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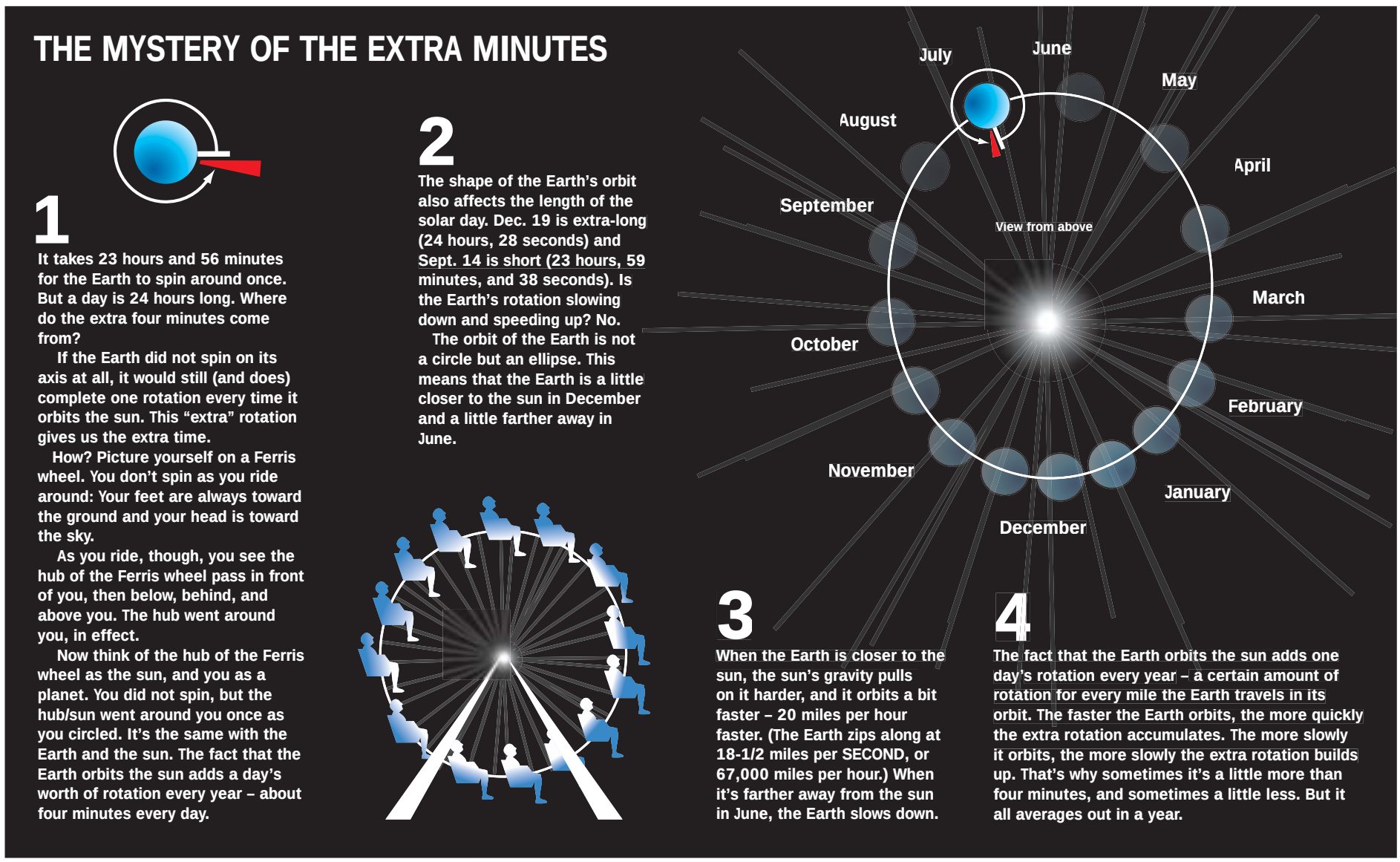

SCOTT WALLACE – STAFF

Why the day is even longer than it seems

ONE of the great things about New Year's Day is that the days are finally starting to get shorter.

"Wait a minute!" you say. "In January, aren't the days getting longer?" That is true, too. After Dec. 21, the north pole starts to slowly tilt toward the sun again. That means those of us in the Northern Hemisphere are getting more daylight now.

But I'm not talking about sunlight. I'm talking about the actual length of the day. Jan. 1 is slightly shorter than Dec. 31. Jan. 2 is slightly shorter than Jan. 1. No, you don't need to set your clocks back. The lost time is found in what scientists call the solar day.

A solar day begins when the sun passes directly overhead at noon. It ends the following noon. Unlike the time of day shown on a clock, which is called "mean time," the length of a solar day varies from season to season.

The longest solar day is Dec. 19. It is 24 hours, 28 seconds long. The shortest day, Sept. 14, is 23 hours, 59 minutes and 38 seconds long. Is the Earth spinning slower, then faster? No. The change is not caused by the spin of the Earth but by its orbit around the sun.

Pretend you're standing off in space, looking down at the Earth spinning. If you timed the spin, you'd find that it takes 23 hours and 56 minutes for the Earth to spin around once. But you know a day is 24 hours. Where are the missing four minutes? They are supplied by the orbit of the Earth around the sun. **(See illustration above.)** Each time the Earth orbits the sun, it adds an extra day to the calendar – four minutes at a time. Here's how:

Pretend you're on a Ferris wheel. Let's say that the hub of the Ferris wheel represents the sun. You represent the Earth, sitting in one of the chairs. As the ride starts, you begin to orbit the hub of the Ferris wheel, just as the Earth orbits the sun.

Unlike the Earth, though, you do not spin as you orbit (thank goodness!). Your head always points toward the sky, and your feet are always toward the ground. As you begin your ride, notice that the hub is above you. As you rise, the hub is in front of you. Now it's below you and then behind you. From your point of view, the center of the wheel has gone around you once.

In the same way, each time the Earth orbits the sun, the sun goes around the Earth. One solar day is added.

We don't get that extra day all at once. It's spread out over an entire year. In half a year, the motion of the Earth around the sun has added half a solar day to our calendar, or 12 hours. In 1/365th of an orbit – about the amount of time it takes the Earth to spin on its axis – 1/365th of a day has been added, or about four minutes. Those minutes complete our day, making it 24 hours.

kid space

HOW WE GET AN EXTRA 'DAY' EVERY YEAR – FOUR MINUTES AT A TIME.

NOW that we've discovered those extra minutes, we can explore why Dec. 19 is extra-long and Sept. 14 short. That's because the extra four minutes are not spread out evenly over the year. Some days get more extra time than others. The reason: The Earth's orbit is not a circle but an ellipse, or oval.

An elliptical orbit means that the Earth is a little closer to the sun in December and a little farther away from it in June. When the Earth is closer to the sun, the sun's gravity pulls on it a little harder. That makes the Earth move faster in its orbit. The extra speed isn't much – about 20 miles an hour. Normally, the Earth moves along its orbit at 18-1/2 miles every *second* (about 67,000 miles per hour). But that little extra speed is enough to advance the Earth an extra 500 miles a day in its orbit. The extra distance translates into another 28 seconds tacked onto the solar day, besides the four minutes.

When the Earth is farther away from the sun, during the Northern Hemisphere's summer, it moves a bit more slowly. The Earth doesn't travel quite far enough to add a full four minutes to the solar day.

We do not live our lives by solar days. Our clocks record "mean time." ("Mean" as in "average.") Mean time is computed by averaging the lengths of all the days of a year. On average, a day is exactly 24 hours long. But the solar day is exactly 24 hours long only four times a year: Feb. 12, April 13, July 25, and Oct. 29.

To find the difference between the mean day and the solar day, we use a graph called the analemma. **(See figure on facing page.)** The analemma is the big figure 8 that you see on globes. (It is usually printed on the Pacific Ocean.) "Analemma" comes from a Greek word meaning "sundial." The ancient Greek astronomers knew that the length of the solar day varied, but not until the invention of accurate mechanical clocks in the 1700s could astronomers draw accurate analemmas.

The analemma shows how the length of the solar day varies over the course of

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Calendar confusion: The year with 354 days

WE START the new year in January for the same reason we start a new day at midnight. At midnight, most people are asleep and a new day can start without confusion. In January, farming has come to a stop (in the Northern Hemisphere) so we can start a new year without confusing farmers.

Our calendar is designed to keep track of the agricultural seasons by matching the days of the year to the Earth's position in its orbit around the sun. For this reason, it is called a solar calendar. In the northern hemisphere, March, April, and May are the months for planting crops. September, October and November are harvest times.

In nomadic or herding cultures, people often use a lunar calendar. That's a calendar that marks the passing days by the phases of the moon. In a lunar calendar, the first crescent of the new moon marks the start of each month. Using such a calendar, an individual will always know when the moon will be full, and hence when it will be easy to travel at night.

The Islamic calendar is an example of a lunar calendar. Because it's so strictly based on the phases of the moon, and because the phases of the moon do not coincide with a solar year, Islamic New Year happens about 11 days earlier each year. Year 1423 of the Islamic calendar began March 15, 2002. Year 1424 begins March 4, 2003.

In the Western world, New Year's has not always fallen on Jan. 1.

An early Roman calendar began the new year at the start of spring planting. That would be March 21 on a modern calendar. As the calendar developed, first in Rome and then in the rest of Europe, the date of the new year moved back and forth between the first day of spring and Jan. 1. In 1582, the start of the year was fixed by Pope Gregory XIII at Jan. 1. Gregory also introduced the system of leap years so that the calendar always matches the season of the year. Without adding a day every four years, the calendar had drifted so that the first day of spring was March 11 instead of March 21. Gregory solved that problem by simply removing 11 days from the calendar. Thu., Oct. 4, 1582, was followed by Fri., Oct. 15, 1582.

Many nations quickly adopted Gregory's changes, but others delayed accepting the changes. Great Britain and its colonies (including its American ones) added the 11 days to their calendar in 1752. Egypt made its adjustments in 1875. But Turkey didn't follow along until 1926.

D.A.G.

Continued from previous page

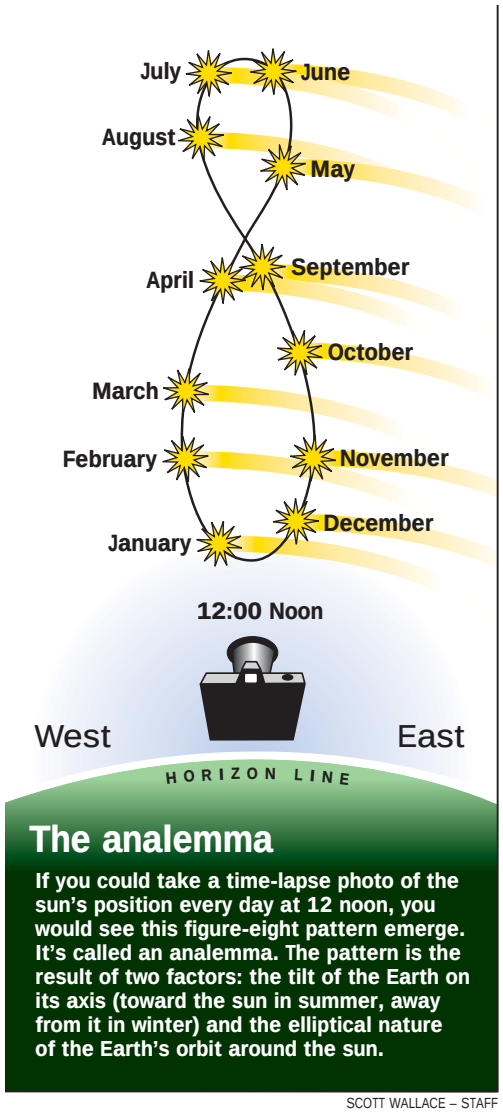
the year. If you look at an analemma, you see the months of the year written around the figure 8 and little marks to represent days. Those marks show you where the sun will be at noon (mean time) on any given day.

LOOK at the analemma on this page. January is near the bottom. That means that the sun is low in the sky of the Northern Hemisphere and the night is longer than the day. January is also on the left side of the figure. That means that the sun is running slow compared with clock time. The sun requires extra time to make a complete trip across our sky from noon to noon.

That extra time is the extra seconds in the solar day – in addition to the four minutes. The day will continue to be extra long until Feb. 12.

So New Year's Day will be slightly longer than average, if you're living your life by solar time. Why not save those extra seconds for summer? In fact, we do. By living our lives on mean time, we take the extra seconds from the longer days and give them to the shorter ones, so that every day is the same length.

David Alan Grier



The analemma

If you could take a time-lapse photo of the sun's position every day at 12 noon, you would see this figure-eight pattern emerge. It's called an analemma. The pattern is the result of two factors: the tilt of the Earth on its axis (toward the sun in summer, away from it in winter) and the elliptical nature of the Earth's orbit around the sun.

SCOTT WALLACE – STAFF

TODAY'S ARTICLE ON CHRISTIAN SCIENCE

Bringing a spiritual perspective to daily life

My new New Year's resolution

THERE'S NOTHING LIKE the New Year to get people thinking about one word: resolution. We vow to exercise more, to lose weight. We pledge to spend more time with family or to get involved in the community.

When I was growing up, my resolutions included things like "Be nicer to my sister" or "Learn how to do a flip on the trampoline." They were simple objectives, usually – things I might have achieved even if they hadn't been on my list.

As time went on, my resolutions shifted to more spiritually oriented goals. One year, my list contained only one item: "Be more loving." Over the next 365 days, I prayed daily to express love more freely. To let God as Love animate my every thought and action.

I grew a lot that year, but I still hit the end of it feeling vaguely dissatisfied. And my dissatisfaction confused me. Hadn't my resolution been God-inspired and God-impelled? Hadn't I benefited from the endeavor?

As the New Year approaches once again, I have yet another opportunity to consider why – even when I've followed through on my resolutions – I've often felt less than 100 percent satisfied with my efforts. And as I pondered the "why," I was struck by the answer to my question.

I've been going about this resolution thing all wrong.

I was stunned when I realized that I'd always approached my resolutions from the premise of incompleteness – that I needed to be more loving or more generous or more patient because I exhibited a distinct lack of love or generosity or patience, among other qualities. My desire to improve – though heartfelt – stemmed from accepting that my very existence was the result of some cosmic mistake. I was an unfinished symphony, a story without an ending. My resolutions were all about adding to an incomplete me in hopes of reaching a point where I could finally be satisfied with who I was.

Mary Baker Eddy stoutly refuted these mistaken notions about identity when she declared, "Man is God's reflection, needing no cultivation, but ever beautiful and complete" ("Science and Health with Key to the Scriptures," pg. 527). What she was claiming for each of us is our spiritual perfection – our completeness – based on the idea that each one of us is the reflection of God. Since God is infinite and includes every good quality, then these qualities must be innate in His children.

But then what about "needing no cultivation"? Does that make resolutions obsolete? No, I realized. There was something I could resolve to do: I could vow to reject that I was merely a work in progress.

Rather than focusing on obtaining a quality we think we lack, we can become so familiar with our real, spiritual identity that what feels missing simply sharpens into view. Nothing else but that needs to happen since good qualities are already a part of the beautiful, complete individual that God created. We can each assert with conviction that one impatient gesture doesn't mean we lack patience, nor does one unloving thought mean we are inherently unloving. We are complete.

> I was trying to add to an incomplete me, hoping to be finally satisfied with who I was.

The Psalmist echoed these sentiments: "I will praise thee; for I am fearfully and wonderfully made" (Ps. 139:14). I *am* – that's present tense – fearfully and wonderfully made. And so is each one of us. There's no "will be" or "might be"; instead, it's an acknowledgment of present perfection, of completeness here and now.

This makes goal-setting a whole lot easier. Recognizing that we are "beautiful and complete" inspires us to turn away from a mistaken concept of ourselves. This frees us from trying to perfect an imperfect selfhood; instead we're starting from the standpoint that each of us is immortal – perfect this very instant.

A hundred years of adding more qualities to a flawed personality won't get us where we want to go. But one glimpse of ourselves as the reflection of God shows us we have everything we need. It's a matter of recognition. And we can resolve to see this perfection – for ourselves, and for others. That's resolutionmaking that ensures progress.