A fix from 1908

In the Finnish (then under Russian flag) barque *Prompt*, captain Hugo Lundqvist (1878-1936), 16 days out from Hamburg bound for Antofagasta in Chile, the following note was made in the logbook on the evening of 14 August 1908, in approximate position 31°N 15°W:

"At 10.30 [pm] observed meridian altitude of Altair 67°57.5′ and Moon's lower limb altitude in the east 20°12.5′ when chronometer showed $11^h12^m48^s$ ..."

At the top of the same log page is shown that the chronometer was $17^m30.9^s$ slow at 25 July noon, with a rate of losing 2.1^s per day. Elsewhere in the log it is stated that height of eye is 15 feet, unless otherwise stated.

According to page 393 of "The Nautical Almanac and Astronomical Ephemeris for the Year 1908" the declination of Altair was N 8°37′39.02″ for 8 August and 8°37′40.33″ for 18 August. As the altitudes are given to 0.1′ it is reasonable to use a declination of 8°37.7′. Then the latitude is found from

sextant altitude	67°57.5′
correction for dip	-3.8′
correction for refraction	-0.4′
true altitude	67°53.3′ S
zenith distance	22° 6.7′ N
declination	8°37.7′ N
latitude	**30°44.4′ N**

Knowing the latitude, we could use the moon altitude to find the longitude. Let's start with finding GMT of the observation. Note that in 1908 GMT was starting at noon.

chronometer reading	$11^h12^m48^s$
error on 25 July	$17^m30.9^s$
correction since then	43.1^s (6 days in July plus 14.5 days in August, times 2.1^s a day)
GMT	$11^h31^m\ 2^s$

On page 88 of the NA the moon's semidiameter and horizontal parallax are found. Taking the midnight values, we get sd=16.5′ and hp=60.4′. On page 93 we find hourly values of right ascension and declination respectively, and their variation in 10 minutes of time. By interpolation we get RA=$12^m\ 0^s$ and declination S 4°17.1′. Finally, on page 87 we find sidereal time at Greenwich mean noon as $9^h30^m01.13^s$. At the time of observation, we have

GST noon	$9^h30^m01.1^s$
GMT at observation	$11^h31^m\ 2^s$
acceleration 11^h	$1^m48.4^s$
acceleration 31^m	5.1^s
GST at observation	$21^h\ 2^m57^s$

The acceleration values are found in any contemporary nautical table.

To reduce the moon's altitude, we get

sextant altitude LL	20°12.5′		
correction for dip	-3.8′		
correction for refraction	-2.6′	log hp	1.7810
local altitude LL	20° 6.1′	log cos alt	9.9727
parallax	56.7′	log par	1.7537
sd	16.5′		
true altitude	21°19.3′		

Now, to find the moon's local hour angle and hence the longitude

altitude	21°19.3′		
latitude	30°44.4′		log sec 0.06577
polar distance	94°17.1′	(85°42.9′)	log csc 0.00122
sum	146°20.8′		
half	73°10.4′		log cos 9.46161
half minus altitude	51°51.1′		log sin 9.89565
local hour angle (east)	$4^h\ 8^m11^s$		log hav 9.42425
local hour angle	$19^h51^m49^s$		
right ascension	$0^h12^m\ 0^s$		
local sidereal time	$20^h\ 3^m49^s$		
Greenwich sidereal time	$21^h\ 2^m57^s$		
longitude in time	$-\ 0^h59^m\ 8^s$		
longitude	**14°47.0′ W**		

A critical reader might find that log sec latitude actually is 0.06576 but the value used above is the result obtained by linear interpolation between 30°44′ and 30°45′ in a 5-figure table. To find the log csc for a value larger than 90° in a table ending at 90°, use csc(90°+x)=csc(90°-x).

Now, how does this result compare with the result shown in the log?

"... when chronometer showed $11^h12^m48^s$, of which latitude 30°44′ N, longitude 14°46.7′ W"

Not bad at all.