

AN ESTIMATE OF TIDES DURING THE BATTLE OF SULLIVANS ISLAND SC, 28 JUNE 1776

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Events during the British naval and land attack on Sullivans Island on 28 June 1776 had to be coordinated with the tides. Parker’s fleet had to approach on a rising tide to keep from being grounded as the tide went out, and the attack had to be abandoned when an ebbing tide would carry the ships away from shore. Clinton’s land troops originally intended to ford Breach Inlet, which had been thought possible at low tide. Movements of boats in the creeks and the placement of artillery also had to be coordinated with tides. It is of some interest, therefore, to determine at what times low and high tides occurred during the engagement. Using the reasoning and methods outlined below, I arrived at the times shown in Table 1.

Table 1. Local times of tides at Charleston on 28 June 1776 estimated from the time of lunar transit on the preceding day, as explained below. Accuracy is estimated to be ± 20 min.

Lunar transit	HIGH	LOW	HIGH	LOW
8:55 PM 27 June	4:15 AM	10:22 AM	5:07 PM	11:15 PM

- 1) Tides are governed by the positions of the moon and sun, with high tide resulting from the gravitational pull of the moon. The high tide next following a lunar transit (midpoint between moon rise and set) should therefore occur after an interval that will be the same at a given time of year and phase of the moon. I used the US Naval Observatory online calculator to find lunar phase and time of lunar transit at Charleston in 1776. That source calculates that the Moon was at first quarter at 9:08 PM EST on 23 June 1776. This would actually be 8:45 local solar time, because at Charleston on 28 June solar noon occurs at 12:23 PM EST. This time was checked by comparing it with the time of first quarter given by *The South-Carolina Almanack, for the Year of Our Lord 1776*, kindly provided by Doug MacIntyre. That time was 8:51 PM – only 6 min different.
- 2) The online calculator determined the time of lunar transit on 27 June 1776 to be 9:18 PM EST. I used tide tables for Charleston to find the date in late June 2010 on which the time of lunar transit was closest to 9:18 PM EST. That time was 10:26 PM EDT on 22 June. (See Table 2 and Fig. 1.) The four tides following this lunar transit are shown in Table 2.

Table 2. Times (EDT) of lunar transit on 22 June 2010 and the four succeeding tides on 23 June.

Lunar transit	HIGH	LOW	HIGH	LOW
10:26 PM	5:46 AM	11:53 AM	6:38 PM	12:46 PM

- 3) The lunar transit at 9:18 PM EST on 27 June 1776 should have been followed by a high tide after the same interval (7 hr and 20 min) as on 23 June 2010. It would therefore have occurred at 4:38 AM EST on 28 June 1776. Other tides on that day should have occurred at intervals close to those in Table 2, as shown in Table 3.

Table 3. Times (EST) of lunar transit on 27 June and the four succeeding tides on 28 June 1776.

Lunar transit	HIGH	LOW	HIGH	LOW
9:18 PM	4:38 AM	10:45 AM	5:30 PM	11:38 PM

- 4) The final step to arriving at the times shown in Table 1 is to subtract 23 min to correct for the difference between EST and local solar time.

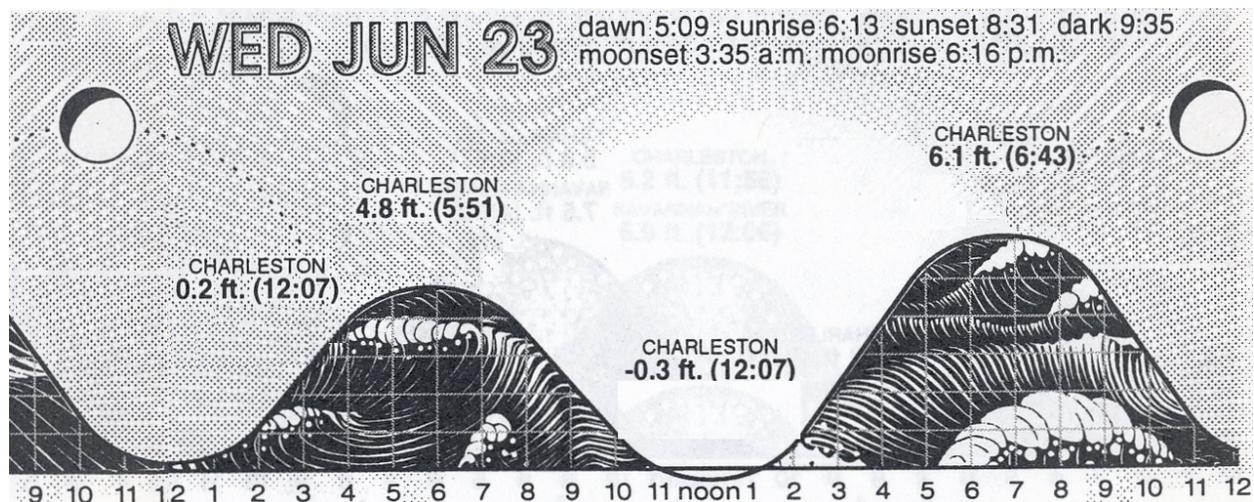


Fig. 1. Tide chart for 22 June 2010 and the preceding lunar transit. Times are EDT. Note that these tide predictions differ by several minutes from those used for my calculations (Table 2). If the night was clear on the evening of the Battle of Sullivan's Island, the moon would have appeared as in the right of this chart.

- 5) To test this procedure I used it to "predict" recorded tides in the past. The 1776 Almanack lacks tide tables, but Doug MacIntyre found that the Carolina and Georgia Almanac for 1796 predicted high tides in Charleston Harbor on 28 June 1796 at "0:47" and "1:11." Lunar transit on 28 June 1796 was at 6:33 AM EST. The time of lunar transit was closest to that at 7:45 AM EDT on 5 July 2010, and the next high tide on that day was 7 hr 17 min later. The second high tide of 28 June 1796 should therefore have been at 1:50 PM EST, or 1:27 local solar time (Table 4). The preceding high tide on 5 July 2010 came 5 hr 23 min before lunar transit, so the first high tide on 28 June 1796 should have been at 12:47 AM local time.

Table 4. Times of high tide at Charleston on 28 June 1796 derived from the *Almanac* compared with times estimated by the procedure used for Table 1.

	<u>Almanac</u>	<u>Estimated</u>
First high tide	12:47 AM	12:47 AM
Second high tide	1:11 PM	1:27 PM

My estimated times for 28 June 1796 for Charleston are 0 and 16 min later than the times derived from the *Almanac*, which shows that the method is sufficiently accurate for estimating tides during the Battle of Sullivan's Island to within 20 min.

- 6) Since I first made the calculations shown in Table 1, Mr. Hugh Harrington has obtained tidal calculations for Charleston from Admiralty EasyTide <<https://easytide.ukho.gov.uk>>. Their estimates are made by an entirely different method of projecting tide patterns backward from the present. By their calculation on 28 June 1776 the tides were as follows at EST:
 High 4:41 AM Low 10:24 AM High 5:29 PM Low 11:50 PM
 These tides would have been 23 min earlier at local solar time, i.e.:
 High 4:18 AM Low 10:01 AM High 5:06 PM Low 11:27 PM
- 7) All the data above are referenced to Charleston. Tides at Fort Moultrie are now several minutes earlier than at Charleston Harbor, and at Breach Inlet they are as much as a 15 minutes earlier. That was also likely the case in 1776.
- 8) The difficulty of correlating tides with events during the Battle of Sullivan's Island is compounded by the fact that in 1776 most people could not easily determine the true time. Solar time, which was probably most often used for setting clocks, differs from true local time by an amount called the

“equation of time” that can be up to 16.4 min ahead or behind true time. On 28 June the sun is highest at 3 min past true noon, so a clock set by the sun on that day would have been only 3 min behind. A clock set according to a sundial that had been set on Nov 4, however, would have been 16.4 min ahead at the time of the battle. Even people in 1776 who knew about the equation of time probably did not bother to correct for it. They had less need for precision than we do today, and they would probably be surprised that we tend to think that a statement such as “The battle began at 10 AM” means that it began precisely at 10:00.

- 9) Because sailors and soldiers in 1776 probably had no practical need or ability to determine times or tides with great accuracy, it may be convenient and adequate to estimate the times of the tides during the Battle of Sullivans Island as follows:

High: 4 AM Low: 10:30 AM High: 5 PM Low: 11:00 PM

Table 5. Events of 28 and 29 June correlated with calculated times of tides.

<p>28 JUNE</p> <p>Foster: “the firing from the Shipping began at nine in the morning and continued without intermission till six in the Evening.”</p> <p>Foster: “On the morning of the 28th, the wind proved favourable; it was a clear fine day, but very sultry. The <i>Thunder</i>, bomb, began the attack at half past eleven.”</p> <p>Moultrie: [The British] begun their attack most furiously about 10 o’clock A.M. and continued a brisk fire till about 8 o’clock P.M.”</p> <p>Gen. Charles Lee: "Yesterday, about eleven o' clock, the enemy's squadron... began one of the most furious cannonades ever heard or seen. Their project was, apparently, at the same time to land their troops on the east end of the Island. Twice they attempted it, and as often were gallantly repulsed. The ships continued their fire on the fort till eleven o' clock at night.</p>	<p>LOW 10:22 AM HIGH 5:07 PM</p> <p>I assume the naval attack occurred on a rising tide to get as close as possible without risk of grounding as the tide ebbed.</p>
<p>28 JUNE</p> <p>Parker: "About 9 o'clock [PM], it being very dark, great part of our ammunition expended, the people fatigued, the tide of ebb almost done, no prospect from the eastward, and no possibility of our being of any further service, I ordered the ships to withdraw to their former moorings."</p>	<p>LOW 11:15 PM</p>

Table 6. Other tide-related events.

<p>3 JUNE</p> <p>Foster aboard the <i>Pigot</i>, 4 June: “Last night we safely passed this so much dreaded Bar, we sailed just ahead of the Bristol, we cleared it intirely, she struck but very fortunately got off again very soon, we were near enough to Sullivans Battery to see the Rebels expressing great joy at the Bristols striking on the Sand” This incident is also described in a letter by a British surgeon, probably Foster, but with the incorrect date: “it was the 9th of June before the Bristol and Pigot passed the bar of Charlestown; the Bristol in passing struck, which alarmed us all exceedingly; but, as it wanted two hours of high water, she soon floated again.”</p>	<p>HIGH 8:29 PM</p> <p>These accounts taken together indicate that the <i>Bristol</i> struck the Charleston Bar in the early evening while it was still light enough for the Americans to see it – probably after 6 PM and before darkness at about 8:00 PM local time. Two hours before the calculated high tide would have been about 6:30 PM. The 1796 <i>Almanac</i>, however, states, “High Water at Charleston Bar, 1 h. 15 m. earlier than in the harbour.” If true in 1776, then high tide at the Bar would have been at 7:14 PM, and the <i>Bristol</i> would have struck at about 5:15 PM.</p>
<p>16 JUNE</p> <p>Foster on Long Island: “I find a party of Light Infantry have been endeavoring to find their way over to Sullivans Island, but find it impossible, which prevents our passing as was intended at twelve o’clock this Evening.”</p>	<p>LOW 2:01 AM 17 JUNE</p> <p>The intended crossing of Breach Inlet should have been at low tide.</p>
<p>29 JUNE</p> <p>Foster: “The Action [sic] Friggat during the Action ran aground and at low tide was so fast in the sand they could not get her off, therefore the Captain set fire to her himself and abandoned her.”</p> <p>Moultrie: “Early the next morning was presented to our view the <i>Acteon</i> frigate hard and fast aground.”</p>	<p>HIGH 5:26 AM</p> <p>The <i>Acteon</i> might have floated free before the next high tide if daylight had not come earlier and revealed her plight to the Americans. Sunrise was 4:55 AM, and by 4 AM it probably would have been light enough to see the <i>Acteon</i>.</p>

SOURCES

Foster, Thompson. *Personal Journal of Thompson Foster (aka Forster or Forrester) Surgeon to his Majesty’s Detached Hospital in North America October 19, 1775 - October 23, 1777, Transcribed from the original in possession of his family, circa 1938*

Extract of a Letter from a Surgeon in Sir Peter Parker's Fleet, Dated July 9, 1776. [Presumably by Thompson Foster.] Reprinted in Commager and Morris, Eds. *The Spirit of Seventy-Six*, p. 1065.

Moultrie, William. *Memoirs*, vol. 1.

Times of lunar transit: http://aa.usno.navy.mil/data/docs/RS_OneDay.php

Time of solar noon: <http://www.srrb.noaa.gov/highlights/sunrise/azel.html>

Tide tables: http://co-ops.nos.noaa.gov/get_predictions.shtml?year=2010&stn=2197+Charleston&secstn=Breach+Inlet,+Isle+of+Palms&thh=%2D0&thm=5&tlh=%2D0&tlm=14&hh=*0.95&hl=*1.05&footnote=