



COLLECTION OF DONALD OLSON

CAESAR'S INVASION OF BRITAIN

DONALD W. OLSON, RUSSELL L. DOESCHER, AND THE TEXAS STATE HONORS STUDENTS

A team of astro-sleuths discovers that most historians have misdated this historic Roman amphibious landing.

🕒 In 55 BC an invasion fleet commanded by Julius Caesar sailed from Gaul (France) to a location on the coast of Britain. For the Romans, it was a daring push beyond the edge of the known world. Caesar's account, read by generations of high-school students in Latin class, marks the very start of



DAVID ROSE

This aerial view looks northeastward from Dover harbor, showing the white cliffs. Most historians and archaeologists think an afternoon tidal stream carried the Roman fleet around the South Foreland promontory to the long stretch of open beach near present-day Walmer and Deal.

recorded history (as we have it) for the British Isles.

Caesar, referring to himself in the third person, gives crucial details of the venture in Book IV of his *Gallic Wars*:

Only a small part of the summer was left. . . . Caesar himself reached Britain with the first ships about the fourth hour of the day [mid-morning], and there he beheld the armed forces of the enemy displayed on all the cliffs. Such was the nature of this place, so steep were the heights that bordered the sea, that a spear could be hurled from the higher positions down onto the shore.

Considering this by no means a suitable place for landing, he waited at anchor until the ninth hour [mid-afternoon] for the rest of the ships to assemble there. . . . With the wind and tide both favorable, the signal was given to weigh anchor, and the fleet moved forward about seven miles to an open and flat shore.

Note that Caesar does not say *which way* he went the seven miles — to the southwest (indicated by 🏹 later in this



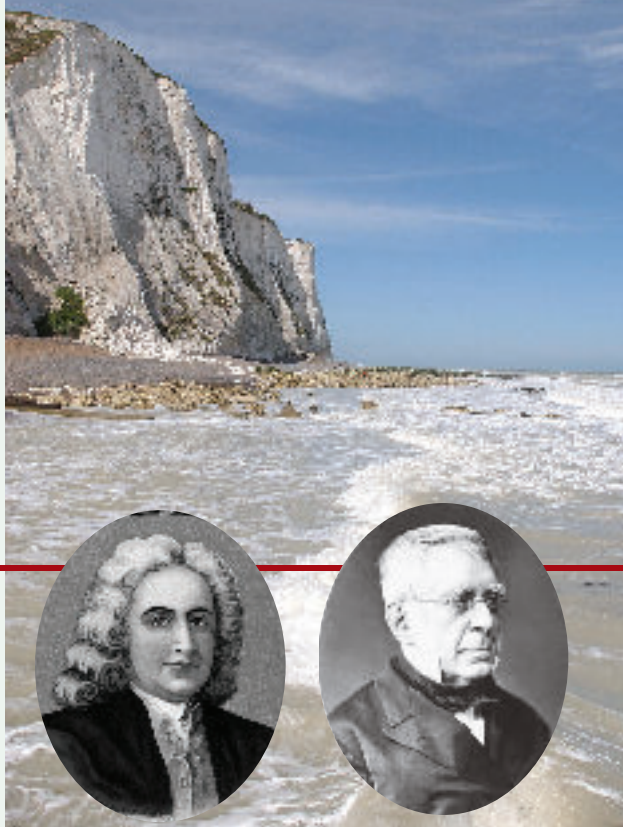
Late one August afternoon in 55 BC, the Roman army under Julius Caesar lands near the white cliffs, as depicted in Cassell's *History of the British People* (1925).

Not a good place to land two legions of Roman soldiers! The white cliffs at St. Margaret's Bay lie just northeast of Dover's harbor. The authors believe Caesar sailed past this point in August of 55 BC.

Astronomers
Edmond Halley
(1656–1742) and
George Biddell
Airy (1801–92)
both used evi-
dence of the

Sun, Moon, and
tides in their
attempts to
determine when
and where Julius
Caesar landed in
55 BC.

WHITE CLIFFS: DOVER DISTRICT COUNCIL; PORTRAITS: COLLECTION OF DONALD OLSON



ships which transported the cavalry weighed anchor. . . . When they were approaching Britain . . . a storm suddenly arose. . . . On that same night it happened that there was a full Moon, which day brings about the greatest maritime tides in the ocean . . . the tide was found to be filling up the warships in which Caesar had transported his army and which had been drawn up on dry land.

After campaigning in Britain for a few weeks, Caesar mentions the time of year when he returned to Gaul: “The day of the equinox was drawing near. . . . Having gotten a spell of fair weather, the ships weighed anchor a little after midnight, and all came safely back to the continent.”

Now, in 55 BC the autumnal equinox fell on September 25th (on the Julian calendar), and the previous full Moon occurred on August 31st near 3 hours Universal Time. So it appears the storm began on August 30th. Caesar’s reference to “fourth day” seems to place the landing on August 26th, or possibly on the 27th if he was using inclusive counting. (For this discussion, it doesn’t matter which.)

○ Halley vs. Airy

Astronomer Edmond Halley was the first person to date Caesar’s arrival in Britain using the clues about the Moon and equinox. In the 1691 *Philosophical Transactions* of the Royal Society, Halley wrote that the landing must have taken place on the afternoon of August 26th. He added, “As to the Place, the high Land and Cliffs described, could

article) or northeast (📍) — along the British coast.

In his classic *Roman History* (written in about AD 200), historian Dio Cassius tells us more:

Caesar did not land at the place where he intended, for the Britons learned in advance that he was sailing against them, and they had occupied all the usual landing places on the coast facing the continent. Accordingly, Caesar sailed around a certain projecting headland, sailed along the other side, disembarked there in the shallows, and vanquished the enemy.

But just when in 55 BC did Caesar’s fleet land on the coast of Britain? And where did his two Roman legions, some 10,000 men, actually come ashore? These two questions have made lively topics of debate, not only for the coastal residents of Kent, but also for distinguished historians — and astronomers.

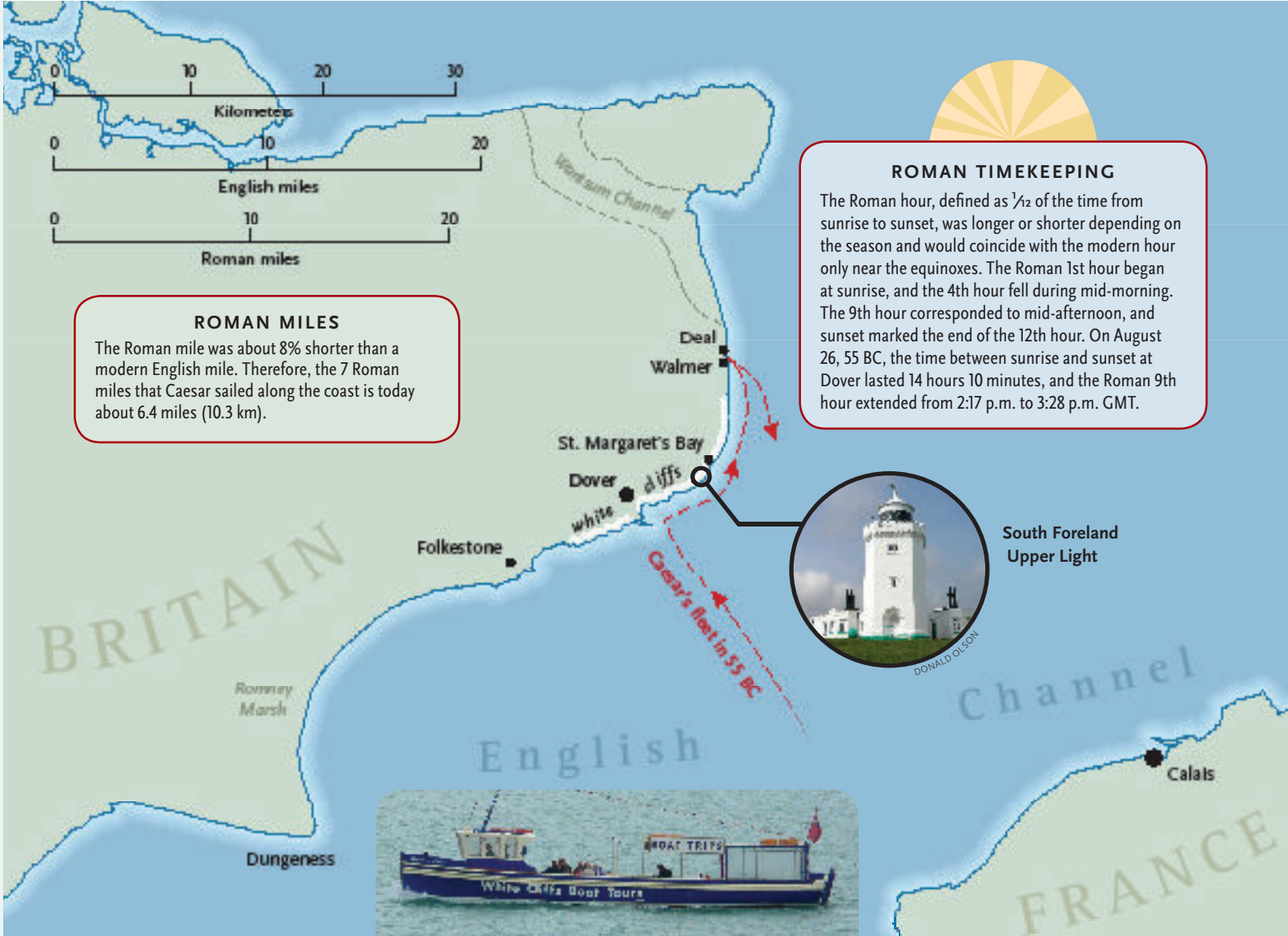
Caesar provides intriguing astronomical clues in a later passage about some ships delayed for several days in their departure from Gaul:

On the fourth day after our arrival in Britain, the eighteen



As the Romans approach, the Britons in their war chariots stand ready to oppose them in this 1868 chromolithograph.

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ROMAN MILES

The Roman mile was about 8% shorter than a modern English mile. Therefore, the 7 Roman miles that Caesar sailed along the coast is today about 6.4 miles (10.3 km).

ROMAN TIMEKEEPING

The Roman hour, defined as $\frac{1}{12}$ of the time from sunrise to sunset, was longer or shorter depending on the season and would coincide with the modern hour only near the equinoxes. The Roman 1st hour began at sunrise, and the 4th hour fell during mid-morning. The 9th hour corresponded to mid-afternoon, and sunset marked the end of the 12th hour. On August 26, 55 BC, the time between sunrise and sunset at Dover lasted 14 hours 10 minutes, and the Roman 9th hour extended from 2:17 p.m. to 3:28 p.m. GMT.



South Foreland
Upper Light

DONALD OLSON

be no other than those of Dover.”

✓ Halley had used the lunar phase to estimate the tide times and the direction of the tidal stream. His own study of English Channel tides told him that four days before full Moon there should be a low water about 2 p.m., and a northeastward-flowing flood current by 3 p.m., just as Caesar had described. “It is plain that . . . the open shore where he landed was to the Northward of the Cliffs.”

Concerning the promontory around which Caesar sailed, it “must needs be the South-Foreland,” Halley wrote, and the landing place the open beach near Walmer and Deal, towns to the northeast of Dover.

But Halley incorrectly considered low water to be simultaneous with the beginning of the flood stream. On average, near Dover, the northeast-going tidal stream does not begin to run until about $3\frac{1}{4}$ hours after low water. George Biddell Airy, Astronomer Royal and a tide expert, noticed Halley’s mistake and reopened the subject.

✗ Airy concluded that the tide must have carried Caesar to the southwest (not northeast) of Dover, because four days before full Moon “. . . the current off Dover would run to the westward from noon to half-past six o’clock.”

(*Athenaeum*, March 29, 1851.) Airy was certain of his conclusions: “For Caesar then to have first attempted Dover and then to have landed at Walmer or Deal . . . appears absolutely impossible. . . .” (*Archaeologia*, 1852.)

But historians argued that the ancient authors were unambiguously describing the coastline northeast of Dover, especially the long stretch of open beach just north of the distinctive headland called the South Foreland.

✗ Impressed by this topography, Rev. E. Cardwell judged that Airy’s calculations contained “incongruities and contradictions.” After discussing tides with local mariners, Cardwell concluded: “On the 27th of August, 55 B.C., . . . at 3 o’clock p.m. the stream had turned, and was running up the Channel . . . to the eastward . . . in favour of the coast of Deal as the landing-place of Julius Caesar.” (*Archaeologia Cantiana*, 1860.)

✗ The British Admiralty then sent a Royal Navy surveyor, George H. Richards, to observe the Chan-



Don Olson, Amanda
Gregory, and Kellie Beicker
with S&T’s Roger Sinnott
(far left) at Dover harbor.

RUSSELL DOESCHER

With choppy seas and a gentle rain, Russell Doe-scher (at left), Kellie Beicker, Don Olson, and Amanda Gregory head out from Dover harbor to measure the English Channel's tidal stream.



S&T: ROGER SINNOTT (1); MARILYNN OLSON (2)

nel tides. Richards sided firmly with Airy: "At 3 P.M. of 27th August, B.C. 55, the current was running to the westward, and would continue to do so until 6.30 P.M." (*Archaeologia*, 1867.)

Elementary, My Dear Holmes

There the matter might have stood, but for his 1907 book *Ancient Britain and the Invasions of Julius Caesar*, classics scholar Thomas Rice Holmes decided to conduct his own study of nautical almanacs, tide tables, and publications for channel pilots.

❗ Holmes rejected the Admiralty result, concluding, "If he landed on the 26th of August . . . it is not improbable that the stream may have turned eastward . . . from 2.20 till 3.30 p.m. . . . There is but one conclusion to which we can come, and that conclusion is absolutely certain: when Caesar weighed anchor off the Kentish cliffs, he sailed towards the north-east. . . . He did land . . . between Walmer Castle and Deal Castle. . . . The problem is solved."

And so the debate continued.

❗ Harold Dreyer Warburg, coauthor of the *Admiralty Manual of Tides*, expressed his exasperation with historians who'd argued for a northeastward

current. "It should be running to south-westward at nearly its maximum velocity." (*English Historical Review*, 1923.)

❗ More recently, archaeologist Charles Francis Christopher Hawkes, a distinguished expert on ancient Britain, revisited the problem. Despite the assertions of all the tide experts, Hawkes again argued for a northeastward current on August 27th: "Caesar . . . got the tide about 3 p.m. . . . and sailed round to Deal. By 6 he was off the beach (near Walmer Castle) and could land." (*Proceedings of the British Academy*, 1977.)

You've perhaps noticed a pattern in these various claims. Archaeologists and historians insist that Caesar landed to the northeast of Dover in the late afternoon of August 26 or 27, 55 BC. But hydrographers and astronomers are equally adamant that the afternoon tidal stream on either of those dates must have carried Caesar's fleet to the southwest.

So who's right? How can this contradiction be resolved?

Along the British coast the Roman fleet sailed around South Foreland, pictured here.

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ACTUAL TIDE on the Traditional Invasion Dates in 55 BC

August 26	August 27	Event
11:33 a.m.	12:39 p.m.	Slack water; current turns to SW
1:50 p.m.	3:06 p.m.	Low water at Dover
2:17 p.m.	2:16 p.m.	Roman 9th hour begins (tidal stream running SW)
2:35 p.m.	3:37 p.m.	Max. SW-going stream: 1.6 knots (26th), or 1.7 (27th)
3:28 p.m.	3:26 p.m.	Roman 9th hour ends (tidal stream running SW)
5:21 p.m.	6:19 p.m.	Slack water; current turns to NE
7:00 p.m.	6:58 p.m.	Sunset, water level is rising
7:32 p.m.	8:30 p.m.	High water at Dover
8:20 p.m.	9:24 p.m.	Maximum NE-going stream

Dates are according to the Julian calendar in 55 BC; times are GMT. Because the full Moon, perigee, and equinox each came three days earlier in 2007 (due to slight calendrical and astronomical changes in 2,061 years), the Texas State team made its measurements three calendar days earlier as well.

ACTUAL TIDE on the Corrected Invasion Dates in 55 BC

August 22	August 23	Event
12:46 p.m.	1:25 p.m.	Slack water; current turns to NE
2:20 p.m.	2:19 p.m.	Roman 9th hour begins (tidal stream running NE and accelerating)
2:57 p.m.	3:36 p.m.	High water at Dover
3:32 p.m.	3:31 p.m.	Roman 9th hour ends (tidal stream running NE)
3:42 p.m.	4:25 p.m.	Max. NE-going stream: 2.9 knots (22nd) or 2.7 knots (23rd); Roman fleet is sailing NE
5 to 7 p.m.	5 to 7 p.m.	Roman fleet approaches and lands on open beach near Walmer and Deal; incident of the falling tide
7:08 p.m.	7:06 p.m.	Sunset; water level still falling, down 8.7 feet (22nd) or 5.5 feet (23rd) from prior high water
7:29 p.m.	8:09 p.m.	Slack water; current turns to SW
10:01 p.m.	10:44 p.m.	Low water at Dover

South Foreland, Lower Light



SkyandTelescope.com highlights other mysteries solved by the Texas State team, such as when Ansel Adams photographed his *Autumn Moon* and the cause of the lurid twilight in Edvard Munch's *The Scream*.

Adrift in Dover

Our Texas State group has a long-standing interest in amphibious landings, including those during World War II at the atoll of Tarawa (*S&T*: November 1987, page 526) and at Normandy on D-day (*S&T*: June, 1994, page 84).

For the Caesar problem, we discovered that certain days in late August of 2007 would have tidal conditions almost exactly like those for Caesar's landing. The full Moon fell about three days before lunar perigee and about 3½ weeks before the equinox — just as it did in 55 BC — so the most important tidal parameters (lunar phase, distance, and declination) would also be nearly the same. Not since 1901 had the match been so good, and it wouldn't happen again until 2140.

Accordingly, we spent a week on the coast of Kent in August 2007. Local authorities there maintain tide gauges that record data at the Dover and Deal piers. We also checked the water level on tide staffs fastened to the piers. To determine the direction of the tidal stream, we observed the motion of floating objects in the channel from the ends of the piers, and we arranged a charter from White Cliffs Boat Tours in order to use GPS during a free drift.

We found that the direction of the tidal stream during the 9th hour does imply a landing southwest of Dover (see the facing page, left table), just as tide experts concluded in the past. But the historians' argument that the topographic evidence fits the coast to the northeast of Dover is also compelling. Then our library research turned up another intriguing bit of tidal evidence.

In the 1st century AD, Roman writer Valerius Maximus collected anecdotes and often used ancient sources now lost. One story in his *Memorable Deeds and Sayings: Of Courage* describes a Roman soldier's bravery as the tide was falling during the battle on the British shore:

Caesar went to war and laid his divine hands on the island of Britain. You, Scaeva, were carried by ship with four fellow soldiers to a rock close to the island, which was occupied by a vast number of the enemy. The tide retreated, and the space which had divided the rock and the island was reduced to a shallow ford that was easy to cross. A vast multitude of the enemy streamed across, and while the other Romans were carried by ship to the shore, you held your station alone . . . as the enemy tried eagerly from all directions to attack you.

Valerius's account, if accurate, raises serious problems for the landing-beach scenarios favored by either the historians or the tide experts. Our table shows that on both August 26 and 27, 55 BC, high water occurred shortly after sunset. On both dates the water level was rising during the late afternoon — in conflict with this story of the falling tide during the shore battle. The same conclusion applies to all nearby beaches, whether northeast or southwest of Dover. But Caesar must have landed somewhere!

Our Solution

We found the clue to resolving this problem in a comment by historian Robin G. Collingwood regarding the number of days between Caesar's landing and the storm just before the full Moon: "I suspect that something has gone wrong with the numeral quartum [4]. . . if the interval was more like a week, the stream would be running north-eastwards when he weighed." (*Roman Britain and the English Settlements*, 1937.)

Indeed, if a transcription error occurred and four (IIII) days should actually have been seven (VII) or eight (VIII), then the landing may have taken place on August 22 or 23, 55 BC. As we show on the facing page, this single assumption matches perfectly all the topographic and tidal evidence — and our own findings from 2007.

✓ On both August 22 and 23, 55 BC, the northeast-going tidal stream began to run in early afternoon, accelerated during the Roman 9th hour, and continued until after sunset — explaining how Caesar could sail around the South Foreland to reach the landing beach near Deal.



S&T: ROGER SINNOTT

From the end of Deal Pier, Don Olson deploys an Arm-Propelled Personal Lunitidal Estimator (APPLE) into the channel to measure the southwest-moving tidal stream.

On both August 22nd and 23rd high water occurred in mid-afternoon, and then the water level began to drop, at first slowly and then more rapidly in late afternoon — explaining the story of the falling tide as the battle raged onshore.

The scientific evidence of Sun, Moon, and tides therefore suggests that August 22nd or 23rd — earlier than stated in the usual history books — correctly marks the beginning of the historic military campaign of 55 BC when the Romans under Julius Caesar first reached the island of Britain. ♦

Don Olson and Russell Doescher teach physics at Texas State University. Students Kellie N. Beicker and Amanda F. Gregory participated in this project with support from the Honors Program and the University College at Texas State. The authors are grateful for research assistance from Margaret Vaverek of the Alkek Library at Texas State and for advice on channel tides and storms from Gerald Grainge of Deal.