The Great Eclipse of 1878

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In time, every place on Earth gets its chance at a total solar eclipse. The odds often quoted are roughly once in 400 years, but this figure is coldly statistical. On the human side, the local passage of an eclipse track brings suspense, excitement, and a feeling of cosmic importance. Yet the feeling is temporal, for history shows that when a total eclipse occurs over a town, it receives the world’s attention for a year or so before—and a day or so after. Fame passes with the shadow of the moon, and how quickly it goes on by!

A good example is the total eclipse of the sun of July 29, 1878, which crossed the Rocky Mountain West when Colorado and Wyoming were young and eager for national attention. The shadow path was spectacular. It swept down through Yellowstone and the Wind River Range, across the central highland of the Wyoming Territory, along the Medicine Bow and southward into Colorado, where it ran across the top of Long’s Peak and right down the front range of the Rockies through Boulder, Central City, Georgetown, Denver, Colorado Springs, and the lofty summit of Pikes Peak, then to La Junta and into Oklahoma Indian Territory and Texas.

In the American Ephemeris and Nautical Almanac for 1878, the mountains and towns given in the predictions for the coming eclipse had read like a tour guide of the Rockies! The new transcontinental railroad, completed only nine years before, made western travel easy. Astronomers were attracted by the prospect of observing an eclipse from clear high-altitude sites, and scientific interest began to soar. The U.S. Naval Observatory in Washington made plans to set up eight observing stations with a special

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*The National Center for Atmospheric Research is sponsored by the National Science Foundation.
Congressional appropriation of $8,000. In the original plan, these would be distributed along the shadow path from the Montana Territory to Texas, but on second look the northern end was shifted, because of Indian troubles, to Creston on the Union Pacific Railroad in Wyoming.

These were years when astronomers' interest in the sun and solar eclipses was high, for significant and startling discoveries had been made at the eclipses of 1868 in India and St. Ignatius, 1870 in Iowa, 1870 in Spain, and 1871 in India and Ceylon. The eclipses of 1875 and 1876 were short and inaccessible, and it was time for a better one. And another reason pointed to the Rockies.

In 1872 Charles A. Young, a famous Dartmouth College astronomer, had spent the summer at Sherman, Wyoming, in charge of a government-funded expedition to evaluate the astronomical benefit of high-altitude observation. His published conclusion, that telescopes were much better placed on mountains than on the Eastern lowlands, had much to do with astronomers' interest in the 1878 eclipse. And if more incentive were needed, the Pennsylvania Railroad offered half-fare tickets to astronomers headed west.

Young, who had moved to Princeton, made plans to go, as did nearly every American astronomer of note, and many from abroad. To lonely Creston went Simon Newcomb of the Naval Observatory, the first official of American astronomers. To Rawlins went Prof. Henry Draper of New York University, with a distinguished party that included the English solar physicist Sir Norman Lockyer. To Central City and the flat roof of the Teller Hotel went another team from the Naval Observatory, Johns Hopkins University, and West Point. At Idaho Springs were astronomers from New York and St. Louis. Young himself, with many others, chose Denver. To the top of Pikes Peak climbed a determined party led by Samuel P. Langley, later director of the Smithsonian Institution and pioneer in heavier-than-air flight, but then a noted infrared astronomer and head of Allegheny Observatory. And to the plains of La Junta went another famous Washington astronomer, Asaph Hall, who had discovered the two moons of Mars only the year before.

"Through the early summer of 1878, while astronomers were building apparatus, the press was busy building up suspense. A well-publicized eclipse might do a lot to spark the growth of a frontier state. The coming eclipse would be "One of the Great Events of the Century," promised the Denver Times. "The world has never witnessed such extensive preparations," said the Laramie Daily Sentinel, "as are now in progress for viewing the great coming event and profiting thereby. Scientists from every quarter of the globe inhabited by intellectual beings are today within the limits of totality, awaiting with prayerful interest the grand moment."

The arrival of astronomers made good newspaper copy. In return, they relished citation as distinguished professors, scientific gentlemen, or, in the Boulder County News, "wise men from the east." And yet, answered the Rocky Mountain News, "they are the most modest and unpretending, and unassuming and unostentatious men anywhere to be found. They do not profess to know much."

Local papers vied with each other and with correspondents from Chicago and New York for the best coverage of the eclipse. In Cheyenne, after the Daily Sun more accurately predicted the time of the eclipse than had the rival Daily Leader, the Sun told its readers that obviously "the other paper knew more about hogs and hominy than it did about astronomy."

The great day came, and anxious faces watched the weather. For several weeks the afternoons had been cloudy. On Sunday, the day before the eclipse, a number of Denver churches offered special prayers for fair skies on the morrow, but that same day, at four o'clock, came hail and rain. Totality was to occur on Monday afternoon, 3:29 Denver time, and last less than three minutes. Would the weather clear?

Monday dawned a perfect day. In Wyoming the sky was "as slick and clean as a Cheyenne free-lunch table." In Boulder it was gloriously bright. And at 1:30 p.m., two hours before totality, word came in by railroad telegraph to the Denver Daily Times from Walter Spencer, their excited correspondent in Castle Rock, Colorado: "Weather splendid for eclipse—clear as hell."

"Whenever the astronomers want an eclipse that is an eclipse, let them arrange for it in Colorado," added the Times. "This state," sang the Colorado Banner, "has furnished the grandest eclipse of the age."

Tourists from everywhere filled hotels in front-range towns, and astronomers, it was said, were thick as blackberries. In Denver, thousands gathered along the crest of Capitol Hill to watch, and others lined the roofs of high buildings. Most places of business were closed for the event, including the Denver banks. A Colorado Springs hotel provided an Italian band to play Beethoven as background music for those watching the heavenly show.

Wherever there were crowds along the shadow path, a hushed silence fell as the last sliver of sun was covered and darkness came in mid-afternoon. Where there were
astronomers, a harsh command of “silence!” was usually given in the final seconds before totality. In many places, a muffled “oh” or “ah” was heard as first the stars and then the shimmering corona were seen. The two or three minutes of darkness went all too fast. Then, as the sun returned with a flash of light at the moon’s limb, it was greeted with a rousing cheer.

During the brief minutes of totality, the astronomers worked, along with many volunteers, at scattered places along the path. The Naval Observatory had asked for local assistance in several kinds of observations. Drawings of the solar corona were sought, preferably made following the booklet Instructions for Observing the Eclipse, which had been provided some time before. Although the corona had been photographed as early as 1851, results were disappointing, and in 1878 drawings still provided the best information on its size and shape. Volunteers could make drawings with the naked eye, opera glass, or telescope, either during the darkness of totality (with the aid of someone holding a lantern) or just after the eclipse, from memory—admittedly a less valuable method.

Forwarded to the astronomers in Washington, these original works of art today rest in several boxes in the Old Military Records Division on an upper floor of the National Archives building. Some are in pencil, some in pen, a few in charcoal, and one in oil. Many are accompanied by apologies for a lack of talent, an imperfect eye, an unsteady hand. None was ever really used, but they tell in simple, hurried lines the eagerness of a pioneer people to help the scientists.

In the clear air of the mountains, the eclipse was most striking. At the summit of Argentine or Snake River Pass, nine miles from Georgetown, stood a hardy band of ladies and gentlemen from the Central Presbyterian Church of Denver, who had left home on the 7 a.m. excursion train to travel by rail, carriage, and saddle to a cold and rocky pass 13,156 feet high. They watched lofty peaks around them merge into the lunar shadow as it swept from north to south, covering Long’s Peak, the Mount of the Holy Cross, Gray’s, Torrey’s, and Mount Evans. For a few seconds, while they were themselves in darkness, Pikes Peak shone in sunlight, then blinked out. But quickly the great peaks emerged from the gloom like huge ghosts, in the words of the artist-correspondent of Harper’s Weekly whose sketch is seen here.

At 14,110 feet on top of Pikes Peak were the survivors of Langley’s stalwart crew. They had reached the summit nine days before the eclipse, by way of an 18-mile foot path, instead of the expected wagon road. Since their original cargo proved too heavy for pack donkeys, along the way nonessential equipment and supplies were jettisoned or cached piece by piece. Three hard nights after the group arrived at the peak the tents came. The men endured gale winds, sickness, snow, and hail while working and waiting for July 29th. Some who could not adjust to the altitude went down the mountain.

The others built stone piers on which to set their apparatus and a horizontal telescope tube, 34 feet long, made of timber covered with black canvas. Within the tube was a candle, mounted on a miniature wagon that ran on brass wheels along a metal track. The light from this reference candle was compared with that of the corona during the eclipse by moving the wagon, with a string, until the brightness of its flame and the corona appeared equal when projected on a paper screen. In this way Langley’s brother John, a professor of chemistry at the University of Michigan, measured the brightness of the corona in candlepower.

Langley was himself at work with visual and infrared observations. They saw the lunar shadow sweep down from Mount Evans, carried out their programs during totality, then watched the shadow race across the plains to the southeast. From the top of Pikes Peak, Samuel Langley had seen the corona extend to 24 solar radii, more than six degrees from the sun.
RAWLINS, WYOMING

In Wyoming, which in 1878 had 12 years to wait for statehood, interest in the
eclipse had focused on a narrow strip in
the central south where the path of to-
tality crossed the Union Pacific Railroad
—from Rock Springs in the west to the
present Rock River in the east. Laramie
City and Cheyenne lay outside the shadow
path. For astronomers coming west, this
region was easy to reach; moreover, it
consisted of high plains, 6,000 to 7,000
feet above sea level, like those Young had
tested and found so promising for as-
tronomy in the summer of 1872.

The only rail stop of consequence on
this stretch was Rawlins, a young town of
about 800 people and a good hotel, where
astronomers of world renown were lodged.
The most famous guest was not an as-
tronomer at all, but a 31-year-old inventor
from New Jersey named Thomas A. Edi-
son. Just the year before, in 1877, he had
invented the phonograph, and in 1879
would invent the incandescent lamp. He
knew a number of eastern astronomers,
who invited him to the eclipse for a sort
of vacation, which he needed. But, being
Edison, he brought along his latest inven-
tion, a pocket-sized gadget that would
measure infrared radiation. He planned
to attach it to a borrowed telescope to
measure the heat of the corona during the
eclipse.

Edison’s was no ordinary heat detector
like the one Young and Langley had in
Denver and on Pikes Peak. His radiometer,
according to Edison, could measure a
temperature change of 0.000001° Fahr-
heit! And whether or not scientists be-
lieved this, the press did. “It is so
sensitive,” wrote the Laramie Daily Sen-
tinel, “that let a person come into a room
with a lighted cigar and it will drive the
little animal wild.”

Throughout totality, Edison worked at
tasimeter and telescope, alone in a hen
house in a wood-fenced Rawlins chicken
yard where he hoped to escape the ever-
present wind and dust. After the eclipse,
he quickly announced to the press that,
though hampered by difficulties, he had
succeeded in recording coronal heat.
Again the headlines went his way. His
style did not appeal to the staid astron-
omers, who tired of finding themselves in
the papers as “Professor Edison attended
by a party of scientists.” By and large,
they ignored his feat at the 1878 eclipse,
as did Edison himself. The last laugh is
his, however, for a modern reduction of
his Rawlins measurement has revealed
that Edison did indeed record the heat of
the corona, and that the tasimeter was as
good as his claim.

Later, an apocryphal story would be
told of how Edison’s choice of a hen house
had nearly brought disaster. In the last
minutes before totality he was frantically
adjusting his apparatus, with his tele-
scope in the doorway directed toward the
sky outside. As the eclipse darkness deep-

The astronomical party at Rawlins, with Thomas Edison second from the right. Sir Norman Lockyer from England
stands at his left, Henry Draper of New York at his right. In addition to the two refractors on tripods, a telescope protrudes
from the partly opened roof of the shelter. Photograph courtesy Edison National Historic Site, West Orange, New Jersey.
ened at second contact, he was still not quite ready. Then to his dismay, through the door and over and around his telescope and tasimeter, the chickens came home to roost!

**Separation, Wyoming**

In newspaper datelines after the great eclipse, the name of Separation, Wyoming Territory, frequently appears. Thirteen railroad miles west of Rawlins, in sandy jackrabbit country, the whistle-stop called Separation was only a wooden water tower, a rail siding, and a few buildings where the station agent worked and lived.

All of it now has disappeared, with time and the wind, and the moving of the main-line rails a long time ago. Yet it was a rather important place for a few hours on the afternoon of July 29, 1878.

At Separation, so the papers said, Prof. James C. Watson of the University of Michigan had discovered a new planet, near the edge of the sun during totality. On the siding at Separation, in a special car fitted as a photographic darkroom, Sir Norman Lockyer of London spread wet emulsion on plates of glass, exposed them to the coronal spectrum, and developed them there. Nearby, Simon Newcomb observed the corona visually by an ingenious new scheme which today is used in most modern coronographs, including those in orbit around the earth. Thomas Edison visited Separation a few days before the eclipse, to see the bustling camp of “the government astronomers.” And on the day itself, by rail from Cheyenne came the territorial governor of Wyoming, John Wesley Hoyt, doctor, lawyer, chemist, editor, first president of the University of Wyoming, and for one day, artist, to sketch the corona.

Newcomb originally planned to set up his station at Creston, on the continental divide about 30 miles west of Rawlins. An advance party under Comdr. W. T. Sampson, USN, had come out in mid-July to establish the site. A rare combination of seaman and scientist, Sampson graduated from Annapolis at the head of his class in 1861 and served at sea under canvas sail. His third ship, an ironclad of the Monitor class, was torpedoed in the Civil War and he swam ashore to Fort Sumter. In 1867 he founded the department of physics and chemistry at the Naval Academy, where he taught Midshipman Albert A. Michelson, who later won America’s first Nobel prize in physics for measuring the velocity of light. Sampson became famous as an admiral, 20 years after the eclipse, in command of the United States fleet at Santiago Bay in the Spanish-American War.

When he stepped off the train at Creston, the seaman in Sampson told him this was no place for delicate astronomical work, for the wind was blowing half a gale. Turning back east, halfway to Rawlins he found a natural wind shelter formed by a semicircular sand bank 15 feet high, protecting a flat depression about 50 yards across. His decision was wise, for on eclipse day a violent wind scoured the plains.

After setting up a tent camp, Sampson determined his longitude in degrees west from the old dome of the Naval Observatory in Washington, for there was yet no international prime meridian. He next erected piers of mortared stone for the two larger telescopes.

The 2 minutes and 56 seconds of total eclipse at Separation were tense indeed, chiefly because of the presence of Watson and the arrangements for observing an intramericural planet.

The existence of a small planet between Mercury and the sun had been predicted in 1859 by U. J. Leverrier, whose successful 1846 predictions of Neptune gave widespread credence to this new claim. The hypothetical planet should have been most easily seen during total eclipse, when the sun’s glare was blocked, and thus the quest for Vulcan had become a popular eclipse experiment, of special promise in the mountain skies of 1878.

Watson arrived at Separation on eclipse morning with a portable telescope. Newcomb, who planned to spend part of totality looking for Vulcan, had arranged for confirming observations to be made at the Naval Observatory eclipse site at Dallas, Texas, where totality would begin 22 minutes after it ended at Separation.

Should Vulcan be found at Separation, an immediate message was to be sent by the Union Pacific telegrapher to Dallas, where a man on horseback waited at the railroad station, set to gallop a quarter-mile to where astronomer David P. Todd was at his telescope. The expected message would tell Todd where to look for Vulcan.

The message from Separation never came. In the final minute of totality, Watson discerned what he took to be Vulcan in a starlike object just south of the sun in Cancer. As totality ended, he ran to Newcomb to ask him to confirm it. Newcomb, busy with two experiments of

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*Sketches of the corona made by three side-by-side observers at Separation. The top one is by Mrs. James C. Watson from Michigan; the middle by J. W. Hoyt, Wyoming territorial governor; the bottom by D. H. Talbot, Sioux City, Iowa. Coronal pictures on this and page 345 are from the U.S. Naval Observatory’s 1878 eclipse book.*

*The polar plumes are delicately depicted by the astronomer-artist Leopold Trouvelot, then associated with Harvard Observatory, who went with his son George to Creston, Wyoming, for the eclipse.*
At left, Jackie Eddy looks toward Rawlins from atop the semicircular dune. The old railbed runs at upper left, and the piers found by the author are hidden by sagebrush. At right, Eddy family members are seen on the ridge of the dune, as viewed from one of the excavated piers. Photographs on this page are from color transparencies by the author.

The land appears much as when the astronomers left it, for the treeless sweep of Wyoming's Great Divide Basin is still largely in its natural state, uncultivated and undeveloped. An 1882 map showed us roughly where the town and the original railbed had been, with reference to Rawlins and Creston. Sampson's longitude and latitude further restricted our search to an area about two miles square, bounded on one side by the new Union Pacific tracks and on the other by highway Interstate 80. There were no buildings within these bounds, nor anywhere to the horizon. The only things of man in sight were fences and a narrow sand road, which cut through hills and dunes and seemed likely to mark the old railbed. For a day or so we searched along this desolate road, looking in particular for the semicircular sand dune, which had given protection to Sampson and Newcomb. We eventually eliminated all but one crescent-shaped hill, but its wall of sandy dirt and sagebrush was more rounded and lower than described. And where were the stone telescope piers?

We searched the area carefully, and were just about to give up when my wife Marjorie found a small and unusual stone
beneath a shrub in the middle of the area. The stone was soft, like old mortar. Perhaps the piers lay buried beneath us, covered by 90 years of windblown sandy soil.

An hour later, a hardware store in Rawlins sold its first astro-archeological shovel to my wife, who had driven there while Marcee, Amy, Jackie, and Buffy helped me decide where we should dig. We made a few test holes at likely distances from the dune, since we knew the compass bearing of the sun on that afternoon in 1878.

Just below the ground and under a little bush, we struck the solid surface of a square-cornered stone block, which we then excavated. There was no doubt this was one of Sampson's piers, for its sides lay precisely north, east, south, and west. This stone pier had been built by an Army mason, and measured a yard on each side.

A storm drove us out of Separation, but in the summer we returned and found the second pier. Then we located the site of the railroad station where the telegrapher had waited, and the railbed for the siding where Lockyer's car had stood. But there remain no boards, no foundation stones, no rails. If you look hard in the sandy soil and cinders, you can find rusted spikes and other bits of railroad iron, but little else from the day the train puffed into Separation with astronomers for the Great Eclipse.