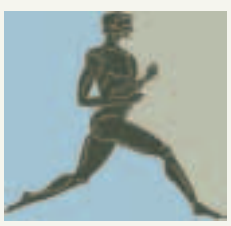
The Moon

By Donald W. Olson, Russell L. Doescher, and Marilynn S. Olson

ANTHONY AYIOMAMITIS

MOST OF US HAVE HEARD the stirring tale of the lone messenger who ran all the way to Athens, without pause for some 26 miles, and then died as he delivered urgent news from the battlefield. The Boston Marathon, the New York City Marathon, and all the other marathon races today held worldwide trace their origin to the Battle of Marathon in ancient Greece, more than two millennia ago.

Much less well known is that the historical sources actually describe *two* different runs: a longer run before the battle, and the "marathon" run after the battle. The ancient calendars and uncertain records have made it difficult for scholars to date these events precisely. But astronomical clues about the longer run suggest that the widely accepted date for the Battle of Marathon needs to be revised. And the new date, just possibly, makes it easier to understand why the messenger collapsed on his arrival.



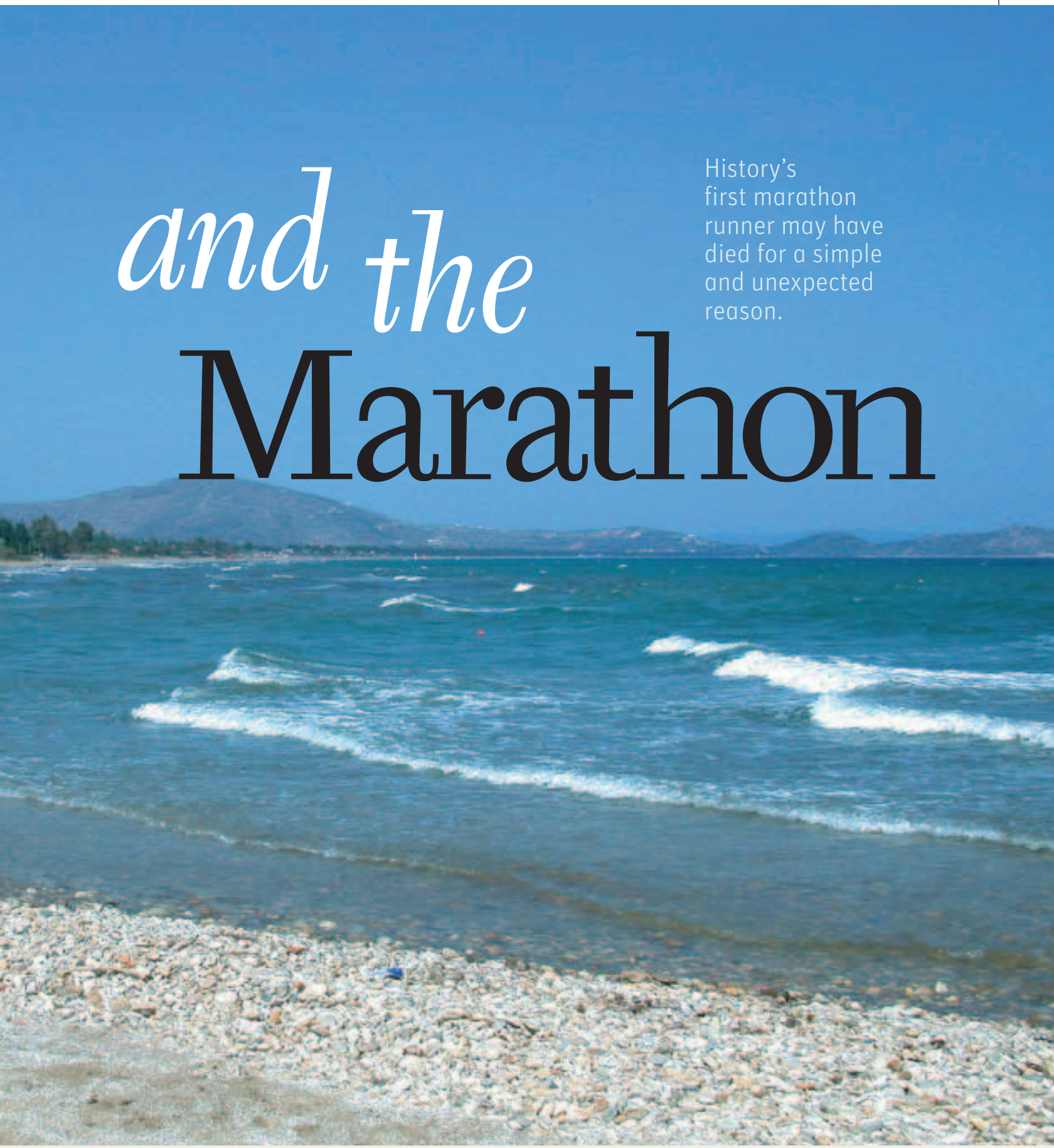
S&T: CASEY B. REED

The Run Before the Battle

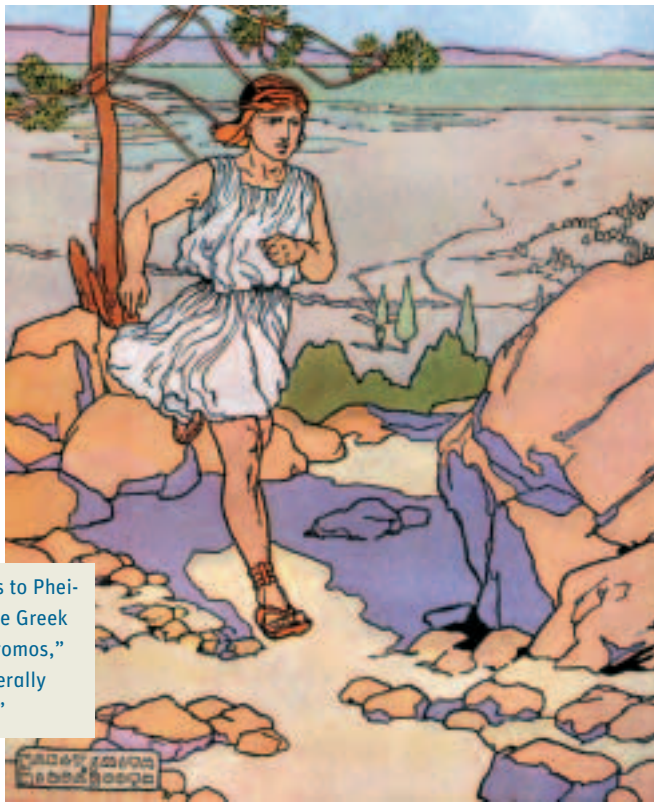
In 490 BC, King Darius of Persia sent the general Datis to Greece with orders to defeat, punish, and enslave the Athenians, because Athens had supported Ionian Greeks in a revolt against the Persian empire. The invasion

and the Marathon

History's first marathon runner may have died for a simple and unexpected reason.



The Persian invasion force landed near the north end of this beach, called Schoinias, which borders the plain of Marathon.



PIERS PLOWMAN HISTORIES, 1913

Herodotus refers to Pheidippides with the Greek word "hemerodromos," which means literally "all-day runner."

force, perhaps 20,000 to 30,000 Persian soldiers accompanied by cavalry, landed at the plain of Marathon.

The Athenian military leaders ordered the citizen army, about 10,000 strong, to Marathon. They also urgently appealed to the town of Sparta, 150 miles away in the region of Lacedaemon, for help from the formidable Spartan army. Greek historian Herodotus tells the story:

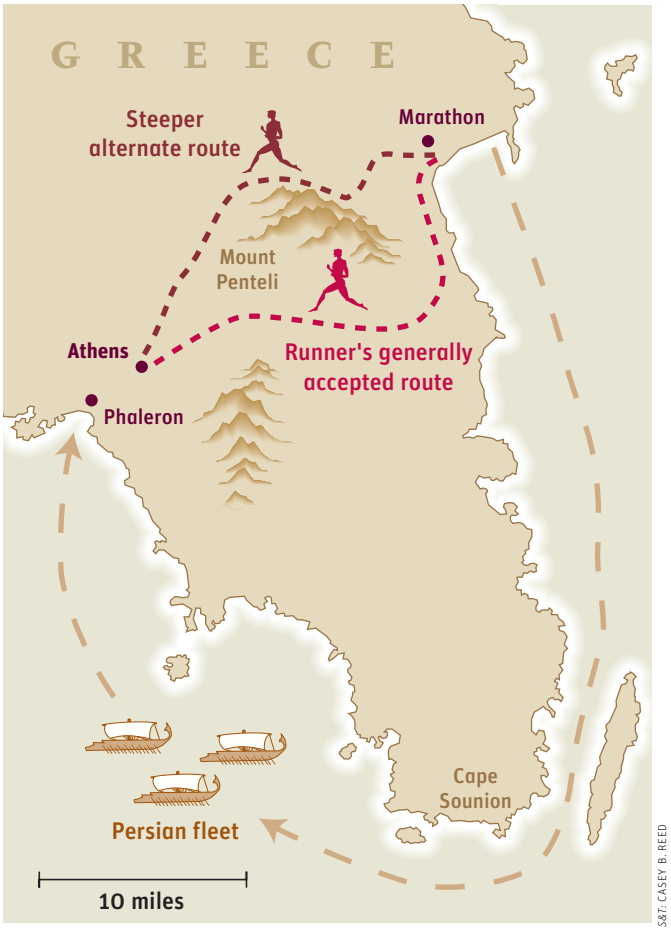
> The generals sent to Sparta a messenger, an Athenian named Pheidippides, by profession a runner of long distances. . . . Pheidippides reached Sparta the next day after departing from Athens. He went before the rulers and said to them: "Men of Lacedaemon, the Athenians entreat you to hasten to their aid, and not allow that most ancient city in all Greece to be brought into bondage by foreigners." . . . The Spartans said they wanted to assist the Athenians, but they were unable to do this immediately, because they did not wish to break the established religious laws. For it was the ninth day of the first decade of the lunar month, and they could not lead out the army on an expedition on the ninth day, they said, when the circle of the Moon was not yet full. And so they waited for the full Moon.

Herodotus does not give the calendar date for the run before the battle, except by his intriguing reference to the phases of the Moon. The Greeks began each lunar month at new Moon and then divided the following 29 or 30 days into three periods: the first 10 days were the "rising" or "waxing" period, the next 10 days were the "middle" period centered around a full Moon, and the last 9 or 10 days were the "dying" or "waning" period. The ninth day of the first decade is therefore the ninth day of the entire lunar month, and the full Moon mentioned by Herodotus would fall about six days later.

Herodotus does not name the religious festival, but most scholars identify this passage as a reference to the Spartan month of Karneios, when they abstained from warfare for about a week. As explained by the playwright Euripides, the full Moon that culminated the event occurred ". . . at Sparta when the time for the Karneian festival comes circling round, and the Moon is aloft all night long."

Writing in 1879, English poet Robert Browning describes the Athenian appeal and the Spartan law that their army could not march out to war until the time of the full Moon:

> *"Run, Pheidippides, run and race, reach Sparta for aid!*
> *Persia has come, we are here, where is She?" Your command I obeyed,*
> *Ran and raced: like stubble, some field which a fire runs through,*
> *Was the space between city and city: two days, two nights did I burn. . . .*
>
> *"Ponder that precept of old, 'No warfare, whatever the odds*
> *In your favor, so long as the moon, half-orbed, is unable to take*
> *Full-circle her state in the sky!' Already she rounds to it fast:*
> *Athens must wait, patient as we — who judgment suspend."*
>
> — Robert Browning, "Pheidippides"



S&T: CASEY B. REED

The events of 490 BC took place in the region of Greece called Attica. The Persian fleet sailed from Marathon and around Cape Sounion in an attempt to land at Phaleron, the port of Athens. The route of the herald and the Athenian army between Marathon and Athens is not known. Most scholars advocate the path southeast of Mount Penteli, and this course will be used in the Athens 2004 Olympic Games. A few authors argue that the messenger in 490 BC might have used a shorter but steeper route passing through the hills northwest of Mount Penteli.

Modern athletes have demonstrated that Pheidippides' long-distance run is definitely possible. A race called the Spartathlon, held annually since 1983, follows a route of about 150 miles from Athens to Sparta, with winning times under 27 hours.

Battle of Marathon

The outnumbered Greek army constructed a strong defensive position at Marathon and waited for aid from the Spartans. For their part, the Persians were reluctant to attack and hoped that traitors on the Greek side could persuade the Athenians to surrender the city without a fight. The two armies faced each other at Marathon for about a week as, night by night, the Moon grew brighter. Both sides knew that the Spartan army would be setting out as soon as the Moon was full and would reach Marathon a few days after that.

The Persians apparently divided their forces in an effort to produce decisive action before the Spartans could arrive. The Persians may have loaded some of the army and much of their highly regarded cavalry back onboard the ships, to sail around Cape Sounion and land at Phaleron, the port of Athens (see the facing map).

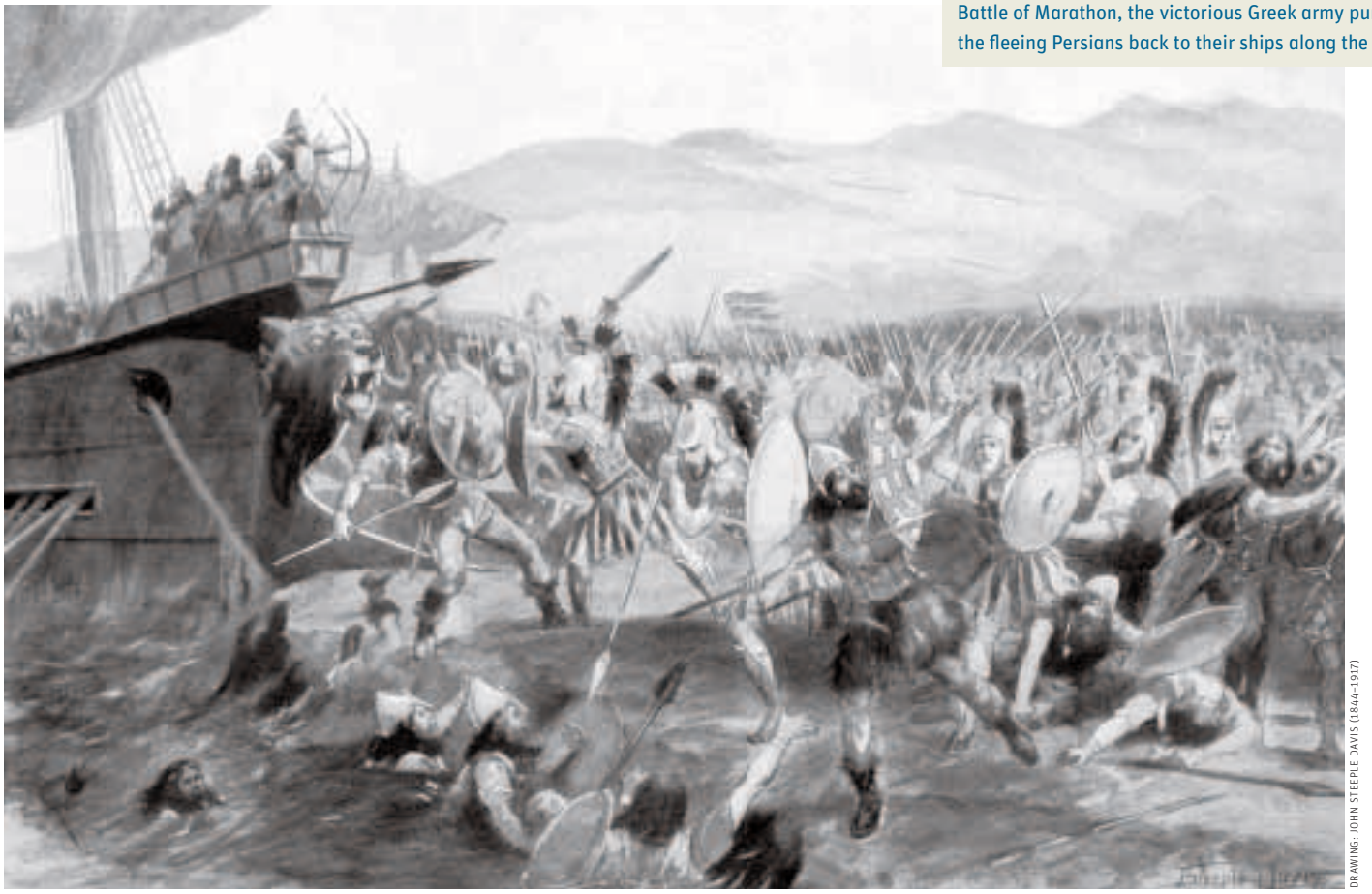
The Greek army then had no choice but to attack immediately, try to quickly defeat the Persians remaining at Marathon, and then hasten back to defend the city of Athens against the seaborne forces already on their way to Phaleron.

Tradition has it that the Greeks attacked on the run to minimize the time they were exposed to the Persian archers. The Greek army had purposely weakened its center and strengthened the wings. After the Persians broke through at the center, the two Greek wings turned inward and caught the Persians in a pincer movement. The Greek victory quickly turned into a rout, as the Persian army broke and ran for their ships. Herodotus tells us that 6,400 Persians were killed against only 192 dead on the Athenian side. These Greek heroes are buried in the mound called the Soros, still visible on the battlefield today.

The importance of this event can hardly be overestimated. The great achievements in art, sculpture, drama, poetry, medicine, philosophy, mathematics, science — and astronomy — during the Golden Age of Athens might never have occurred without the Greek victory at the Battle of Marathon.

TOLEDO MUSEUM OF ART, ANDERTON BENTLEY FUND

Above: This helmet was found about 10 miles east of Athens, just north of the new airport and not far from the marathon route that will be used in the 2004 Olympics. The helmet was made of hammered bronze around 500 BC to 450 BC, the time of the Battle of Marathon, and could be worn either down over the face or pushed back to the nape of the neck. *Below:* In the last stage of the Battle of Marathon, the victorious Greek army pursued the fleeing Persians back to their ships along the beach.



DRAWING: JOHN STEEPLE DAVIS (1844–1917)

The burial mound known as the Soros, the final resting place of the 192 Greek warriors who fell at Marathon, can still be seen on the battlefield today. Anthony Ayiomamitis made this composite with solar images to show the altitude of the midmorning Sun on various dates during the year. The Sun is near the top of the analemma (figure-8 curve) at the summer solstice. According to Greek philosopher Plato, the Athenian year began with the first new Moon after the summer solstice.

DONALD W. OLSON

Rounding Cape Sounion in 490 BC, the Persian fleet must have been a fearsome sight from the promontory where the Temple of Poseidon now stands. On June 2, 2004, the full Moon rises on a more tranquil scene.

The Run After the Battle

Robert Browning's poem of 1879 credited Pheidippides with both runs — the one calling for aid and the "marathon" run after the battle. His romantic description helped inspire the modern marathon. But he did not invent the heroic and fatal run announcing the victory. The Greek biographer Plutarch notes, "The news of the Battle of Marathon was brought back by Thersippos of Eroiades, according to Heracleides Ponticus." The latter was the Greek philosopher of the 4th century BC famous for teaching that the diurnal motion of the heavens was caused not by the motion of the stars around Earth but by Earth's rotation on its axis. Plutarch continues, "But most writers say that it was Eukles who ran in full armor, hot from the battle, and bursting in through the doors of the first men of the state, could say only, 'Rejoice! We are victorious!' and then immediately expired."

Greek satirist Lucian similarly states, "Philippides, the long-distance runner, reporting the victory from Marathon to the archons, who were seated anxiously awaiting the result of the battle, said 'Rejoice! We are victorious!' and saying this, he died at the same time as his report."

Whatever his name was, the runner after the battle had a good reason for using all possible speed: not simply to announce the victory at Marathon, but to deliver the urgent message that the Persians were coming by sea to attack the port of Athens.

Plutarch tells us, "When the Athenians had routed the foreigners and driven them back on board their ships, they saw that the foreigners were sailing away, not toward the islands, but were being carried by wind and current toward Attica. They were afraid that the Persians might find Athens empty of defenders, and so they hastened back with nine of the tribes and reached the city on the same day."

Herodotus adds the route of the Persian fleet: "The Persians sailed around Cape Sounion, hoping to reach the city before the arrival of the Athenians. . . . And so they sailed around Cape Sounion, but the Athenians marched back to the rescue, as fast as their feet could carry them, and reached the city before the foreigners. . . . The foreigners lay at anchor off Phaleron, the harbor of Athens at that time. After riding at anchor there for a time, the Persians sailed their ships back to Asia."

Too late to help, the Spartan advance guard now arrived. "After the full Moon two thousand Lacedaemonians [Spartans] came to Athens, making so great haste to reach it that they were in Attica on the third day from their leaving Sparta," writes Herodotus. And Greek philosopher Plato adds, "The Lacedaemonians [Spartans] . . . arrived too late by one single day for the battle which took place at Marathon."

These last two passages allow astronomers to date the battle, provided we can calculate in the ancient Greek calendar systems.

The Athenian calendar included 12 lunar months. A passage in Plato tells us when the Athenian year began: "The commencement of a new year begins with the month next after the summer solstice." But 12 lunar synodic months include only about 354 days, about 11 days short of a solar year. To ensure that the first month, Hekatombaion, began

at the first new Moon *after* the summer solstice, the Athenians were forced, about every two or three years, to insert a leap month.

Battle of Marathon in September?

Using the Athenian calendar, German classical scholar August Böckh (1785–1867) carried out an astronomical calculation, now widely adopted, for the date of the Battle of Marathon. Böckh wanted to determine the time of the Karneian full Moon — the culmination of the Karneian festival that delayed the Spartans. Böckh knew of a passage by Plutarch stating that certain events in 413 BC fell in "the month Karneios, which the Athenians call Metageitnion." Metageitnion is well known as the second month of the Athenian year.

To identify the second new Moon after the summer solstice, Böckh asked Johann Franz Encke (1791–1865), the German astronomer best known now for the short-period Comet Encke and the Encke Division in Saturn's rings, to compute the dates of the lunar phases for 490 BC.

Putting the calendar information together with the accounts by Herodotus and Plato, Böckh placed the Battle of Marathon on September 12, 490 BC (see the box below).

Böckh's calculation is enormously influential, cited in authoritative editions of Herodotus by Heinrich Stein (1877), Reginald W. Macan (1895), and W. W. How and J. Wells (1912), along with numerous books and essays since then — most recently, by Nicholas Sekunda (*Marathon 490 BC*, Osprey Publishing, 2002). The organizers of the Spartathlon schedule the race "every September as, according to Herodotus' account, Pheidippides' mission to Sparta was made at that time of the year" (see http://spartathlon.webvista.net).

Battle of Marathon in August?

But a few scholars have doubted that the Battle of Marathon was fought in September, arguing that the Persians would not have invaded Attica so late in the summer. Historian Andrew R. Burn agreed and judged that the astronomical calculation was ambiguous. He noted that the Persians, having met no effective resistance, should have reached Euboia, a Greek island adjacent to Marathon, by the end of July. But "an element of uncertainty is introduced by the fact that there was a new moon practically *at* the summer solstice that year." Astronomically it came before the solstice and would have fallen in the old year, but whether it was so reckoned depended on when it was actually observed, and on how Athens and Sparta defined the solstice. "If the Karneian moon of 490 was that of August . . . one is the less puzzled by the question how the Persians had managed to spend so much time in reaching Euboia."

As we were evaluating these arguments and checking the times of the seasons and the lunar phases, we suddenly realized that Böckh's calculations had been done in the Athenian calendar, but the Karneia was a Spartan festival. The calculation should be done in the Spartan calendar!

The Spartans did not keep records as faithfully as the Athenians, and their calendar and culture are the subject of renewed controversy in our own day. The months of their year are being freshly investigated by scholars, but

S&T: ALAN MACROBERT

Marathoning as a sport dates from 1896 and is now more popular than ever. The 16,733 runners who finished the 2004 Boston Marathon ran 438,718 miles, nearly twice the distance to the Moon. And despite unseasonable heat on April 19th, none died.

Böckh's Calculation Using the Athenian Year

The rule employed by August Böckh: The Karneian festival culminates at the full Moon of the month Metageitnion, which is the second month of the Athenian year. Therefore, the Karneian full Moon is the full Moon following the second new Moon after the summer solstice. Dates in the left-hand column are given in the Julian calendar. The lunar months may have commenced with the first visibility of the waxing crescent, about one day after the astronomical new Moons listed here.

490 BC	
June 27	New Moon
June 29	Summer solstice
July 26	New Moon begins Athenian month 1 (Hekatombaion)
Aug. 25	New Moon begins Athenian month 2 (Metageitnion)
Sept. 2	Pheidippides starts run from Athens to Sparta
Sept. 3	Pheidippides reaches Sparta on ninth day of lunar month
Sept. 9	Karneian full Moon; Spartan festival ends
Sept. 10	Spartan army marches out from Sparta
Sept. 12	Battle of Marathon; messenger runs from Marathon to Athens
Sept. 13	Spartan army reaches Athens too late by one day

the facts so far do not permit an unequivocal answer. Our calculations show some of the astronomical oddities inherent in a lunar calendar.

Early in the 20th century, classical scholars generally concluded that the Spartan new year began with the new Moon after the fall equinox, based on the work of Friedrich K. Ginzel and Ernst F. Bischoff. In accord with Plutarch's statement about Karneios and Metageitnion, Bischoff listed Karneios as the 11th Spartan lunar month.

In the "normal" case, nine new Moons occur in the time period between a fall equinox and the next summer solstice, and the 11th month after the fall equinox is simultaneous with the second Athenian month (Metageitnion), the month employed by Böckh in his calculation for Marathon.

But occasionally 10 new Moons can occur between a fall equinox and the next summer solstice, and the table on the facing page shows that this did happen in the time period overlapping 491 BC and 490 BC. This situation for new Moons is similar to the phenomenon of a blue Moon, which involves four full Moons occurring in a season instead of the usual three (*S&T:* May 1999, page 36).

Our calculation depends on three assumptions: that the Spartan festival was the Karneia, that the festival fell in the 11th month after the fall equinox, and that no leap month intervened that year. If these assumptions are correct, then the Battle of Marathon must have been fought on August 12, 490 BC.

Some independent arguments support a Karneian festival and a battle date in August. Shortly before landing at Marathon, Herodotus notes, the Persians landed near Karystos on the island of Euboia and "devastated their farmland" by cutting down the crops. That tactic suggests a date before the harvesting was completed. Writing about events later in the Persian War, Herodotus tells us that (in 480 BC) the Karneian festival at Sparta, the Olympic festival, and the Battle of Thermopylae all occurred nearly simultaneously and "in the middle of summer."

Our proposed August date for Marathon also explains a mystery about the run after the battle.

Death of the Runner

The herald's melodramatic death has contributed to some doubt that he even existed. Running guru Jim Fixx addressed this point in a skeptical account of the first

MARY EVANS PICTURE LIBRARY / FREDERICK GEORGE COTMAN (1850–1920)

The exhausted messenger collapsed and died after running back to Athens from the battlefield at Marathon.

marathon run (*Second Book of Running*, 1978): "We know that the Battle of Marathon . . . occurred in September, a month when nowadays the average maximum temperature in Athens is 83 degrees. . . . The Pheidippides story is so patently improbable. Ask yourself: How likely is it, given the fact that thousands of modern marathon runners compete every weekend without mishap, that a trained runner would not have just collapsed but died. . . . Did he in fact die as a result of the run?" Fixx considered the possibility of heat stroke but eventually decided that the entire marathon-run story was a myth.

Our calculation moves the Battle of Marathon from the relatively cooler month of September to the hotter month of August and allows us to estimate the temperature. Our calculated date, August 12, 490 BC (Julian calendar), is 48 days before the fall equinox of that year. The equivalent modern date would be August 5, 2004 (Gregorian calendar), 48 days before the fall equinox this year. While Herodotus does not give a precise time of day for the battle, it is plausible to place the fighting in the morning and the run back to Athens either in midday or afternoon. Climate data of the Hellenic National Meteorological Service (www.hnms.gr) for early August show that the expected average afternoon temperatures along the route would be 31° to 33°C (88° to 91°F), with maximum temperatures up to 39°C (102°F) possible near Athens.

It is precisely to avoid such hot weather that modern race organizers prefer cooler months like April for the Boston Marathon and November for the New York City Marathon.

This commemorative envelope was postmarked on September 12, 1980, the anniversary of the Battle of Marathon according to the standard date calculated by August Böckh.

The hot afternoon of August 12, 490 BC, could induce the condition that can be fatal to even a trained athlete: heat exhaustion and heat stroke. Our astronomical calculation therefore suggests an explanation for the death of the runner and makes the story of the first marathon run more plausible.

The 2004 Olympics

As this issue of *Sky & Telescope* appears, athletes from all over the world will be gathering in Greece. On August 29, 2004, as the final event on the last day of the Summer Olympics, a field of runners will break from a starting line at Marathon and run along the ancient route.

To avoid the worst heat of the day, the race start is scheduled for 6 p.m., and it happens that a full Moon will rise that evening, at about the same time that the Olympic runners reach the finish line in Athens. This modern full Moon can remind us of how another full Moon affected the movements of three armies almost 25 centuries ago. ✶

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New Calculation Using the Spartan Year

Rule employed: The Karneian full Moon is that following the 11th new Moon after the preceding fall equinox. Unlike Böckh, we assume Herodotus used "inclusive counting" for the rapid march from Sparta (August 11, 12, 13 = 3 days).

491 BC	
Sept. 29	**Fall equinox**
Oct. 4	**New Moon begins Spartan month 1**
Nov. 3	**New Moon begins Spartan month 2**
490 BC	
June 27	**New Moon begins Spartan month 10**
June 29	**Summer solstice**
July 26	**New Moon begins Spartan month 11**
Aug. 3	**Pheidippides starts run from Athens to Sparta**
Aug. 4	**Pheidippides reaches Sparta on ninth day of lunar month**
Aug. 10	**Karneian full Moon; Spartan festival ends**
Aug. 11	**Spartan army marches out from Sparta**
Aug. 12	**Battle of Marathon; messenger runs from Marathon to Athens**
Aug. 13	**Persian fleet off the port of Athens departs for Asia; Spartan army reaches Attica too late by one day**
Aug. 25	**New Moon begins Spartan month 12**

Sources and Further Reading

Much of what is known about the Battle of Marathon comes from Greek historian Herodotus, *The Histories,* Book 6; our translations are from chapters 106, 116, and 120. Also important are Euripides' *Alcestis* (lines 445–450); Plutarch's *Moralia* (Chapter 347), *Life of Aristides* (Book 5, Chapter 4), and *Nicias* (Chapter 28); Lucian's *Pro Lapsu inter Salutandum* (Chapter 3); and Plato's *Laws* (sections 698e and 767c).

The date of the Battle of Marathon that became widely accepted in modern times is from August Böckh's 1855 work, *Zur Geschichte der Mondcyclen der Hellenen.*

More recent commentary can be found in Andrew R. Burn, *Persia and the Greeks* (St. Martin's Press, 1962); Peter Green, *The Greco-Persian Wars* (University of California Press, 1996); and Noel Robertson, *American Journal of Ancient History,* Vol. 1, No. 2, 2002–03, pages 5–74.