Understanding the Impossibly Huge

Every day we are bombarded with numbers so large they extend beyond the limits of comprehension. The U.S. national debt is well over 10 trillion dollars (just how far over depends on whom you ask). A 2013 Forbes Magazine article reported that there are now over 450 billionaires in the United States alone, with Bill Gates leading the pack with a net worth of more than 72 billion dollars. Hard drives for personal computers, once limited to 32 gigabytes (giga = 1 billion), can now be purchased with over a terabyte of storage space (tera = 1 trillion). Neuroscientists tell us that the human brain has tens of billions of neural connections, and the earth's population will soon reach 9 billion.

Although these numbers are large, it is possible to visualize just how big these numbers are by using two common items that you are quite familiar with: a penny and a railroad boxcar.

Let's begin by getting a feel for multiplying things by 1000. If you handed $10.00 to a bank cashier and asked her to give you an equivalent amount in pennies, she would hand you 20 rolls of pennies, each containing 50 pennies. Open the rolls on your kitchen table and empty them in a pile. You have before you a small mound containing 1000 pennies.

Now imagine that you did this exercise every day for almost 3 years, 1000 trips to the bank. Each time you return home, you add the freshly acquired pennies to the growing mound on your table. Before long, the small mound has become a mountain, pennies are falling off the edges of the table on the floor, and your table is on the verge of collapse from the weight. After 1000 trips to the bank, you will have brought home 1 million pennies. That's right, 1000 times 1000 is 1 million. Furthermore a thousand millions is a billion, while a thousand billions equals one trillion. Multiplying by 1000 results in a very significant enhancement of whatever you are dealing with.

It's not too difficult imagining the space occupied by 1 million pennies. In fact, if you stacked your stash carefully, it would take up about 13 cubic feet. Now if instead we had made 10 trips to the bank every day for 300 years, we would have brought home 1 billion pennies and your whole 1800 square-foot house would be stuffed floor to ceiling with pennies. Of course, you would need $10 million in order to get 1 billion pennies. And here is where the railroad boxcars come in. For 1 billion pennies, you would need two typical 50-foot railroad boxcars in order to store all that loose change. **Think of two boxcars filled to the brim with pennies to imagine a number as large as 1 billion.**

Imagine, for example, that each penny represents a single person, one living, breathing, consuming human being on our planet Earth. Our current population of 7 billion people would be represented by 14 boxcars filled to the brim with pennies. Imagine opening the doors to these crammed boxcars and watching the pennies spill out onto the ground by the tens of thousands.

In terms of net worth, if you can claim a net worth after all debts have been paid of $10,000, then that stack of 1 million pennies on your kitchen table represents your wealth. If each penny represented a dollar bill, then Bill Gates' net worth would be equal to 144 boxcars filled with pennies and the four Waltons (of WalMart fame) who made the Forbes list of billionaires would bring in 3 boxcar loads of pennies every year just from their investment dividends alone.

Jumping from the mundane (money) to the sublime, contemplate for a moment the size of our universe. Earth is a small speck compared to the sun, which is a million times as large (by volume) as the earth. But imagine if the sun were the size of a penny. Then Earth would be a microscopic mote of dust 8 feet away. The nearest star would also be about the size of a penny, but it would be 350 miles away. Imagine all that empty space between stars. Photons of light, the speediest particles in the universe, take 8 minutes to travel between the sun and earth, but require 4 years to travel between the sun and its nearest neighbor.

But the sun and our nearest neighboring star are just two of over 200 billion stars that make up our Milky Way galaxy, a big, spinning pin-wheel shaped disk of stars held together by gravity. And these stars are similarly distant from each other. Think of 400 boxcars filled with pennies to get some feel for how many stars are in our galaxy. Light takes 120,000 years to travel across the galaxy from one edge to the other.

And our galaxy is just one of an estimated 200 billion galaxies that inhabit our universe! That's right. 200 billion galaxies with an average of 200 billion stars in each. So if each star is represented by a penny, and 400 boxcars are needed to hold all of the pennies representing the stars in just our galaxy, we will need 80 trillion boxcars filled with pennies to account for all of the stars in the universe. Even thinking of each penny as an entire galaxy, we would need 400 boxcars. But don't forget in this instance that now each penny represents 200 billion stars!

One final thought. In pondering the true dimensions of our universe, I am persuaded to believe that there is no supernatural being big enough to encompass this vast universe, let alone one who could give one whit to what takes place here on Earth. We humans like to think we are more important than we really are. And finally, with 200 billion galaxies, each containing 200 billion stars, perhaps 40% of which are similar in nature to our sun, the likelihood that there are millions, perhaps billions, of other intelligent life forms inhabiting our universe seems very high indeed. However, exploring this topic will have to be the subject of another essay.

Footnote: Basis for Calculations.

Volume occupied by a single penny:

Diameter = 1.91 cm; width = .127 cm; so pi x radius squared x width = 0.363 cubic cm.

Volume contained in a 50-foot standard railroad boxcar:

Length = 50 feet; Width = 9.5 feet; Height = 12.3 feet. Volume = 50 x 9.5 x 12.3 = 5860 cubic feet.

Number of pennies in a filled standard railroad boxcar:

Since there are 12 inches/foot, there are 12 x 12 x 12 = 1728 cubic inches in a cubic foot.
Since there are 2.54 cm/inch, there are 2.54 x 2.54 x 2.54 = 16.38 cubic cm in a cubic inch.
Multiplying these two together gives us 28,317 cubic cm in a cubic foot, and multiplying this by 5860 cubic feet gives us a rounded figure of 166,000,000 cubic cm in a boxcar.
Since each penny occupies 0.363 cubic cm, dividing 166 million by 0.363 gives:
457 million pennies. So two boxcars will hold about 1 billion pennies.