		Fair, but hurried.
91. Bluff E. of Ching-ti	Sun	28 15 5	28 14 30	Good.
92. Kuo-ch'ian-t'an ..	Mars	28 13 29	28 13 0	Very good.
93. Hsin-tien-tzū ..	Sun	28 14 51	28 14 15	Good.
94. Huang-lung-ch'i	Do.	28 35 30	28 35 0	Fair.
95. $1\frac{1}{2}$ mile W. of Ming-yuan Bridge.	Do.	28 38 38	28 38 0	Fair.
96. Sū-chou Fu .. (N. corner of).	Do.	28 47 23	28 46 50	Good.
97. 2 miles above Niu- shih-pien. (See Chart).	Do.	28 48 11	28 47 35	Satisfactory.

(A.) OBSERVATIONS for LATITUDE—continued.

STATION.	Position of Object observed N. or S. of Zenith.	Result.	Mean, or accepted, Lat.	REMARKS.
98. Ni-ch'i-chang .. (Upper end).	Sun	29 1 15	29 0 40	Fair, result doubtful.
99. Chu-kên-t'an .. (½ mile above centre).	Do.	29 25 31	29 24 55	Fair.
100. Tung River .. (Mouth of, R.B.).	Do.	29 34 4	29 33 30	Fair.
101. Chia-ting Fu .. (Middle of E. wall).	Do.	29 34 40	29 34 5	Very rough.
102. Lu-lu-p'ing ..	Do.	29 18 45	29 18 10	Fair.
103. Ta-t'ien-ch'ih ..	Do.	29 24 0	29 23 25	Fair.
104. Mu-hsü	Do.	29 21 18	29 20 45	Satisfactory.
105. Fu-lin	Do.	29 21 46	29 21 10	Good.
106. Ho-chiang-pa ..	Do.	29 21 29	29 20 55	Good.
107. Lao-wa-hsüan .. (1 mile W.S.W.).	Do.	29 16 0	?	Unsatisfactory.
108. Tzū-ta-ti	Do.	29 17 35	} 29 16 45	Very good.
109. Ditto	Star S. (Sirius)	29 17 27		Good.
110. Ditto	Star N. (α Urs. Ma.)	29 16 0	} 29 14 50	Very good.
111. Lao-wa-hsüan ..	Sun	29 15 38		Good.
112. Na-erh-pa	Do.	29 16 22	} 29 15 25	Poor.
113. Ditto	Star N. (α Urs. Ma.)	29 14 37		Good.
114. Ditto	Star S. (Spica)	29 16 14	} 29 15 25	Fair.
115. Ditto	Star N. (α Urs. Ma.)	29 14 38		Fair.
116. Ditto	Star S. (Spica)	29 16 13	} 29 20 20	Good.
117. Ch'u-la ravine .. (¾ mile S. of mouth).	Star N. (α Urs. Ma.)	29 19 50		Fair.
118. Ditto	Star S. (Spica)	29 20 53	} 29 32 5	Good.
119. Wan-tung	Sun	29 32 37		Fair, but sun too high to be trustworthy.
120. Ta-chien-lu (Near S. Gate).	Star N. (γ Urs. Ma.)	30 2 40	} 30 3 6	Good.
121. Ditto	Star N. (γ Urs. Ma.)	30 2 25		Poor.
122. Ditto	Star S. (Antares)	30 3 49	} 29 54 55	Fair.
123. Ditto	Star S. (Spica)	30 3 28		Good.
124. Lu-ting-ch'iao ..	Star N. (γ Urs. Ma.)	29 54 27	} 29 54 55	Good.
125. Ditto	Star S. (γ Virg.)	29 55 8		Fair.
126. Ditto	Star S. (Spica)	29 55 24	} 29 32 55	Good.
127. Ditto	Star N. (γ Urs. Ma.)	29 54 43		Good.
128. Fu-chuang (S.E. end).	Star S. (Spica)	29 33 23	29 32 55	Fair.

OBSERVATIONS FOR LONGITUDE.

(B)

Ch'iao-chia T'ing, 18 Sept. 1877. Obs. for Longitude, in n. lat. 26° 54' 52", with Sextant C.

Adjusted slight side error. Observed Index error, 25" +. Observed Barometer 27.11, and Thermometer 71°.

Time obs.			Star W.			Time obs.			Star E.		
Watch.			Double Alts. Jupiter.			Watch.			Double Alts. Mars.		
H.	M.	s.	°	'	"	H.	M.	s.	°	'	"
8	19	15	58	49	40	8	26	40	65	45	20
8	21	40	58	10	20	8	28	15	66	18	3
8	23	35	57	37	50	8	29	25	66	47	30

LUNAR DISTANCES.

Watch.			Dist. Jupiter fr. N.L.			Watch.			Dist. Mars fr. F.L.		
H.	M.	s.	°	'	"	H.	M.	s.	°	'	"
8	34	20	45	55	20	8	55	2	29	21	20
8	37	55	45	56	20	8	58	35	29	20	30
8	40	10	45	57	10	9	0	40	29	19	20
8	44	15	45	58	10	9	3	25	29	18	40
8	47	3	45	59	0	9	5	20	29	18	0

Time obs.			Star E.		
Watch.			Double Alts. Mars.		
H.	M.	s.	°	'	"
9	16	55	81	50	10
9	18	23	82	15	40
9	19	48	82	39	20

Time obs.			Star E.		
Watch.			Double Alts. β Ceti.		
H.	M.	s.	°	'	"
*11	25	46	78	28	20
11	27	3	78	57	0
11	28	38	79	16	20

LUNAR DISTANCES.

Watch.			Dist. Saturn fr. F.L.		
H.	M.	s.	°	'	"
11	34	11	34	20	20
11	39	5	34	18	30
11	41	10	34	17	50
11	45	2	34	16	30
11	47	26	34	15	50

Time obs.			Star E.			Time obs.			Star W.		
Watch.			Double Alts. β Ceti.			Watch.			Double Alts. Mars.		
H.	M.	s.	°	'	"	H.	M.	s.	°	'	"
11	52	32	83	38	50	12	56	43	86	32	50
11	54	13	83	54	20	12	58	16	86	10	0
11	55	42	84	8	20	13	0	6	85	42	10
						13	1	3	85	26	10
						13	2	1	85	10	40

RESULTS : By Jupiter 103 3.5
 ,, By Saturn 102 39

102 51 E. long.

* This should be 11 h. 24 m. 46 s.

(C.)

Tzū-ta-ti, A.M. *24th March, 1878, in n. lat. 29° 16' 44". Observed with Sextant B.

Time obs. Star W.				Time obs. Star E.							
Watch.			Double Alts. Regulus.			Watch.			Double Alts. Vega.		
H.	M.	S.	°	'	"	H.	M.	S.	°	'	"
1	38	46	73	15	30	1	48	52	64	44	10
1	40	5	72	41	40	1	50	13	65	14	10
1	41	7	72	14	20	1	51	15	65	38	30
1	42	10	71	47	20	1	52	27	66	5	30
1	43	18	71	18	10	1	53	29	66	29	20

LUNAR DISTANCES.

Watch.				Dist. Spica fr. F.L.				Watch.				Dist. Jupiter fr. n.L.L.					
H.	M.	S.	°	'	"	H.	M.	S.	°	'	"	H.	M.	S.	°	'	"
2	23	30	48	52	20	—	3 A.M.	4	0	10	50	7	0				
2	26	40	48	52	50	—	Ther. 58°.	4	2	26	50	6	10				
2	27	58	48	53	10	—	Bar. 26·98.	4	4	34	50	5	40				
2	35	33	48	55	50	—	I.E. 1' 50".	4	6	15	50	5	10				
2	38	24	48	57	30	—	1' 30".	4	7	57	50	4	30				
2	41	51	48	58	50	—	1' 50".	4	10	4	50	3	50				
2	45	50	49	0	20	—	1' 30".	4	12	33	50	3	10				

Time obs. Star E.				Time obs. Star W.							
Watch.			Double Alts. Altair.			Watch.			Double Alts. Spica.		
H.	M.	S.	°	'	"	H.	M.	S.	°	'	"
4	20	16	77	3	40	4	30	27	57	1	40
4	21	28	77	35	30	4	31	55	56	29	10
4	24	3	78	41	0	4	33	0	56	5	20
4	25	11	79	10	0	4	34	1	55	43	10
4	26	11	79	35	20	4	35	27	55	11	50

NOTE.—Subtract four seconds from all times.

RESULT: By Spica 102 39·5
 ,, By Jupiter 102 39·3

102 39·4 E. long.

(D.)

Tsū-ta-ti, A.M. 25th March, 1878, in n. lat. 29° 16' 44". Sextant B.
 1.30 A.M. Ther. 67°. Bar. 26·76.

Index Error 1' 20"
 ,, 1' 40"
 ,, 1' 20"
 ,, 1' 20"
 ,, 1' 40"

Time obs. Star W.				Time obs. Star E.							
Watch.			Double Alts. Regulus.			Watch.			Double Alts. Vega.		
H.	M.	S.	°	'	"	H.	M.	S.	°	'	"
1	51	31	65	28	0	2	2	12	71	47	10
0	52	55	64	50	0	0	3	39	72	20	40
0	54	27	64	10	10	0	4	54	72	50	40
0	56	10	63	25	10	0	6	11	73	19	50
0	57	20	62	54	20	0	7	40	73	55	10

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LUNAR DISTANCES.

Watch.			Dist. Spica fr. F.L.			Watch.			Dist. Altair fr. N.L.		
H.	M.	S.	°	'	"	H.	M.	S.	°	'	"
2	15	25	62.	6	50	2	33	24	48	23	0
0	18	39	62	7	30	0	36	13	48	22	0
0	21	44	62	8	10	0	40	53	48	21	20
2	50	12	62	20	10	3	2	4	48	17	10
0	54	0	0	21	30	0	4	17	0	16	20
0	57	55	0	22	30	0	8	49	0	14	20
3	12	53	62	29	20	3	22	15	48	12	40
0	15	20	0	30	10	0	28	42	0	10	50
0	18	36	0	31	0	0	30	37	0	10	30

Time obs.			Star E.			Time obs.			Star W.		
Watch.			Double Alts.			Watch.			Double Alts. Spica.		
H.	M.	S.	°	'	"	H.	M.	S.	°	'	"
3	47	39	65	20	20	3	59	40	66	8	50
0	48	45	65	47	40	4	0	59	65	41	20
0	50	30	66	33	10	4	2	10	65	16	50
0	51	37	67	0	5(?)	4	3	23	64	50	20
0	52	57	67	36	0	4	4	33	64	26	40

Index Error .. 1 30 — Bar. 26·77. Ther. 64°.

1 50
1 20
1 30
1 30
1 30
1 30

NOTE.—Subtract four seconds from all times.

RESULTS:	By Spica:			By Altair:		
	°	'	"	°	'	"
	102	32	30 E.	101	23	15
	102	24	45	101	31	0
	102	25	30	101	44	45

Rejected.

(E.)

Na-erh-pa, 7th April, 1878. Obs. for Longitude, in N. lat. 29° 15' 25".
NOTE.—Subtract four seconds from (1) and (3), not from (2).
Observed with Sextant C.

Time obs. by ☉.

Watch.			Double Alts. ☉		
H.	M.	S.	°	'	"
2	2	59·5	105	32	40
	4	7	105	8	40
	5	7	104	46	30
	6	12	104	22	50
	7	6	104	1	0

DISTANCES of SUN from MOON'S N.L.

Watch.			Distances.		
H.	M.	S.	°	'	"
2	13	45	49	46	10
	16	47		46	50
	18	35		47	30
	21	25		48	20
	23	36		49	20
	25	41		49	50
	27	50		50	30
	29	31		50	50
	31	31		51	30
	34	7		52	0
	35	43		52	40
	37	44		53	10
	39	49		53	50
	42	40		54	30
	44	52		55	10

Time obs. by ☉.

Watch.			Double Alts. ☉		
H.	M.	S.	°	'	"
2	49	15	87	24	30
	50	20	86	57	50
	51	17	86	34	0
	52	10	86	13	0
	53	10	85	47	20

Index Error .. 10''+
 ,, .. 15''+
 ,, .. 10''+

Bar. 26·50.
 Ther. 72°.

(F.)

Na-erh-pa; same evening (7th April, 1878).

NOTE.—Subtract four seconds from all times.

Observed with Sextant C.

Bar. 26·70. Ther. 70°.

Time obs. Star E.					Time obs. Star W.				
Watch.			Double Alts. Regulus.		Watch.			Double Alts. Betelgeux.	
H.	M.	S.	°	'	H.	M.	S.	°	'
7	5	39	119	13	7	26	15	91	11
	7	12	119	49		27	24	90	43
	8	40	120	23		28	30	90	16
	9	55	120	52		29	38	89	48
	11	10	121	20		30	42	89	22

DISTANCES of POLLUX from MOON'S F.L.

Watch.			Distances.		
H.	M.	S.	°	'	"
7	39	31	42	10	50
	42	34		10	10
	45	28		9	0
	47	31		8	10
	50	8		7	10

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DISTANCES OF POLLUX from MOON'S F.L.—*continued.*

Watch.			Distances.		
H.	M.	S.	°	'	''
	53	15		5	0
	56	31		3	30
	58	15		3	0
8	0	15		2	30
	2	31		1	0
	6	11	41	59	40
	8	2		58	30
	9	52		58	0

Time obs. Star W.						Time obs. Star E.					
Watch.			Double Alts. Procyon.			Watch.			Double Alts. Benetnasch.		
H.	M.	S.	°	'	''	H.	M.	S.	°	'	''
8	16	21	109	30	0	8	26	55	78	59	10
	17	33	109	4	0		28	13	79	24	10
	18	32	108	44	30		29	23	79	46	10
	19	44	108	19	0		30	29	80	7	30
	21	0	107	50	50		31	46	80	32	40

Bar. 26·87. Ther. 66°.

RESULTS : By Sun (E.)	103	1	15
,, By Pollux (F.)	102	26	15
	102	43	45 E. long.

(G.)

OBS. FOR COMPASS VARIATION.

			Var. E.
1	Mar. 1876	YUNNAN-FU	4 50
2	Aug. 1877	Lu-ku	3
3	,,	Ning-yuan Fu	4 30
4	Sept. ,,	Hsiao-kao-ch'iao	3
5	,, ,,	T'ieh-hsiang-fang	4 45
6	,, ,,	Hui-li Chou	5 40
7	,, ,,	Chiang-chou	4 25
8	,, ,,	Lo-po-ti	6 30
9	,, ,,	Ai-chuo	5 15
10	Oct. ,,	Yeh-chu-chai	30 (?)
11	,, ,,	Short distance from preceding	7 30
12	,, ,,	Hsin-tien-tzū	4 10
13	,, ,,	Two miles north of preceding	4
14	,, ,,	Ya-k'ou	3 20
15	,, ,,	Yu-fang-kou	3 30
16	Feb. 1878	SŪ-CHOU	3
17	,, ,,	Tao-ssü-kuan	2 30
18	Mar. ,,	Lu-lu-p'ing	4 30
19	,, ,,	Mount Ma-lieh	4 35
20	,, ,,	Lao-wa-hsüan	7 25
21	,, ,,	Tzū-ta-ti	7 50
22	April ,,	Hsiao-ma-ch'ang	4 50
23	,, ,,	Ta-chien-lu	8 50
24	May ,,	Lu-ting-ch'iao	4 30

(H.) COMPARISON of RESULTS with those accepted by the JESUIT SURVEYOR, and by LIEUT. GARNIER.

PLACES.			Jesuits.	Lieut. Garnier.
Ta-chien-lu	Lat.	30 4 6	0 1 1	0
"	Long.	102 18		
O-mei Hsien	Lat.	29 34		
"	Long.	103 47		
Chia-ting Fu	Lat.	29 34	29 27 30	
"	Long.	104	103 55	
Fu-lin'	Lat.	29 21 10		
"	Long.	102 57		
Ch'ien-wei Hsien	Lat.	29 10	29 9	
"	Long.	104 11	104 8	
Sü-chou Fu	Lat.	28 46 50	28 38 25	
"	Long.	104 51 30	104 45 38	104 30
P'ing-shan Hsien	Lat.	28 39 8	28 31	
"	Long.	104 25	104 18 30	
Yüeh-hsi T'ing	Lat.	28 39		
"	Long.	102 43		
Fu-kuan-ts'un	Lat.	28 37		
"	Long.	104 10		
Lui-po T'ing	Lat.	28 18 30		
"	Long.	103 50		
Ning-yuan Fu	Lat.	27 53 30	27 50	
"	Long.	102 27	102 12	
Yung-shan Hsien	Lat.	27 48		
"	Long.	103 52		
Chao-t'ung Fu	Lat.	27 20 35	27 20	27 26
"	Long.	103 53	103 50	103 25
Ch'iao-chia Ting	Lat.	26 54 50		
"	Long.	103 5		
Hui-li-chou	Lat.	26 39	..	26 38
"	Long.	102 26	..	102 11
Tung-ch'uan Fu	Lat.	26 25	26 21	26 25
"	Long.	103 25	103 25 40	103 2
Hsün-tien-chou	Lat.	25 33 50		
"	Long.	103 19		
Yün-nan Fu	Lat.	25 2 40	25 6	25 4
"	Long.	102 41 30	102 51 40	102 36
Lu-fêng Hsien	Lat.	25 9	25 12	
"	Long.	102 2 30	102 14	
Kuang-t'ung Hsien	Lat.	25 10 20	25 15	
"	Long.	101 40 30	101 55	
Ch'u-hsiung Fu	Lat.	25 1 45	25 6	
"	Long.	101 26 10	101 43	
Chên-nan-chou	Lat.	25 11 10	25 16	
"	Long.	101 9 40	101 24	
Chao-chou	Lat.	25 35	25 38	
"	Long.	100 13 28	100 31	
Ta-li Fu	Lat.	25 41 50	25 44 25	25 44
"	Long.	100 3	102 22	100 27
Yung-ch'ang Fu	Lat.	25 7 10	25 4 50	
"	Long.	99 6	99 26	
T'êng-yüeh	Lat.	25 1 45	24 58	
"	Long.	98 24	98 45	

Chung-ching, 25th July, 1879.

E. COLBORNE BABER.

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