VILLAGE VIEW

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How far is far away? What do we really mean when we speak about a long way? There's an old song entitled "It's a Long Way to Tipperary," and another with the opening line, "Long ago and far away..." More precisely, we might say, "Relatively speaking, that's a long time." Distance and time are measurable only when we have two points separated by space or intervals, and the tools for determining the length between them.

The tools for measuring both distance and time are related to and based on the familiar clocks and calendars, the tapes, rulers and meters we use in our daily lives, combined with movement and mathematics. Without that equipment, we would have no way of knowing whether the sun or the moon is nearer to Earth. If the planets and the stars didn't appear to move in the sky, we couldn't measure the distance between them and us. That they do move enables us to determine where they are in relation to Earth and each other.

When we look up at the great panorama of stars and planets in the night sky, it's clear some stars must be further from us than others and some must be bigger than others. How far away is the nearest star? Ninety-three million miles away; it is, of course, our own sun.

How far away is the next nearest star? It is 4.3 light years away. Since light travels 5.8 trillion miles in a year, that makes the distance between the next nearest star and us a staggering 25 trillion miles. Because numbers mean little to us, printed on paper, and we can't imagine a distance so huge, let's try to put things in better perspective.

We all know what a second is. One, two three... sixty seconds in a minute... it takes three minutes to poach an egg. Each hour contains 3,600 seconds. A million seconds is about 11½ days. A billion seconds is 33 years. A trillion seconds is 33,000 years!

A trillion seconds ago, Cape Cod was covered by a glacier and remained covered by it for another 20,000 years. The glacier retreated about 12,000 years ago.

In one light year, light traveling at 186,000 miles a second will have reached a point about 5.8 trillion miles away. And, you'll remember, the nearest star to Earth, after our own sun, is 4.3 light years away.

To bring this distance into proportions we can deal with, look at it another way. When Astronaut John H. Glenn traveled around Earth in his Mercury spacecraft, his altitude was about a hundred miles. Mt. Everest, the world's highest mountain, is about 5-2/3 miles above sealevel; commercial jet planes rarely fly higher than eight miles above Earth's surface.

Let's reduce the size of things by imagining a hundred miles on Earth equals one inch. On this scale, the world is about 8,000 miles in diameter, we can visualize Earth as a sphere 80 inches in diameter, or just under seven feet. A six-foot-tall man would be a few inches shorter than such a ball. On this scale,, Mr. Glenn, flying around the ball in his space craft a hundred miles up, would travel just an inch above its surface. That's pretty close!

Of course, he's traveling at a high speed; his orbital velocity was approximately 18,000 miles per hour or nearly eight times faster than a rifle bullet. Commercial jets fly at speeds just under 600 MPH. Mr. Glenn, going 30 times faster than commercial jets, is really whistling along.

Since Earth's diameter is around 8,000 miles, it has a circumference of 24,000 miles. At the spacecraft's speed, it takes Mr. Glenn about an hour-and-a-half to go around Earth once.

Consider this: the minute-hand of a clock makes one turn an hour. Mr. Glenn takes an hour-and-a-half; therefore, if we imagine the spacecraft one inch above our seven-foot ball, it moves so slowly we can't even see its progress unless we watch a while. The ship looks as though it were suspended in space. Perspective is clearly different on a scale of things the size of Earth.

On the scale of seven-foot Earth, how far away is the moon? How big is it? It's 200 feet away and the size of a basketball; the sun is an incandescent ball 700 feet in diameter, twenty miles away.

If we shrink our 700-foot sun down to the size of a pea, Earth becomes a tiny grain of sand approximately three feet from the pea-sized sun, and the moon, no more than a speck of dust a quarter-inch from Earth. On this scale, where would the next nearest star be? It would be another pea-sized sphere 160 miles away.

Looking up from where we stand at sealevel, under what are unquestionably imperfect viewing conditions, all the stars we see in the heavens are in our own galaxy (or galactic system). The great nebula in Orion is in our galaxy. Most of us have seen pictures of galaxies they are those great pin-wheel-shaped objects containing billions of stars. Our own galaxy looks like that from afar.

Galaxies are island universes separated by enormous distances. We live within just such a system. What does **galactic** mean? Lactic has to do with milk and, in the sky, like a pale broad river of light, we see our Milky Way. The Milky Way is the edge-on view of the great pin-wheel of our own galaxy.

Within our galactic system our sun is about 30,000 light years, or two-thirds of the way, from the center of rotation. As our system rotates, we rotate with it, moving through space at 150 miles per second. That's more than half a billion miles an hour. Even so, our galaxy is so large it takes over 150 million years to make one revolution.

How long is 150 million years? Well, if you go out to Hadley in Western, Massachusetts, you can find sandstone beds of triassic rock, once the bottom of shallow lakes. On the surface of these rocks you can see dinosaur footprints. They look like footprints of large birds. Each print shows three toes and a stride of about four feet. They were made about 150 million years ago. At that time, there were no people on Earth; humans had not yet evolved. The earliest mammals were just beginning to appear. Between the time those footprints were made and today, our galaxy has made one revolution.

In the observable space around us, it's estimated there are at least a billion other galaxies. They tend to appear in clusters; near Cornona Borealis is a cluster of about 400. Only the nearest galaxy to us is visible to the naked eye, and that very poorly at sealevel. If you spent a night on top of a high mountain when the skies were clear, you could see clearly, in Andromeda, the nearest galaxy.

Space is so enormous it's difficult to imagine. What difference does it make to us who can expect to exist, at most, for around a hundred years? Did you ever think that maybe the footprint you left in a patch of mud might still be there, 150 million years from now when our galaxy makes a second revolution? Long ago... far away...